DNS Conformance Test Specification For Server

Revision 1.0

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References

This test specification focus on following DNS related RFCs.

RFC 1034	DOMAIN NAMES - CONCEPTS AND FACILITIES
RFC 1035	DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
RFC 1123	Requirements for Internet Hosts -- Application and Support
RFC 1995	Incremental Zone Transfer in DNS
RFC 1996	A Mechanism for Prompt Notification of Zone Changes (DNS NOTIFY)
RFC 2181	Clarifications to the DNS Specification
RFC 2308	Negative Caching of DNS Queries (DNS NCACHE)
RFC 2671	Extension Mechanisms for DNS (EDNS0)
RFC 2782	A DNS RR for specifying the location of services (DNS SRV)
RFC 3401	Dynamic Delegation Discovery System (DDDS) Part One: The Comprehensive DDDS
RFC 3402	Dynamic Delegation Discovery System (DDDS) Part Two: The Algorithm
RFC 3403	Dynamic Delegation Discovery System (DDDS) Part Three: The Domain Name System (DNS) Database
RFC 3404	Dynamic Delegation Discovery System (DDDS) Part Four: The Uniform Resource Identifiers (URI) Resolution Application
RFC 3405	Dynamic Delegation Discovery System (DDDS) Part Five: URI.ARPA Assignment Procedures
RFC 3425	Obsoleting IQUERY
RFC 3596	DNS Extensions to Support IP Version 6

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1. Introduction

These DNS conformance test specifications have aimed to evaluate the server's behavior described in RFC1034 which defines domain names concepts and facilities.

These specifications evaluate DNS message. And the following points are also evaluated:

- The DNS server can exchange DNS messages over IPv6 transport satisfying the DNS specifications.
- The DNS server can exchange DNS messages over IPv4 transport satisfying the DNS specifications.

2. Common Topology

```
        AP Server1 (TN)
          |3ffe:501:ffff:101::10
          |192.168.1.10
          |
Net-y   --+--------+------------------------- 3ffe:501:ffff:101::/64
                   |                           192.168.1/24
                   |
                   |
                Router (TN)
                   |3ffe:501:ffff:100::1
                   |192.168.0.1
                   |
                   |
Net-z   --+--------+-----------------+-------- 3ffe:501:ffff:100::/64
          |                          |          192.168.0/24
          |                          |
        DNS Server1 (NUT)            DNS Client1 (TN)
           3ffe:501:ffff:100::XXXX     3ffe:501:ffff:100::20
           192.168.0.10                192.168.0.20
```

Fig. 1　Topology No.1

```
                            . domain              org domain             example.org domain
     AP Server1 (TN)        DNS Server2           DNS Server3            DNS Server4
       |                      |A.ROOT.NET           |NS3.example.org       |NS3.example.org
       |3ffe:501:ffff:101::10 |3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40
       |192.168.1.10          |192.168.1.20          |192.168.1.30          |192.168.1.40
       |                      |                      |                      |
Net-y--+--------+-------------+----------------------+----------------------+-- 3ffe:501:ffff:101::/64
                |                                                              192.168.1/24
                |
                |
              Router (TN)
                |3ffe:501:ffff:100::1
                |192.168.0.1
                |
                |
Net-z--+--------+-----------------+-------- 3ffe:501:ffff:100::/64
       |                          |         192.168.0/24
       |                          |
     DNS Server1 (NUT)           DNS Client1 (TN)
        3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
        192.168.0.10               192.168.0.20
```

Fig. 2　Topology No.2

```
                          IN-ADDR.ARPA domain  192.IN-ADDR.ARPA domain  168.192.IN-ADDR.ARPA domain
     AP Server1 (TN)       DNS Server2          DNS Server3              DNS Server4
       |A.example.org         |A.ROOT.NET            |NS3.example.org       |NS3.example.org
       |3ffe:501:ffff:101::10 |3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40
       |192.168.1.10          |192.168.1.20          |192.168.1.30          |192.168.1.40
       |                      |                      |                      |
Net-y--+--------+-------------+------------+---------+----------------------+-- 3ffe:501:ffff:101::/64
                |                          |                                       192.168.1/24
                |                          |
                |                          |1.168.192.IN-ADDR.ARPA domain
              Router (TN)                DNS Server5
                |3ffe:501:ffff:100::1       NS5.example.org
                |192.168.0.1                3ffe:501:ffff:101::50
                |                           192.168.1.50
                |
                |
Net-z--+--------+-----------------+-------- 3ffe:501:ffff:100::/64
       |                          |          192.168.0/24
       |                          |
     DNS Server1 (NUT)          DNS Client1 (TN)
        3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
        192.168.0.10               192.168.0.20
```

Fig. 3　Topology No.3

```
        AP Server1 (TN)
          |3ffe:501:ffff:101::10
          |192.168.1.10
          |
Net-y   --+--------+-------------------------- 3ffe:501:ffff:101::/64
                   |                            192.168.1/24
                   |
                   |
                 Router (TN)
                   |3ffe:501:ffff:100::1
                   |192.168.0.1
                   |
                   |
Net-z   --+--------+-----------------+-------- 3ffe:501:ffff:100::/64
          |                          |         192.168.0/24
          |                          |
        DNS Server1 (NUT)            DNS Client1 (TN)
           3ffe:501:ffff:100::11       3ffe:501:ffff:100::20
           192.168.0.10                192.168.0.20
```

Fig. 4　Topology No.4

```
        AP Server1 (TN)            DNS Server2 (TN)
          |3ffe:501:ffff:101::10     |3ffe:501:ffff:101::20
          |192.168.1.10              |192.168.1.20
          |                          |
Net-y   --+--------+-----------------+-------- 3ffe:501:ffff:101::/64
                   |                           192.168.1/24
                   |
                   |
                Router (TN)
                  |3ffe:501:ffff:100::1
                  |192.168.0.1
                  |
                  |
Net-z   --+--------+-----------------+-------- 3ffe:501:ffff:100::/64
          |                          |          192.168.0/24
          |                          |
        DNS Server1 (NUT)            DNS Client1 (TN)
           3ffe:501:ffff:100::XXXX     3ffe:501:ffff:100::20
           192.168.0.10                192.168.0.20
```

Fig. 5　Topology No.5

```
        AP Server1 (TN)
          |3ffe:501:ffff:101::10,11
          |192.168.1.10,11
          |
Net-y   --+--------+-------------------------- 3ffe:501:ffff:101::/64
                   |                           192.168.1/24
                   |
                   |
                Router (TN)
                  |3ffe:501:ffff:100::1
                  |192.168.0.1
                  |
                  |
Net-z   --+--------+-----------------+-------- 3ffe:501:ffff:100::/64
          |                          |         192.168.0/24
          |                          |
        DNS Server1 (NUT)            DNS Client1 (TN)
           3ffe:501:ffff:100::XXXX     3ffe:501:ffff:100::20
           192.168.0.10                192.168.0.20
```

Fig. 6　Topology No.6

```
        AP Server1 (TN)
          |3ffe:501:ffff:101::10
          |192.168.1.11,12
          |
Net-y   --+--------+------------------------- 3ffe:501:ffff:101::/64
                   |                           192.168.1/24
                   |
                   |
                Router (TN)
                   |3ffe:501:ffff:100::1
                   |192.168.0.1
                   |
                   |
Net-z   --+--------+-----------------+-------- 3ffe:501:ffff:100::/64
          |                          |         192.168.0/24
          |                          |
        DNS Server1 (NUT)            DNS Client1 (TN)
           3ffe:501:ffff:100::XXXX     3ffe:501:ffff:100::20
           192.168.0.10                192.168.0.20
```

Fig. 7　Topology No.7

```
                          . domain              org domain             example.org domain
     AP Server1 (TN)      DNS Server2           DNS Server3            DNS Server4
       |A.example.org       |A.ROOT.NET           |NS3.example.org       |NS3.example.org
       |3ffe:501:ffff:101::10 |3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40
       |192.168.1.100       |192.168.1.20         |192.168.1.30          |192.168.1.40
       |                    |                     |                      |
Net-y--+--------+-----------+---------------------+----------------------+-- 3ffe:501:ffff:101::/64
                |                                                              192.168.1/24
                |
             Router (TN)
               |3ffe:501:ffff:100::1
               |192.168.0.1
               |
Net-z--+--------+-----------------+-------- 3ffe:501:ffff:100::/64
       |                          |         192.168.0/24
       |                          |
     DNS Server1 (NUT)            DNS Client1 (TN)
        3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
        192.168.0.10               192.168.0.20
```

Fig. 8　Topology No.8

```
                                . domain
        AP Server1 (TN)          DNS Server2
          |A.example.com           |
          |A.example.org           |A.ROOT.NET
          |3ffe:501:ffff:101::10   |3ffe:501:ffff:101::20
          |192.168.1.10            |192.168.1.20
          |                        |
Net-y   --+--------+---------------+----------------- 3ffe:501:ffff:101::/64
                   |                                  192.168.1/24
                   |
                   |
                Router (TN)
                   |3ffe:501:ffff:100::1
                   |192.168.0.1
                   |
                   |
Net-z   --+--------+-----------------+------- 3ffe:501:ffff:100::/64
          |                          |        192.168.0/24
          |                          |
        DNS Server1 (NUT)          DNS Client1 (TN)
           3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
           192.168.0.10               192.168.0.20
```

Fig. 9 Topology No.9

```
        AP Server1 (TN)
          |
          |3ffe:501:ffff:101::10
          |192.168.1.10
          |
Net-y   --+--------+---------------------------------- 3ffe:501:ffff:101::/64
                   |                                  192.168.1/24
                   |
                   |
                Router (TN)
                   |3ffe:501:ffff:100::1
                   |192.168.0.1
                   |
                   |
Net-z   --+--------+-----------------+-------- 3ffe:501:ffff:100::/64
          |                          |         192.168.0/24
          |                          |
        DNS Server1 (NUT)          DNS Client1 (TN)
           3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
           192.168.0.10               192.168.0.20
```

Fig. 10 Topology No.10

```
                              . domain
     AP Server1 (TN)          DNS Server2
       |A.example.org           |A.ROOT.NET
       |3ffe:501:ffff:101::10   |3ffe:501:ffff:101::20
       |192.168.1.10            |192.168.1.20
       |                        |
Net-y--+--------+---------------+---------------------------- 3ffe:501:ffff:101::/64
                |                                             192.168.1/24
                |
                |
              Router (TN)
                |3ffe:501:ffff:100::1
                |192.168.0.1
                |
                |
Net-z--+--------+-----------------+-------- 3ffe:501:ffff:100::/64
       |                          |          192.168.0/24
       |                          |
     DNS Server1 (NUT)          DNS Client1 (TN)
        3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
        192.168.0.10               192.168.0.20
```

Fig. 11 Topology No.11

```
                              . domain
                              DNS Server2
                                |
                                |A.ROOT.NET
                                |3ffe:501:ffff:101::20
                                |192.168.1.20
                                |
Net-y   -----------+---------------+----------------- 3ffe:501:ffff:101::/64
                   |                                  192.168.1/24
                   |
                   |
                 Router (TN)
                   |3ffe:501:ffff:100::1
                   |192.168.0.1
                   |
                   |
Net-z   --+--------+-----------------+-------- 3ffe:501:ffff:100::/64
          |                          |         192.168.0/24
          |                          |
        DNS Server1 (NUT)          DNS Client1 (TN)
           3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
           192.168.0.10               192.168.0.20
```

Fig. 12 Topology No.12

```
     AP Server1 (TN)
       |A.sub.example.com
       |3ffe:501:ffff:101::10
       |192.168.1.10
       |
Net-y--+--------+------------------------------------ 3ffe:501:ffff:101::/64
                |                                     192.168.1/24
                |
                |
                |                         sub.example.com zone
              Router (TN)             DNS Server6 (TN)
                |3ffe:501:ffff:100::1     |NS6.sub.example.com
                |192.168.0.1              |3ffe:501:ffff:100::30
                |                         |192.168.0.30
                |                         |
Net-z--+--------+-----------------+-------+--- 3ffe:501:ffff:100::/64
       |                         |            192.168.0/24
       |                         |
     DNS Server1 (NUT)          DNS Client1 (TN)
        3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
        192.168.0.10               192.168.0.20
```

Fig. 13　Topology No.13

```
Net-y   -----------+--------------------------------- 3ffe:501:ffff:101::/64
                   |                                  192.168.1/24
                   |
                   |
                   |                         sub.example.com zone
                 Router (TN)             DNS Server6 (TN)
                   |3ffe:501:ffff:100::1     |NS6.sub.example.com
                   |192.168.0.1              |3ffe:501:ffff:100::30
                   |                         |192.168.0.30
                   |                         |
Net-z   --+--------+-----------------+-------+--- 3ffe:501:ffff:100::/64
          |                         |            192.168.0/24
          |                         |
        DNS Server1 (NUT)          DNS Client1 (TN)
           3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
           192.168.0.10               192.168.0.20
```

Fig. 14　Topology No.14

```
        AP Server1 (TN)
          |3ffe:501:ffff:101::10
          |192.168.1.10
          |
Net-y   --+--------+---------------------------- 3ffe:501:ffff:101::/64
                   |                              192.168.1/24
                   |
                   |
                   |                          sub.example.com zone
                 Router (TN)             DNS Server6 (TN)
                   |3ffe:501:ffff:100::1     |NS6.sub.example.com
                   |192.168.0.1              |3ffe:501:ffff:100::30
                   |                         |192.168.0.30
                   |                         |
Net-z   --+--------+-----------------+-------+-- 3ffe:501:ffff:100::/64
          |                         |           192.168.0/24
          |                         |
        DNS Server1 (NUT)           DNS Client1 (TN)
           3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
           192.168.0.10               192.168.0.20
```

Fig. 15 Topology No.15

```
Net-y----------+---------------------------------------- 3ffe:501:ffff:101::/64
               |                                          192.168.1/24
               |
               |                     sec.example.com domain
             Router (TN)             DNS Server7
               |3ffe:501:ffff:100::1  |3ffe:501:ffff:100::31
               |192.168.0.1           |192.168.0.31
               |                      |
               |                      |
Net-z-----+----+-----------------+----+---------------+-- 3ffe:501:ffff:100::/64
          |                     |                    |   192.168.0/24
          |                     |                    |
  DNS Server1 (NUT)         DNS Client1 (TN)         DNS Client2 (TN)
   3ffe:501:ffff:100::XXXX   3ffe:501:ffff:100::20   3ffe:501:ffff:100::21
   192.168.0.10              192.168.0.20             192.168.0.21,22
```

Fig. 16 Topology No.16

```
Net-y----------+---------------------------------------- 3ffe:501:ffff:101::/64
               |                                          192.168.1/24
               |
               |                      sec.example.com domain
             Router (TN)              DNS Server7
               |3ffe:501:ffff:100::1  |3ffe:501:ffff:100::31
               |192.168.0.1           |192.168.0.31
               |                      |
               |                      |
Net-z-----+----+-----------------+----+------------------ 3ffe:501:ffff:100::/64
          |                     |                         192.168.0/24
          |                     |
  DNS Server1 (NUT)          DNS Client1 (TN)
  3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
  192.168.0.10               192.168.0.20
```

Fig. 17 Topology No.17

```
     AP Server1 (TN)
       |3ffe:501:ffff:101::10
       |192.168.1.10
       |
Net-y--+--------+---------------------------------------- 3ffe:501:ffff:101::/64
                |                                        192.168.1/24
                |
                |                       secondary for example.com zone
              Router (TN)             DNS Server6 (TN)
                |3ffe:501:ffff:100::1   |3ffe:501:ffff:100::30
                |192.168.0.1            |192.168.0.30
                |                       |
                |                       |
Net-z--+--------+-----------------+-----+---------------- 3ffe:501:ffff:100::/64
       |                         |                        192.168.0/24
       |                         |
     DNS Server1 (NUT)          DNS Client1 (TN)
        3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
        192.168.0.10               192.168.0.20
```

Fig. 18 Topology No.18

```
                          . domain              org domain            org, example.org domain
     AP Server1 (TN)        DNS Server2           DNS Server3           DNS Server4
       |A.example.org         |A.ROOT.NET           |NS3.example.org       |NS3.example.org
       |3ffe:501:ffff:101::10 |3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40
       |192.168.1.10          |192.168.1.20          |192.168.1.30          |192.168.1.40
       |                      |                      |                      |
Net-y--+--------+-------------+----------------------+----------------------+---3ffe:501:ffff:101::/64
                |                                                                 192.168.1/24
                |
                |
              Router (TN)
                |3ffe:501:ffff:100::1
                |192.168.0.1
                |
                |
Net-z--+--------+-----------------+-------- 3ffe:501:ffff:100::/64
       |                          |         192.168.0/24
       |                          |
     DNS Server1 (NUT)          DNS Client1 (TN)
        3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
        192.168.0.10               192.168.0.20
```

Fig. 19 Topology No.19

```
                          . domain              org domain            invalid.org domain
     AP Server1 (TN)        DNS Server2           DNS Server3           DNS Server4
       |A.example.org         |A.ROOT.NET           |NS3.example.org       |NS4.invalid.org
       |3ffe:501:ffff:101::10 |3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40
       |192.168.1.10          |192.168.1.20          |192.168.1.30          |192.168.1.40
       |                      |                      |                      |
Net-y--+--------+-------------+----------------------+----------------------+--3ffe:501:ffff:101::/64
                |                                                                 192.168.1/24
                |
                |
              Router (TN)
                |3ffe:501:ffff:100::1
                |192.168.0.1
                |
                |
Net-z--+--------+-----------------+-------- 3ffe:501:ffff:100::/64
       |                          |         192.168.0/24
       |                          |
     DNS Server1 (NUT)          DNS Client1 (TN)
        3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
        192.168.0.10               192.168.0.20
```

Fig. 20 Topology No.20

```
        AP Server1 (TN)
          |3ffe:501:ffff:101::10
          |192.168.1.11,12
          |
Net-y   --+--------+------------------------- 3ffe:501:ffff:101::/64
                   |                           192.168.1/24
                   |
                   |
                Router (TN)
                   |3ffe:501:ffff:100::1
                   |192.168.0.1
                   |
                   |
Net-z   --+--------+-----------------+-------- 3ffe:501:ffff:100::/64
          |                          |         192.168.0/24
          |                          |
        DNS Server1 (NUT)            DNS Client1 (TN)
           3ffe:501:ffff:100::XXXX     3ffe:501:ffff:100::20
           192.168.0.10                192.168.0.20
```

Fig. 21 Topology No.21

```
                          . domain              org domain             example.org domain
     AP Server1 (TN)      DNS Server2           DNS Server3            DNS Server4
       |                    |A.ROOT.NET           |NS3.example.org       |NS4.example.org
       |3ffe:501:ffff:101::10 |3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40
       |192.168.1.10        |192.168.1.20         |192.168.1.30          |192.168.1.40
       |                    |                     |                      |
Net-y--+--------+-------------+---------------------+----------------------+-- 3ffe:501:ffff:101::/64
                |                                                              192.168.1/24
                |
                |
              Router (TN)
                |3ffe:501:ffff:100::1
                |192.168.0.1
                |
                |
Net-z--+--------+-----------------+-------- 3ffe:501:ffff:100::/64
       |                          |         192.168.0/24
       |                          |
     DNS Server1 (NUT)            DNS Client1 (TN)
        3ffe:501:ffff:100::XXXX     3ffe:501:ffff:100::20
        192.168.0.10                192.168.0.20
```

Fig. 22 Topology No.22

```
        AP Server1 (TN)
          |3ffe:501:ffff:101::10
          |192.168.1.13
          |
Net-y   --+--------+------------------------- 3ffe:501:ffff:101::/64
                   |                           192.168.1/24
                   |
                   |
                 Router (TN)
                   |3ffe:501:ffff:100::1
                   |192.168.0.1
                   |
                   |
Net-z   --+--------+-----------------+-------- 3ffe:501:ffff:100::/64
          |                          |         192.168.0/24
          |                          |
        DNS Server1 (NUT)            DNS Client1 (TN)
           3ffe:501:ffff:100::XXXX     3ffe:501:ffff:100::20
           192.168.0.10                192.168.0.20
```

Fig. 23 Topology No.23

```
     AP Server1 (TN)
       |3ffe:501:ffff:101::10
       |192.168.1.10
       |
Net-y--+--------+------------------------- 3ffe:501:ffff:101::/64
                |                           192.168.1/24
                |
                |
              Router (TN)
                |3ffe:501:ffff:100::1
                |192.168.0.1
                |
                |
Net-z--+--------+-------------+----------------------+--- 3ffe:501:ffff:100::/64
       |                      |                      |    192.168.0/24
       |                      |                      |
   DNS Server1 (NUT)         DNS Client1 (TN)         DNS Client2 (TN)
    3ffe:501:ffff:100::XXXX   3ffe:501:ffff:100::20   3ffe:501:ffff:100::21
    192.168.0.10              192.168.0.20             192.168.0.21
```

Fig. 24 Topology No.24

```
                          . domain                org domain
     AP Server1 (TN)        DNS Server2             DNS Server3
       |A.example.org         |A.ROOT.NET             |NS3.example.org
       |3ffe:501:ffff:101::10 |3ffe:501:ffff:101::20  |3ffe:501:ffff:101::30
       |192.168.1.10          |192.168.1.20           |192.168.1.30
       |                      |                       |
Net-y--+--------+-------------+-----------------------+------ 3ffe:501:ffff:101::/64
                |                                             192.168.1/24
                |
                |
              Router (TN)
                |3ffe:501:ffff:100::1
                |192.168.0.1
                |
                |
Net-z--+--------+---------------+-------- 3ffe:501:ffff:100::/64
       |                        |          192.168.0/24
       |                        |
     DNS Server1 (NUT)        DNS Client1 (TN)
      3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
      192.168.0.10               192.168.0.20
```

Fig. 25 Topology No.25

```
                          . domain            org domain           example.org domain
     AP Server1 (TN)        DNS Server2         DNS Server3          DNS Server4
       |A.example.org         |A.ROOT.NET         |NS3.example.org       |NS4.example.org
       |3ffe:501:ffff:101::10 |3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40
       |192.168.1.10          |192.168.1.20       |192.168.1.30          |192.168.1.40
       |                      |                   |                      |
Net-y--+--------+-------------+-----------+---------+------------+---------+--3ffe:501:ffff:101::/64
                |                         |                      |             192.168.1/24
                |                         |                      |
                |                         |                      | virtual.org domain
              Router (TN)               AP Server2(TN)         DNS Server5
                |3ffe:501:ffff:100::1       B.virtual.org          NS5.virtual.org
                |192.168.0.1                3ffe:501:ffff:101::11  3ffe:501:ffff:101::50
                |                           192.168.1.11           192.168.1.50
                |
                |
Net-z--+--------+---------------+-------- 3ffe:501:ffff:100::/64
       |                        |          192.168.0/24
       |                        |
     DNS Server1 (NUT)          DNS Client1 (TN)
        3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
        192.168.0.10               192.168.0.20
```

Fig. 26 Topology No.26

```
                              . domain               org domain             example.org domain
     AP Server1 (TN)         DNS Server2            DNS Server3            DNS Server4
       |A.example.org          |A.ROOT.NET            |NS3.example.org       |NS4.example.org
       |3ffe:501:ffff:101::100 |3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40
       |192.168.1.100          |192.168.1.20          |192.168.1.30          |192.168.1.40
       |                       |                      |                      |
Net-y--+--------+--------------+------------+---------+----------------------+--3ffe:501:ffff:101::/64
                |                            |                                   192.168.1/24
                |                            |
                |                            |
              Router (TN)                 AP Server2 (TN)
                |3ffe:501:ffff:100::1         B.example.org
                |192.168.0.1                  3ffe:501:ffff:101::200
                |                             192.168.0.200
                |
                |
Net-z--+--------+-----------------+-------------------------+------- 3ffe:501:ffff:100::/64
       |                          |                         |        192.168.0/24
       |                          |                         |
     DNS Server1 (NUT)          DNS Client1 (TN)           AP Server2 (TN)
        3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20     A.example.com
        192.168.0.10               192.168.0.20               3ffe:501:ffff:100::11
                                                              192.168.0.11
```

Fig. 27 Topology No.27

```
                              . domain               org domain             example.org domain
     AP Server1 (TN)         DNS Server2            DNS Server3            DNS Server4
       |A.example.org          |A.ROOT.NET            |NS3.example.org       |NS4.example.org
       |3ffe:501:ffff:101::100 |3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40
       |192.168.1.100          |192.168.1.20          |192.168.1.30          |192.168.1.40
       |                       |                      |                      |
Net-y--+--------+--------------+----------------------+----------------------+-- 3ffe:501:ffff:101::/64
                |                                                                192.168.1/24
                |
                |
              Router (TN)
                |3ffe:501:ffff:100::1
                |192.168.0.1
                |
                |
                |
Net-z--+--------+---------------+-------- 3ffe:501:ffff:100::/64
       |                        |          192.168.0/24
       |                        |
     DNS Server1 (NUT)         DNS Client1 (TN)
        3ffe:501:ffff:100::XXXX   3ffe:501:ffff:100::20
        192.168.0.10              192.168.0.20
```

Fig. 28 Topology No.28

```
                              . domain                org domain            example.org domain
     AP Server1 (TN)          DNS Server2             DNS Server3           DNS Server4
       |A.example.org           |A.ROOT.NET             |NS3.example.org       |NS4.example.org
       |3ffe:501:ffff:101::10,11|3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40
       |192.168.1.10,11         |192.168.1.20           |192.168.1.30          |192.168.1.40
       |                        |                       |                      |
Net-y--+--------+---------------+-----------------------+----------------------+--3ffe:501:ffff:101::/64
                |                                                                 192.168.1/24
                |
                |
              Router (TN)
                |3ffe:501:ffff:100::1
                |192.168.0.1
                |
                |
                |
Net-z--+--------+-----------------+-------- 3ffe:501:ffff:100::/64
       |                          |          192.168.0/24
       |                          |
     DNS Server1 (NUT)          DNS Client1 (TN)
        3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
        192.168.0.10               192.168.0.20
```

Fig. 29 Topology No.29

```
        AP Server1 (TN)
          |3ffe:501:ffff:101::10
          |192.168.1.10
          |
Net-y   --+--------+--------------------------- 3ffe:501:ffff:101::/64
                   |                            192.168.1/24
                   |
                   |
                 Router (TN)
                   |3ffe:501:ffff:100::1
                   |192.168.0.1
                   |
                   |
Net-z   --+--------+-----------------+--------------------------+------ 3ffe:501:ffff:100::/64
          |                          |                          |       192.168.0/24
          |                          |                          |
        DNS Server1 (NUT)            DNS Client1 (TN)            DNS Server2 (TN)
           3ffe:501:ffff:100::XXXX     3ffe:501:ffff:100::20      3ffe:501:ffff:100::21
           192.168.0.10                192.168.0.20               192.168.0.21
```

Fig. 30 Topology No.30

```
                            . domain                org domain           example.org domain
     AP Server1 (TN)         DNS Server2             DNS Server3          DNS Server4
       |A.example.org          |A.ROOT.NET             |NS3.example.org       |NS4.example.org
       |3ffe:501:ffff:101::100 |3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40
       |192.168.1.100          |192.168.1.20           |192.168.1.30          |192.168.1.40
       |                       |                       |                      |
Net-y--+--------+--------------+----------------------+----------------------+-- 3ffe:501:ffff:101::/64
                |                                                                  192.168.1/24
                |
                |
              Router (TN)
                |3ffe:501:ffff:100::1
                |192.168.0.1
                |
                |
                |
Net-z--+--------+---------------+-----------------------+------- 3ffe:501:ffff:100::/64
       |                        |                        |        192.168.0/24
       |                        |                        |
     DNS Server1 (NUT)         DNS Client1 (TN)        AP Server2 (TN)
      3ffe:501:ffff:100::XXXX   3ffe:501:ffff:100::20    A.example.com
      192.168.0.10              192.168.0.20             3ffe:501:ffff:100::11
                                                         192.168.0.11
```

Fig. 31 Topology No.31

```
                            . domain               org domain            edu domain
     AP Server1 (TN)         DNS Server2            DNS Server3           DNS Server4
       |A.example.org          |A.ROOT.NET            |NS3.example.org       |NS4.example.org
       |3ffe:501:ffff:101::10  |3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40
       |192.168.1.10           |192.168.1.20          |192.168.1.30          |192.168.1.40
       |                       |                      |                      |
Net-y--+--------+--------------+----------------------+------------+---------+--3ffe:501:ffff:101::/64
                |                                                  |            192.168.1/24
                |                                                  |
                |                                                  |
              Router (TN)                                        AP Server2(TN)
                |3ffe:501:ffff:100::1                               A.example.edu
                |192.168.0.1                                        3ffe:501:ffff:101::11
                |                                                   192.168.1.11
                |
                |
Net-z--+--------+----------------+-------- 3ffe:501:ffff:100::/64
       |                         |          192.168.0/24
       |                         |
     DNS Server1 (NUT)          DNS Client1 (TN)
        3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
        192.168.0.10               192.168.0.20
```

Fig. 32 Topology No.32

```
                 |
                 |                     sec.example.com domain
              Router (TN)              DNS Server7
                |3ffe:501:ffff:100::1   |3ffe:501:ffff:100::31
                |192.168.0.1            |192.168.0.31
                |                       |
                |                       |
Net-z --+--------+---------------+-------+------------------- 3ffe:501:ffff:100::/64
        |                        |                            192.168.0/24
        |                        |
      DNS Server1 (NUT)         DNS Client1 (TN)
         3ffe:501:ffff:100::10    3ffe:501:ffff:100::20
         192.168.0.10             192.168.0.20
```

Fig. 33 Topology No.33

```
Net-z   --+------------------------+--------------------------- 3ffe:501:ffff:100::/64
          |                        |                            192.168.0/24
          |                        |
        sec.example.com domain
        DNS Server1 (NUT)         DNS Server2 (TN)
           3ffe:501:ffff:100::10    3ffe:501:ffff:100::11
           192.168.0.10             192.168.0.11
```

Fig. 34 Topology No.34

```
                |
                |                     sec.example.com domain  sec.example.com domain
              Router (TN)             DNS Server7             DNS Server8
                |3ffe:501:ffff:100::1 |3ffe:501:ffff:100::31 |3ffe:501:ffff:100::32
                |192.168.0.1          |192.168.0.31          |192.168.0.32
                |                     |                      |
                |                     |                      |
Net-z--+--------+--------------+------+----------------------+---- 3ffe:501:ffff:100::/64
       |                       |                        192.168.0/24
       |                       |
     DNS Server1 (NUT)        DNS Client1 (TN)
        3ffe:501:ffff:100::10   3ffe:501:ffff:100::20
        192.168.0.10            192.168.0.20
```

Fig. 35 Topology No.35

```
        AP Server1 (TN)
          |3ffe:501:ffff:101::10
          |192.168.1.10
          |
Net-y   --+--------+------------------------- 3ffe:501:ffff:101::/64
                   |                           192.168.1/24
                   |
                   |
                Router (TN)
                   |3ffe:501:ffff:100::1
                   |192.168.0.1
                   |
                   |
Net-z   --+--------+-----------------+-------- 3ffe:501:ffff:100::/64
          |                          |          192.168.0/24
          |                          |
        DNS Server1 (NUT)            DNS Client1 (TN)
           3ffe:501:ffff:100::XXXX     3ffe:501:ffff:100::20
           3ffe:501:ffff:100::11       192.168.0.20
           192.168.0.10
           192.168.0.11
```

Fig. 36 Topology No.36

```
                          . domain              org domain            example.org domain
     AP Server1 (TN)        DNS Server2           DNS Server3           DNS Server4
       |A.example.org         |A.ROOT.NET           |NS3.example.org      |NS4.example.org
       |3ffe:501:ffff:101::10 |3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40,41
       |192.168.1.10          |192.168.1.20          |192.168.1.30         |192.168.1.40,41
       |                      |                      |                     |
Net-y--+--------+-------------+----------------------+---------------------+-- 3ffe:501:ffff:101::/64
                |                                                                192.168.1/24
                |
                |
              Router (TN)
                |3ffe:501:ffff:100::1
                |192.168.0.1
                |
                |
                |
Net-z--+--------+-------------+-------- 3ffe:501:ffff:100::/64
       |                      |          192.168.0/24
       |                      |
     DNS Server1 (NUT)        DNS Client1 (TN)
        3ffe:501:ffff:100::XXXX   3ffe:501:ffff:100::20
        192.168.0.10              192.168.0.20
```

Fig. 37 Topology No.37

```
                            . domain              org domain            example.org domain
     AP Server1 (TN)        DNS Server2           DNS Server3           DNS Server4
       |A.example.org         |A.ROOT.NET           |NS3.example.org       |NS4.example.org
       |3ffe:501:ffff:101::10 |3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40,41
       |192.168.1.10          |192.168.1.20          |192.168.1.30          |192.168.1.40,41
       |                      |                      |                      |
Net-y--+--------+-------------+----------+----------+----------------------+-- 3ffe:501:ffff:101::/64
                |                        |                                    192.168.1/24
                |                        |
                |                        |
              Router (TN)              AP Server2 (TN)
                |3ffe:501:ffff:100::1      B.example.org
                |192.168.0.1               3ffe:501:ffff:101::11
                |                          192.168.1.11
                |
                |
Net-z--+--------+---------------+-------- 3ffe:501:ffff:100::/64
       |                        |          192.168.0/24
       |                        |
    DNS Server1 (NUT)          DNS Client1 (TN)
        3ffe:501:ffff:100::XXXX   3ffe:501:ffff:100::20
        192.168.0.10              192.168.0.20
```

Fig. 38 Topology No.38

```
                            . domain              org domain            example.org domain
     AP Server1 (TN)        DNS Server2           DNS Server3           DNS Server4
       |A.example.org         |A.ROOT.NET           |NS3.example.org       |NS4.example.org
       |3ffe:501:ffff:101::10 |3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40
       |192.168.1.10          |192.168.1.20          |192.168.1.30          |192.168.1.40
       |                      |                      |                      |
Net-y--+--------+-------------+----------+----------+----------------------+-- 3ffe:501:ffff:101::/64
                |                        |                                    192.168.1/24
                |                        |
                |                        |
              Router (TN)              AP Server2 (TN)
                |3ffe:501:ffff:100::1      B.example.org
                |192.168.0.1               3ffe:501:ffff:101::11
                |                          192.168.1.11
                |
                |
Net-z--+--------+---------------+-------- 3ffe:501:ffff:100::/64
       |                        |          192.168.0/24
       |                        |
     DNS Server1 (NUT)         DNS Client1 (TN)
      3ffe:501:ffff:100::XXXX   3ffe:501:ffff:100::20
      192.168.0.10              192.168.0.20
```

Fig. 39 Topology No.39

```
        AP Server1 (TN)            AP Server2 (TN)
          |3ffe:501:ffff:101::10     |3ffe:501:ffff:101::11
          |192.168.1.10              |192.168.1.11
          |                          |
Net-y   --+---------+-----------------+-------- 3ffe:501:ffff:101::/64
                    |                           192.168.1/24
                    |
                    |
                 Router (TN)
                    |3ffe:501:ffff:100::1
                    |192.168.0.1
                    |
                    |
Net-z   --+---------+-----------------+-------- 3ffe:501:ffff:100::/64
          |                          |          192.168.0/24
          |                          |
        DNS Server1 (NUT)            DNS Client1 (TN)
           3ffe:501:ffff:100::XXXX     3ffe:501:ffff:100::20
           192.168.0.10                192.168.0.20
```

Fig. 40 Topology No.40

```
        AP Server1 (TN)
          |3ffe:501:ffff:101::10-3ffe:501:ffff:101::41
          |192.168.1.10
          |
Net-y   --+---------+-------------------------- 3ffe:501:ffff:101::/64
                    |                           192.168.1/24
                    |
                    |
                 Router (TN)
                    |3ffe:501:ffff:100::1
                    |192.168.0.1
                    |
                    |
Net-z   --+---------+-----------------+-------- 3ffe:501:ffff:100::/64
          |                          |         192.168.0/24
          |                          |
        DNS Server1 (NUT)            DNS Client1 (TN)
           3ffe:501:ffff:100::XXXX     3ffe:501:ffff:100::20
           192.168.0.10                192.168.0.20
```

Fig. 41 Topology No.41

```
     AP Server1 (TN)
       |A.example.org
       |3ffe:501:ffff:101::10-3ffe:501:ffff:101::41
       |192.168.1.10
       |                 . domain                org domain              example.org domain
       |                 DNS Server2             DNS Server3             DNS Server4
       |                   |A.ROOT.NET             |NS3.example.org        |NS4.example.org
       |                   |3ffe:501:ffff:101::20  |3ffe:501:ffff:101::30  |3ffe:501:ffff:101::40
       |                   |                       |                       |
       |                   |                       |                       |
       |                   |192.168.1.20           |192.168.1.30           |192.168.1.40
       |                   |                       |                       |
Net-y--+--------+----------+-----------------------+-----------------------+--3ffe:501:ffff:101::/64
                |                                                              192.168.1/24
                |
                |
              Router (TN)
                |3ffe:501:ffff:100::1
                |192.168.0.1
                |
                |
Net-z--+--------+----------------+-------- 3ffe:501:ffff:100::/64
       |                         |          192.168.0/24
       |                         |
     DNS Server1 (NUT)         DNS Client1 (TN)
       3ffe:501:ffff:100::XXXX    3ffe:501:ffff:100::20
       192.168.0.10               192.168.0.20
```

Fig. 42 Topology No.42

```
         AP Server1 (TN)             AP Server2 (TN)
           |www1.example.com.          |www2.example.com.
           |3ffe:501:ffff:101::10      |3ffe:501:ffff:101::20
           |192.168.1.10               |192.168.1.20
           |                           |
Net-y   --+---------+-----------------+-------- 3ffe:501:ffff:101::/64
                    |                            192.168.1/24
                    |
                    |
                  Router (TN)
                    |3ffe:501:ffff:100::1
                    |192.168.0.1
                    |
                    |
Net-z   --+---------+-----------------+-------- 3ffe:501:ffff:100::/64
           |                           |          192.168.0/24
           |                           |
         DNS Server1 (NUT)            DNS Client1 (TN)
            3ffe:501:ffff:100::XXXX     3ffe:501:ffff:100::20
            192.168.0.10                192.168.0.20
```

Fig. 43 Topology No.43

```
        AP Server1 (TN)
          |3ffe:501:ffff:101::10
          |192.168.1.10
          |
Net-y   --+--------+------------------------- 3ffe:501:ffff:101::/64
                   |                           192.168.1/24
                   |
                   |
                 Router (TN)
                   |3ffe:501:ffff:100::1
                   |192.168.0.1
                   |
                   |
Net-z   --+--------+-----------------+-------- 3ffe:501:ffff:100::/64
          |                          |          192.168.0/24
          |                          |
        DNS Server1 (NUT)            DNS Client1 (TN)
           3ffe:501:ffff:100::XXXX     3ffe:501:ffff:100::20
           3ffe:501:ffff:100::10
           192.168.0.10                192.168.0.20
```

Fig. 44 Topology No.44

```
                          E164.ARPA domain     0.8.E164.ARPA domain    0.9.0.8.E164.ARPA domain
     AP Server1 (TN)      DNS Server2            DNS Server3             DNS Server4
       |                    |A.ROOT.NET            |NS3.example.org        |NS4.example.org
       |3ffe:501:ffff:101::10 |3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40
       |192.168.1.10        |192.168.1.20          |192.168.1.30           |192.168.1.40
       |                    |                      |                       |
Net-y--+--------+-------------+----------------------+----------------------+-- 3ffe:501:ffff:101::/64
                |                                                              192.168.1/24
                |
                |
             Router (TN)
                |3ffe:501:ffff:100::1
                |192.168.0.1
                |
                |
                |
Net-z--+--------+----------------+-------- 3ffe:501:ffff:100::/64
       |                         |         192.168.0/24
       |                         |
     DNS Server1 (NUT)         DNS Client1 (TN)
       3ffe:501:ffff:100::XXXX   3ffe:501:ffff:100::20
       192.168.0.10              192.168.0.20
```

Fig. 45 Topology No.45

```
                                                  1.0.5.0.e.f.f.3.       f.f.f.f.1.0.5.0.e.f.f.3.
                           IP6.ARPA domain        IP6.ARPA domain        IP6.ARPA domain
     AP Server1 (TN)       DNS Server2            DNS Server3            DNS Server4
       |www.example.org       |A.ROOT.NET            |NS3.example.org       |NS4.example.org
       |3ffe:501:ffff:101::10 |3ffe:501:ffff:101::20 |3ffe:501:ffff:101::30 |3ffe:501:ffff:101::40
       |192.168.1.10          |192.168.1.20          |192.168.1.30          |192.168.1.40
       |                      |                      |                      |
Net-y--+--------+-------------+-----------+----------+----------------------+-- 3ffe:501:ffff:101::/64
                |                         |                                      192.168.1/24
                |                         |
                |                         |1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA domain
              Router (TN)               DNS Server5
                |3ffe:501:ffff:100::1      NS5.example.org
                |192.168.0.1               3ffe:501:ffff:101::50
                |                          192.168.1.50
                |
                |
Net-z--+--------+----------------+-------- 3ffe:501:ffff:100::/64
       |                         |          192.168.0/24
       |                         |
     DNS Server1 (NUT)         DNS Client1 (TN)
        3ffe:501:ffff:100::XXXX   3ffe:501:ffff:100::20
        192.168.0.10              192.168.0.20
```

Fig. 46 Topology No.46

XXXX: EUI64

3. Terminology

NUT_NETZ	DNS Server1's (NUT) Net-z address
NUT_NETZ2	DNS Server1's (NUT) another Net-z address
CL1_NETZ	DNS Client1's (TN) Net-z address
SV2_NETY	DNS Server2's (TN) Net-y address
SV2_NETZ	DNS Server2's (TN) Net-z address
SV3_NETY	DNS Server3's (TN) Net-y address
SV4_NETY	DNS Server4's (TN) Net-y address
SV5_NETY	DNS Server5's (TN) Net-y address
SV6_NETZ	DNS Server6's (TN) Net-z address
SV7_NETZ	DNS Server7's (TN) Net-z address
SV8_NETZ	DNS Server8's (TN) Net-z address

4. Description

Each test specification consists of following parts.

Purpose: The Purpose is the short statement describing what the test attempts to achieve. It is usually phrased as a simple assertion of the future or capability to be tested.

Category: The Category shows what classification of device must satisfy the test.

Initialization: The Initialization describes how to initialize and configure the NUT before starting each test. If a value is not provided, then the protocol's default value is used.

Procedure: The Procedure describes step-by-step instructions for carrying out the test.

Judgment: The Judgment describes expected result. If we can observe as same result as the description of Judgment, the NUT passes the test.

References: The References section contains some parts of specification

5. Server Test

5.1. Label length

Purpose

Verify that a NUT transmits messages name space specifications

- Each node has a label, which is zero to 63 octets in length
  labels 63 octets or less

Category

Server (Content Server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL  86400                ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600           ; serial
      3600                 ; refresh every 1 hr
      900                  ; retry every 15 min
      604800               ; expire after a week
      3600                 ; Minimum TTL of a 1 hr
)
        IN      NS        NS1.example.com.
;
NS1     IN      A         192.168.0.10
;
A       IN      A         192.168.1.10
AAAA
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |--------------------------------------->|
    |   1. Send standard query              |
    |       QNAME=A.example.com             |
    |<---------------------------------------|
    |   2. Standard query response          |
    |       ADDRESS=192.168.1.10            |
    |--------------------------------------->|
    |   3. Send standard query to NUT       |
    |       QNAME=AAA******A.example.com    |
    |             <---63--->                |
    |<---------------------------------------|
    |   4. Standard query response          |
    |       ADDRESS=192.168.1.10            |
    v                                       v

     1. TN send standard query w/ 1 octet label to NUT.
     2. NUT reply query response to TN (Judgment *2)
     3. TN send standard query w/ 63 octets label to NUT.
     4. NUT reply query response to TN (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)

	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2001
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	AAAA

	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA AAAAAAAA.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA AAAAAAAA.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC04C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC04C)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC079)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response from NUT responding to standard query w/ label length 1
4. Received standard query response from NUT responding to standard query w/ label length 63

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.1. Name space specifications a terminology
  3.5. Preferred name syntax
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  2.3.1 Preferred name syntax
RFC1123 Requirements for internet Hosts -- Application and Support
  2.1 Host Names and Numbers

5.2. Case-insensitive manner

Purpose

Verify that a NUT transmits messages name space specifications

- Domain name comparisons for all present domain functions are done in a case-insensitive manner, assuming an ASCII character set, and a high order zero bit.

Category

Server (Content Server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL  86400                ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600           ; serial
      3600                 ; refresh every 1 hr
      900                  ; retry every 15 min
      604800               ; expire after a week
      3600                 ; Minimum TTL of a 1 hr
)
        IN        NS       NS1.example.com.
;
NS1     IN        A        192.168.0.10
;
A       IN        A        192.168.1.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |--------------------------------------->|
    |   1. Send standard query              |
    |        QNAME=a.example.com            |
    |<---------------------------------------|
    |   2. Standard query response          |
    |        ADDRESS=192.168.1.10           |
    |--------------------------------------->|
    |   3. Send standard query to NUT       |
    |        QNAME=A.example.com            |
    |<---------------------------------------|
    |   4. Standard query response          |
    |        ADDRESS=192.168.1.10           |
    v                                       v

1. TN send standard query using lower case to NUT.
2. NUT reply query response to TN (Judgment *2)
3. TN send standard query using upper case to NUT.
4. NUT reply query response to TN as same as 2.(Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	a.example.com
	QTYPE	A (0x0001)

	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	a.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	a.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2001
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response responding to standard query (QTYPE=A).
4. Received standard query response as same as 2.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.1. Name space specifications and terminology
  3.5. Preferred name syntax
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  2.3.1 Preferred name syntax

5.3. Domain name length

Purpose

Verify that a NUT transmits messages name space specifications

- To simplify implementations, the total number of octets that represent a domain name
  (i.e., the sum of all label octets and label lengths) is limited to 255.

  names 255 octets or less

Category

Server (Content Server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL  86400                ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600           ; serial
      3600                 ; refresh every 1 hr
      900                  ; retry every 15 min
      604800               ; expire after a week
      3600                 ; Minimum TTL of a 1 hr
)
        IN        NS       NS1.example.com.
;
NS1     IN        A        192.168.0.10
;
A       IN        A        192.168.1.10
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA  IN    A     192.168.1.10
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA.BBBB
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                                  DNS Server1 (NUT)
    |                                                   |
    |-------------------------------------------------->|
    |   1. Send standard query                          |
    |       QNAME=A**.B**.C**.D**.E**.example.com       |
    |             <---- Name length is 255 ----->       |
    |<--------------------------------------------------|
    |   2. Standard query response                      |
    |       ADDRESS=192.168.1.10                        |
    v                                                   v

 1. TN send standard query w/ QNAME length 255 to NUT.
 2. NUT reply query response to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA. BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB. CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC. DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD. EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA. BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB. CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC. DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD. EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA. BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB. CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC. DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD. EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE.example.com
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS	NAME	NS1.example.com (Pointer 0xC03B)

Additional section	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response from NUT responding to standard query w/ name length 255

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
Page 8, 3.1. Name space specifications and terminology
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
Page 10, 2.3.4. Size limits
Page 10, 3.1. Name space definitions
RFC1123 Requirements for internet Hosts -- Application and Support
Page 13, 2.1 Host Names and Numbers

5.4. Rule for label

Purpose

Verify that a NUT transmits messages as follow as rule for label

- The syntax of a legal Internet host name was specified in RFC-952.
  One aspect of host name syntax is hereby changed: the restriction on the first character is relaxed to allow either a letter or a digit.
  Host software MUST support this more liberal syntax.

Category

Server (Content Server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL  86400                ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600           ; serial
      3600                 ; refresh every 1 hr
      900                  ; retry every 15 min
      604800               ; expire after a week
      3600                 ; Minimum TTL of a 1 hr
)
        IN        NS       NS1.example.com.
;
NS1     IN        A        192.168.0.10
;
1A      IN        A        192.168.1.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |-------------------------------------->|
    |   1. Send standard query              |
    |       QNAME=1A.example.com            |
    |<--------------------------------------|
    |   2. Standard query response          |
    |       ADDRESS=192.168.1.10            |
    v                                       v

 1. TN send standard query QNAME=1A.example.com to NUT.
 2. NUT reply query response to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	1A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53

	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	1A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	1A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response from NUT responding to standard query QNAME=1A.example.com.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
3.1. Name space specifications and terminology
3.5. Preferred name syntax
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
2.3.1 Preferred name syntax
RFC1123 Requirements for internet Hosts -- Application and Support
2.1 Host Names and Numbers

5.5. Resource record A type

Purpose

Verify that a NUT transmits correct message including A type in the QTYPE field.

- Query type A.
  Header section field has the following value.

QR	0
QDCOUNT	1
ANCOUNT	0
NSCOUNT	0

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	A.example.org
QTYPE	A (0x0001)
QCLASS	IN (0x0001)

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig.2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.
  Example of root server list:

For IPv4:

```
.                    3600000        IN    NS    A.ROOT.NET.
A.ROOT.NET.          3600000              A     192.168.1.20
```

For IPv6

```
 .                          3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.                3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL  86400                 ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600            ; serial
      3600                  ; refresh every 1 hr
      900                   ; retry every 15 min
      604800                ; expire after a week
      3600                  ; Minimum TTL of a 1 hr
)
;
        IN        NS       NS1.example.com.
NS1     IN        A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)     DNS Server1 (NUT)           DNS Server2 (TN)           DNS Server3 (TN)           DNS Server4 (TN)
 |                        |                          |                          |                          |
 |------------------------>|                          |                          |                          |
 |1.Send standard query    |                          |                          |                          |
 | QNAME=A.example.org     |                          |                          |                          |
 | QTYPE=A                 |                          |                          |                          |
 |                         |-------------------------->|                          |                          |
 |                         |2.Send standard query      |                          |                          |
 |                         | QNAME=A.example.org       |                          |                          |
 |                         | QTYPE=A                   |                          |                          |
 |                         |<--------------------------|                          |                          |
 |                         |3.Send standard response   |                          |                          |
 |                         | QNAME=A.example.org       |                          |                          |
 |                         | QTYPE=A                   |                          |                          |
 |                         | AUTHORITY Name=org        |                          |                          |
 |                         | AUTHORITY Name Server     |                          |                          |
 |                         |      =NS3.example.org     |                          |                          |
 |                         | ADDITIONAL Name = NS3.example.org |                  |                          |
 |                         | ADDITIONAL Address = 192.168.1.30 |                  |                          |
 |                         |-------------------------------------------------------->|                          |
 |                         |                           |4.Send standard query     |                          |
 |                         |                           | QNAME=A.example.org      |                          |
 |                         |                           | QTYPE=A                  |                          |
 |                         |<------------------------------------------------------------------------------------|
 |                         |                           |5.Send standard response|                            |
 |                         |                           | QNAME=A.example.org      |                          |
 |                         |                           | QTYPE=A                  |                          |
 |                         |                           | AUTHORITY Name = example.org |                      |
 |                         |                           | AUTHORITY Name Server    |                          |
 |                         |                           |      =NS4.example.org    |                          |
 |                         |                           | ADDITIONAL Name = NS4.example.org |                 |
 |                         |                           | ADDITIONAL Address =192.168.1.40 |                  |
 |------------------------------------------------------------------------------------------------------------------>|
 |                         |                           |                          |6.Send standard query     |
 |                         |                           |                          | QNAME=A.example.org      |
 |                         |                           |                          | QTYPE=A                  |
 |<------------------------------------------------------------------------------------------------------------------|
 |                         |                           |                          |7.Send standard response  |
 |                         |                           |                          | QNAME=A.example.org      |
 |                         |                           |                          | QTYPE=A                  |
 |                         |                           |                          | ANSWER Name = A.example.org |
 |                         |                           |                          | ANSWER Address = 192.168.1.10 |
 |                         |                           |                          | AUTHORITY Name =example.org |
 |                         |                           |                          | AUTHORITY Name Server    |
 |                         |                           |                          |      =NS4.example.org    |
 |                         |                           |                          | ADDITIONAL Name = NS4.example.org |
 |                         |                           |                          | ADDITIONAL Address = 192.168.1.40|
 |<------------------------|                           |                          |                          |
 |8.Standard query response|                           |                          |                          |
 | QNAME=A.example.org     |                           |                          |                          |
 | QTYPE=A                 |                           |                          |                          |
 | ANSWER Name = A.example.org|                        |                          |                          |
 | ANSWER Address = 192.168.1.10 |                     |                          |                          |
 | AUTHORITY Name = example.org |                      |                          |                          |
 | AUTHORITY Name Server   |                           |                          |                          |
 |      =NS4.example.org   |                           |                          |                          |
 v                         v                           v                          v                          v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10 to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	Any
	Dst Port	53
DNS Header	ID	Any
	QR	0

	OPCODE	0
	AA	Any
	TC	0
	RD	0
	RA	Any
	Z	Any
	RCODE	Any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	Any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6

	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	Any
	Dst Port	53
DNS Header	ID	Any
	QR	0
	OPCODE	0
	AA	Any
	TC	0
	RD	0
	RA	Any
	Z	Any
	RCODE	Any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	Any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0

	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	Any
	Dst Port	53
DNS Header	ID	Any
	QR	0
	OPCODE	0
	AA	Any
	TC	0
	RD	0
	RA	Any
	Z	Any
	RCODE	Any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	Any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response including correct address in the ADDRESS field.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
  3.2.2 TYPE values
  3.4.1 A RDATA format

5.6. CNAME type

Purpose

Verify that a NUT transmits correct message including CNAME type in the QTYPE field.

- Query type CNAME.
  Header section field has the following value.

QR	0
QDCOUNT	1
ANCOUNT	0
NSCOUNT	0
ARCOUNT	0

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	A.example.org
QTYPE	CNAME (0x0001)
QCLASS	IN (0x0001)

Category

Server(Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 2 Topology No.2".
  AP server1 has a domain name "www.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

Example of root server list:

```
For IPv4:
 .                        3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.              3600000                   A        192.168.1.20

For IPv6
 .                        3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL  86400               ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600          ; serial
      3600                ; refresh every 1 hr
      900                 ; retry every 15 min
      604800              ; expire after a week
      3600                ; Minimum TTL of a 1 hr
)
;
        IN        NS      NS1.example.com.
NS1     IN        A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)         DNS Server1 (NUT)        DNS Server2 (TN)           DNS Server3 (TN)         DNS Server4 (TN)
 |                        |                        |                          |                        |
 |------------------------>|                        |                          |                        |
 |1.Send standard query    |                        |                          |                        |
 | QNAME=www.example.org   |                        |                          |                        |
 | QTYPE=CNAME             |                        |                          |                        |
 |                         |------------------------>|                          |                        |
 |                         |2.Send standard query    |                          |                        |
 |                         | QNAME=www.example.org   |                          |                        |
 |                         | QTYPE=CNAME             |                          |                        |
 |                         |<------------------------|                          |                        |
 |                         |3.Send standard response|                          |                        |
 |                         | QNAME=www.example.org   |                          |                        |
 |                         | QTYPE=CNAME             |                          |                        |
 |                         | AUTHORITY Name=org      |                          |                        |
 |                         | AUTHORITY Name Server   |                          |                        |
 |                         |      =NS3.example.org   |                          |                        |
 |                         | ADDITIONAL Name         |                          |                        |
 |                         |      =NS3.example.org   |                          |                        |
 |                         | ADDITIONAL Address      |                          |                        |
 |                         |      =192.168.1.30      |                          |                        |
 |                         |-------------------------------------------------->|                        |
 |                         |                        |4.Send standard query     |                        |
 |                         |                        | QNAME=www.example.org    |                        |
 |                         |                        | QTYPE=CNAME              |                        |
 |                         |<-------------------------------------------------|                        |
 |                         |                        |5.Send standard response  |                        |
 |                         |                        | QNAME=www.example.org    |                        |
 |                         |                        | QTYPE=CNAME              |                        |
 |                         |                        | AUTHORITY Name=example.org|                        |
 |                         |                        | AUTHORITY Name Server    |                        |
 |                         |                        |      =NS4.example.org    |                        |
 |                         |                        | ADDITIONAL Name          |                        |
 |                         |                        |      =NS4.example.org    |                        |
 |                         |                        | ADDITIONAL Address       |                        |
 |                         |                        |      =192.168.1.40       |                        |
 |------------------------------------------------------------------------------------------------------>|
 |                         |                        |                          |6.Send standard query     |
 |                         |                        |                          | QNAME=www.example.org    |
 |                         |                        |                          | QTYPE=CNAME              |
 |<------------------------------------------------------------------------------------------------------|
 |                         |                        |                          |7.Send standard response  |
 |                         |                        |                          | QNAME=www.example.org    |
 |                         |                        |                          | QTYPE=CNAME              |
 |                         |                        |                          | ANSWER Name = www.example.org |
 |                         |                        |                          | ANSWER CNAME = A example.org |
 |                         |                        |                          | AUTHORITY Name = example.org |
 |                         |                        |                          | AUTHORITY Name Server    |
 |                         |                        |                          |      =NS4.example.org    |
 |                         |                        |                          | ADDITIONAL Name          |
 |                         |                        |                          |      =NS4.example.org    |
 |                         |                        |                          | ADDITIONAL Address       |
 |                         |                        |                          |      =192.168.1.40       |
 |<------------------------|                        |                          |                        |
 |8.Standard query response |                        |                          |                        |
 | QNAME=www.example.org   |                        |                          |                        |
 | QTYPE=CNAME             |                        |                          |                        |
 | ANSWER Name=www.example.org|                        |                          |                        |
 | ANSWER CNAME = A.example.org |                        |                          |                        |
 | AUTHORITY Name = example.org |                        |                          |                        |
 | AUTHORITY Name Server   |                        |                          |                        |
 |      =NS4.example.org   |                        |                          |                        |
 v                        v                        v                          v                        v
```

1. TN send standard query QNAME=WWW.example.org, QTYPE=CNAME to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=WWW.example.org, QTYPE=CNAME to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=WWW.example.org, QTYPE=CNAME to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name = WWW.example.org, ANSWER CNAME=A.example.org to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	www.example.org
	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY

	QR	0
	OPCODE	0
	AA	Any
	TC	0
	RD	0
	RA	Any
	Z	Any
	RCODE	Any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	www.example.org
	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	www.example.org
	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	Org (Pointer 0xC018)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	1
	OPCODE	0
	AA	Any
	TC	0
	RD	0
	RA	Any
	Z	Any
	RCODE	Any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	www.example.org
	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0

	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	www.example.org
	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	1
	OPCODE	0
	AA	Any
	TC	0
	RD	0
	RA	Any
	Z	Any
	RCODE	Any
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	www.example.org
	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	www.example.org
	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	www.example.org (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	CNAME	A.example.org (A + Pointer 0xC010)
DNS Authority section	NAME	example.org (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC010)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03D)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	www.example.org
	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	www.example.org (Pointer 0xC00C)
	TYPE	CLASS (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	CNAME	A.example.org (A + Pointer 0xC010)
DNS Authority section	NAME	example.org (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC010)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- Termination
  None

Judgment

2. Received standard query including QNAME=www.example.org, QTYPE=CNAME.
4. Received standard query including QNAME=www.example.org, QTYPE=CNAME.
6. Received standard query including QNAME=www.example.org, QTYPE=CNAME.
8. Received standard query response including correct <domain-name> in the CNAME field.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
  3.2.2 TYPE values
  3.3.1 CNAME RDATA format

5.7. HINFO type

Purpose

Verify that a NUT transmits correct message including HINFO type in the QTYPE field.

- Query type HINFO.
  Header section field has the following value.

QR	0
QDCOUNT	1
ANCOUNT	0
NSCOUNT	0

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	A.example.org
QTYPE	HINFO (0x000D)
QCLASS	IN (0x0001)

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig.2 Topology No.2".
  AP server1 has a domain name "www.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
.                    3600000        IN    NS    A.ROOT.NET.
A.ROOT.NET.          3600000              A     192.168.1.20
```

For IPv6

```
 .                        3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL  86400               ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600          ; serial
      3600                ; refresh every 1 hr
      900                 ; retry every 15 min
      604800              ; expire after a week
      3600                ; Minimum TTL of a 1 hr
)
;
        IN        NS      NS1.example.com.
NS1     IN        A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)         DNS Server1 (NUT)        DNS Server2 (TN)          DNS Server3 (TN)         DNS Server4 (TN)
 |                          |                        |                         |                         |
 |-------------------------->|                        |                         |                         |
 |1.Send standard query      |                        |                         |                         |
 | QNAME=www.example.org     |                        |                         |                         |
 | QTYPE=HINFO               |                        |                         |                         |
 |                           |------------------------>|                         |                         |
 |                           |2.Send standard query   |                         |                         |
 |                           | QNAME=www.example.org  |                         |                         |
 |                           | QTYPE=HINFO            |                         |                         |
 |                           |<------------------------|                         |                         |
 |                           |3.Send standard response|                         |                         |
 |                           | QNAME=www.example.org  |                         |                         |
 |                           | QTYPE=HINFO            |                         |                         |
 |                           | AUTHORITY Name=org     |                         |                         |
 |                           | AUTHORITY Name Server  |                         |                         |
 |                           |      =NS3.example.org  |                         |                         |
 |                           | ADDITIONAL Name        |                         |                         |
 |                           |      =NS3.example.org  |                         |                         |
 |                           | ADDITIONAL Address     |                         |                         |
 |                           |      =192.168.1.30     |                         |                         |
 |                           |------------------------------------------------------>|                         |
 |                           |                        |4.Send standard query     |                         |
 |                           |                        | QNAME=www.example.org    |                         |
 |                           |                        | QTYPE=HINFO              |                         |
 |                           |<------------------------------------------------------|                         |
 |                           |                        |5.Send standard response  |                         |
 |                           |                        | QNAME=www.example.org    |                         |
 |                           |                        | QTYPE=HINFO              |                         |
 |                           |                        | AUTHORITY Name=example.org|                         |
 |                           |                        | AUTHORITY Name Server    |                         |
 |                           |                        |      =NS4.example.org    |                         |
 |                           |                        | ADDITIONAL Name = NS4.example.org |                         |
 |                           |                        | ADDITIONAL Address = 192.168.1.40 |                         |
 |-------------------------------------------------------------------------------------------------------------->|
 |                           |                        |                         |6.Send standard query     |
 |                           |                        |                         | QNAME=www.example.org    |
 |                           |                        |                         | QTYPE=HINFO              |
 |<--------------------------------------------------------------------------------------------------------------|
 |                           |                        |                         |7.Send standard response  |
 |                           |                        |                         | QNAME=www.example.org    |
 |                           |                        |                         | QTYPE=HINFO              |
 |                           |                        |                         | ANSWER Name = www.example.org |
 |                           |                        |                         | ANSWER CPU =IBM-PC/AT    |
 |                           |                        |                         | ANSWER OS =UNIX          |
 |                           |                        |                         | AUTHORITY Name=example.org|
 |                           |                        |                         | AUTHORITY Name Server    |
 |                           |                        |                         |      =NS4.example.org    |
 |                           |                        |                         | ADDITIONAL Name          |
 |                           |                        |                         |      =NS4.example.org    |
 |                           |                        |                         | ADDITIONAL Address       |
 |                           |                        |                         |      =192.168.1.40       |
 |<--------------------------|                        |                         |                         |
 |8.Standard query response  |                        |                         |                         |
 | QNAME=www.example.org     |                        |                         |                         |
 | QTYPE=HINFO               |                        |                         |                         |
 | ANSWER Name=www.example.org|                        |                         |                         |
 | ANSWER CPU=IBM-PC/AT      |                        |                         |                         |
 | ANSWER OS=UNIX            |                        |                         |                         |
 | AUTHORITY Name = example.org |                        |                         |                         |
 | AUTHORITY Name Server     |                        |                         |                         |
 |      =NS4.example.org     |                        |                         |                         |
 v                           v                        v                         v                         v
```

1. TN send standard query QNAME=WWW.example.org, QTYPE=HINFO to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=WWW.example.org, QTYPE=HINFO to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=WWW.example.org, QTYPE=HINFO to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=WWW.example.org, ANSWER CPU=IBM-PC/AT, OS=UNIX to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	www.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0

	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	www.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	www.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC018)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6

	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	www.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0

	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	www.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC010)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	amy
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	any
DNS Question section	QNAME	www.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	www.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	www.example.org (Pointer 0xC00C)
	TYPE	HINFO (0x000D)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	15
	CPU	IBM-PC/AT
	OS	UNIX
DNS Authority section	NAME	example.org (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC010)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC048)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	www.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	www.example.org (Pointer 0xC00C)
	TYPE	HINFO (0x000D)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	CPU	IBM-PC/AT
OS	UNIX	
DNS Authority section	NAME	example.org (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC010)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03D)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- Termination
  None

Judgment

2. Received standard query including QNAME=www.example.org, QTYPE=HINFO.
4. Received standard query including QNAME=www.example.org, QTYPE=HINFO.
6. Received standard query including QNAME=www.example.org, QTYPE=HINFO.
8. Received standard query response including correct CPU type and OS type in the CPU and OS field.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
  3.2.2 TYPE values
  3.3.2 HINFO RDATA format

5.8. MX type

Purpose

Verify that a NUT transmits correct message including MX type in the QTYPE field.

- Query type MX.
  Header section field has the following value.

QR	0
QDCOUNT	1
ANCOUNT	0
NSCOUNT	0

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	A.example.org
QTYPE	MX (0x000F)
QCLASS	IN (0x0001)

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig.2 Topology No.2".
  AP server1 has a domain name "mail.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
.                    3600000        IN    NS    A.ROOT.NET.
A.ROOT.NET.          3600000              A     192.168.1.20
```

For IPv6

```
 .                        3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL  86400               ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600          ; serial
      3600                ; refresh every 1 hr
      900                 ; retry every 15 min
      604800              ; expire after a week
      3600                ; Minimum TTL of a 1 hr
)
;
        IN        NS      NS1.example.com.
NS1     IN        A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)        DNS Server1 (NUT)            DNS Server2 (TN)              DNS Server3 (TN)         DNS Server4 (TN)
  |                        |                          |                             |                          |
  |------------------------>|                          |                             |                          |
  |1.Send standard query    |                          |                             |                          |
  | QNAME=example.org       |                          |                             |                          |
  | QTYPE=MX                |                          |                             |                          |
  |                         |-------------------------->|                             |                          |
  |                         |2.Send standard query     |                             |                          |
  |                         | QNAME=example.org        |                             |                          |
  |                         | QTYPE=MX                 |                             |                          |
  |                         |<-------------------------|                             |                          |
  |                         |3.Send standard response  |                             |                          |
  |                         | QNAME=example.org        |                             |                          |
  |                         | QTYPE=MX                 |                             |                          |
  |                         | AUTHORITY Name=org       |                             |                          |
  |                         | AUTHORITY Name Server    |                             |                          |
  |                         |      =NS3.example.org    |                             |                          |
  |                         | ADDITIONAL Name          |                             |                          |
  |                         |      =NS3.example.org    |                             |                          |
  |                         | ADDITIONAL Address       |                             |                          |
  |                         |      =192.168.1.30       |                             |                          |
  |                         |------------------------------------------------------------>|                          |
  |                         |                          |4.Send standard query        |                          |
  |                         |                          | QNAME=example.org           |                          |
  |                         |                          | QTYPE=MX                    |                          |
  |                         |<-------------------------------------------------------------|                          |
  |                         |                          |5.Send standard response     |                          |
  |                         |                          | QNAME=example.org           |                          |
  |                         |                          | QTYPE=MX                    |                          |
  |                         |                          | AUTHORITY Name =example.org|                          |
  |                         |                          | AUTHORITY Name Server       |                          |
  |                         |                          |      =NS4.example.org       |                          |
  |                         |                          | ADDITIONAL Name = NS4.example.org |                          |
  |                         |                          | ADDITIONAL Address = 192.168.1.40 |                          |
  |-------------------------------------------------------------------------------------------------------------------->|
  |                         |                          |                             |6.Send standard query     |
  |                         |                          |                             | QNAME=example.org        |
  |                         |                          |                             | QTYPE=MX                 |
  |<--------------------------------------------------------------------------------------------------------------------|
  |                         |                          |                             |7.Send standard response  |
  |                         |                          |                             | QNAME=example.org        |
  |                         |                          |                             | QTYPE=MX                 |
  |                         |                          |                             | ANSWER Name=example.org  |
  |                         |                          |                             | ANSWER Preference=10     |
  |                         |                          |                             | ANSWER Exchange =mail.example.org |
  |                         |                          |                             | AUTHORITY Name = example.org |
  |                         |                          |                             | AUTHORITY Name Server    |
  |                         |                          |                             |      =NS4.example.org    |
  |                         |                          |                             | ADDITIONAL Name = NS4.example.org |
  |                         |                          |                             | ADDITIONAL Address = 192.168.1.40 |
  |<------------------------|                          |                             |                          |
  |8.Standard query response|                          |                             |                          |
  | QNAME=example.org       |                          |                             |                          |
  | QTYPE=MX                |                          |                             |                          |
  | ANSWER Name=example.org |                          |                             |                          |
  | ANSWER Preference=10    |                          |                             |                          |
  | ANSWER Exchange         |                          |                             |                          |
  |      =mail.example.org  |                          |                             |                          |
  | AUTHORITY Name = example.org |                          |                             |                          |
  | AUTHORITY Name Server   |                          |                             |                          |
  |      =NS4.example.org   |                          |                             |                          |
  v                         v                          v                             v                          v
```

1. TN send standard query QNAME=WWW.example.org, QTYPE=MX to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=WWW.example.org, QTYPE=MX to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=WWW.example.org, QTYPE=MX to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=WWW.example.org, ANSWER PREFERENCE=10, EXCHANGE=mail.example.org to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	Example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0

	AA	Any
	TC	0
	RD	0
	RA	Any
	Z	Any
	RCODE	Any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	Any
DNS Question section	QNAME	Example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC014)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)

DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	1
	OPCODE	0
	AA	Any
	TC	0
	RD	0
	RA	Any
	Z	Any
	RCODE	Any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	Any
DNS Question section	QNAME	Example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00C)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	1
	OPCODE	0
	AA	Any
	TC	0
	RD	0
	RA	Any
	Z	Any
	RCODE	Any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	Any

DNS Question section	QNAME	example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.org (Pointer 0xC00C)
	TYPE	MX (0x000F)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	PREFERENCE	10
	EXCHANGE	mail.example.org (mail + Pointer 0xC00C)
DNS Authority section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00C)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03E)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.org (Pointer 0xC00C)
	TYPE	MX (0x000F)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	PREFERENCE	10
	EXCHANGE	mail.example.org (mail + Pointer 0xC010)
DNS Authority section	NAME	example.org (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC010)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- Termination
  None

Judgment

2. Received standard query including QNAME=example.org, QTYPE=MX.
4. Received standard query including QNAME=example.org, QTYPE=MX.
6. Received standard query including QNAME=example.org, QTYPE=MX.
8. Received standard query response including correct preference and <domain-name> in the PREFERENCE and EXCHANGE field.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
  3.2.2 TYPE values
  3.3.9 MX RDATA format

5.9. NS type

Purpose

Verify that a NUT transmits correct message including NS type in the QTYPE field.

- Query type NS.
  Header section field has the following value.

QR	0
QDCOUNT	1
ANCOUNT	0
NSCOUNT	0

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	A.example.org
QTYPE	NS (0x0002)
QCLASS	IN (0x0001)

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig.2 Topology No.2".
  AP server1 has a domain name "www.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
.                       3600000          IN       NS       A.ROOT.NET.
```

```
 A.ROOT.NET.              3600000                    A        192.168.1.20
For IPv6
 .                        3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL  86400               ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600          ; serial
      3600                ; refresh every 1 hr
      900                 ; retry every 15 min
      604800              ; expire after a week
      3600                ; Minimum TTL of a 1 hr
)
;
        IN        NS      NS1.example.com.
NS1     IN        A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)     DNS Server1 (NUT)        DNS Server2 (TN)           DNS Server3 (TN)       DNS Server4 (TN)
  |                        |                        |                        |                        |
  |------------------------>|                        |                        |                        |
  |1.Send standard query    |                        |                        |                        |
  | QNAME=example.org       |                        |                        |                        |
  | QTYPE=NS                |                        |                        |                        |
  |                         |------------------------>|                        |                        |
  |                         |2.Send standard query   |                        |                        |
  |                         | QNAME=example.org      |                        |                        |
  |                         | QTYPE=NS               |                        |                        |
  |                         |<------------------------|                        |                        |
  |                         |3.Send standard response|                        |                        |
  |                         | QNAME=example.org      |                        |                        |
  |                         | QTYPE=NS               |                        |                        |
  |                         | AUTHORITY Name=org     |                        |                        |
  |                         | AUTHORITY Nsdname      |                        |                        |
  |                         |      =NS3.example.org  |                        |                        |
  |                         | ADDITIONAL Name        |                        |                        |
  |                         |      =NS3.example.org  |                        |                        |
  |                         | ADDITIONAL Address     |                        |                        |
  |                         |      =192.168.1.30     |                        |                        |
  |                         |------------------------------------------------>|                        |
  |                         |                        |4.Send standard query   |                        |
  |                         |                        | QNAME=example.org      |                        |
  |                         |                        | QTYPE=NS               |                        |
  |                         |<------------------------------------------------|                        |
  |                         |                        |5.Send standard response|                        |
  |                         |                        | QNAME=example.org      |                        |
  |                         |                        | QTYPE=NS               |                        |
  |                         |                        | AUTHORITY Name         |                        |
  |                         |                        |      =example.org      |                        |
  |                         |                        | AUTHORITY Nsdname      |                        |
  |                         |                        |      =NS4.example.org  |                        |
  |                         |                        | ADDITIONAL Name        |                        |
  |                         |                        |      =NS4.example.org  |                        |
  |                         |                        | ADDITIONAL Address     |                        |
  |                         |                        |      =192.168.1.40     |                        |
  |------------------------------------------------------------------------------------------------------>|
  |                         |                        |                        |6.Send standard query   |
  |                         |                        |                        | QNAME=example.org      |
  |                         |                        |                        | QTYPE=NS               |
  |<------------------------------------------------------------------------------------------------------|
  |                         |                        |                        |7.Send standard response|
  |                         |                        |                        | QNAME=example.org      |
  |                         |                        |                        | QTYPE=NS               |
  |                         |                        |                        | ANSWER Name=example.org|
  |                         |                        |                        | ANSWER Nsdname         |
  |                         |                        |                        |      =NS4.example.org  |
  |                         |                        |                        | ADDITIONAL Name        |
  |                         |                        |                        |      =NS4.example.org  |
  |                         |                        |                        | ADDITIONAL Address     |
  |                         |                        |                        |      =192.168.1.40     |
  |<------------------------|                        |                        |                        |
  |8.Standard query response|                        |                        |                        |
  | QNAME=example.org       |                        |                        |                        |
  | QTYPE=NS                |                        |                        |                        |
  | ANSWER Name=example.org |                        |                        |                        |
  | ANSWER Nsdname          |                        |                        |                        |
  |      =NS4.example.org   |                        |                        |                        |
  v                         v                        v                        v                        v
```

1. TN send standard query QNAME=example.org, QTYPE=NS to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=example.org, QTYPE=NS to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=example.org, QTYPE=NS to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=example.org, ANSWER Nsdname=NS4.example.org to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0

	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC014)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6

	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0

	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00C)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	any
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	NS	NS4.example.org (NS4 + Pointer 0xC00C)
DNS Authority section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (Pointer 0xC010)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.org (Pointer 0xC00C)
	TYPE	CLASS (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00C)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=example.org, QTYPE=NS.
4. Received standard query including QNAME=example.org, QTYPE=NS.
6. Received standard query including QNAME=example.org, QTYPE=NS.
8. Received standard query response including correct <domain-name> in the NSDNAME field.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
3.2.1 Format
3.2.2 TYPE values
3.3.11 NS RDATA format

5.10. PTR type

Purpose

Verify that a NUT transmits correct message including PTR type in the QTYPE field.

- Query type PTR.
  Header section field has the following value.

QR	0
QDCOUNT	1
ANCOUNT	0
NSCOUNT	0

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	10.1.168.192.IN-ADDR.ARPA
QTYPE	PTR (0x000C)
QCLASS	IN (0x0001)

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig.3 Topology No.3".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.
  Example of root server list:

For IPv4:

```
.                       3600000        IN      NS      A.ROOT.NET.
A.ROOT.NET.             3600000                A       192.168.1.20
```

```
For IPv6
 .                          3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.                3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL  86400                ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600           ; serial
      3600                 ; refresh every 1 hr
      900                  ; retry every 15 min
      604800               ; expire after a week
      3600                 ; Minimum TTL of a 1 hr
)
;
        IN        NS       NS1.example.com.
NS1     IN        A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                <-------------------- TN ----------------->
                                                           DNS Server3(TN)   NS Server5(TN)
Client1(TN)          DNS Server1(NUT)              DNS Server2(TN)  |    DNS Server4(TN) |
 |                        |                            |          |          |         |
 |------------------------->|                          |          |          |         |
 |1.Send standard query    |                          |          |          |         |
 | QNAME                   |                          |          |          |         |
 | =10.1.168.192.IN-ADDR.ARPA|                        |          |          |         |
 | QTYPE=PTR               |                          |          |          |         |
 |                         |------------------------->|          |          |         |
 |                         |2.Recv standard query     |          |          |         |
 |                         | QNAME                    |          |          |         |
 |                         | =10.1.168.192.IN-ADDR.ARPA|         |          |         |
 |                         | QTYPE=PTR                |          |          |         |
 |                         |<-------------------------|          |          |         |
 |                         |3.Send standard query response|      |          |         |
 |                         | QNAME                    |          |          |         |
 |                         | =10.1.168.192.IN-ADDR.ARPA|         |          |         |
 |                         | QTYPE=PTR                |          |          |         |
 |                         | AUTHORITY Name           |          |          |         |
 |                         |      =192.IN-ADDR.ARPA   |          |          |         |
 |                         | AUTHORITY Nsdname        |          |          |         |
 |                         |      =NS3.example.org    |          |          |         |
 |                         | ADDITIONAL Name          |          |          |         |
 |                         |      =NS3.example.org    |          |          |         |
 |                         | ADDITIONAL Address       |          |          |         |
 |                         |      =192.168.1.30       v          |          |         |
```

```
|                         |------------------------------------->|          |         |
|                         |        4.Recv standard query         |          |         |
|                         |         QNAME                        |          |         |
|                         |           =10.1.168.192.IN-ADDR.ARPA |          |         |
|                         |         QTYPE=PTR                    |          |         |
|                         |<-------------------------------------|          |         |
|                         |        5.Send standard query response|          |         |
|                         |          QNAME                       |          |         |
|                         |           =10.1.168.192.IN-ADDR.ARPA |          |         |
|                         |          QTYPE=PTR                   |          |         |
|                         |          AUTHORITY Name              |          |         |
|                         |           =168.192.IN-ADDR.ARPA      |          |         |
|                         |          AUTHORITY Nsdname           |          |         |
|                         |           =NS4.example.org           |          |         |
|                         |          ADDITIONAL Name             |          |         |
|                         |           =NS4.example.org           |          |         |
|                         |          ADDITIONAL Address          |          |         |
|                         |           =192.168.1.40 v            v          |         |
|-------------------------------------------------------------------------->|         |
|                         |                     6.Send standard query       |         |
|                         |                      QNAME                      |         |
|                         |                       =10.1.168.192.IN-ADDR.ARPA|         |
|                         |                      QTYPE=PTR                  |         |
|<--------------------------------------------------------------------------|         |
|                         |                     7.Send standard response    |         |
|                         |                      QNAME                      |         |
|                         |                       =10.1.168.192.IN-ADDR.ARPA|         |
|                         |                      QTYPE=PTR                  |         |
|                         |                      AUTHORITY Name             |         |
|                         |                       =1.168.192.IN-ADDR.ARPA   |         |
|                         |                      AUTHORITY Nsdname          |         |
|                         |                       = NS5.example.org         |         |
|                         |                      ADDITIONAL Name            |         |
|                         |                       =NS5.example.org          |         |
|                         |                      ADDITIONAL Address         |         |
|                         |                       =192.168.1.50             v         |
|------------------------------------------------------------------------------------>|
|                         |                              8.Send standard query        |
|                         |                               QNAME                       |
|                         |                                =10.1.168.192.IN-ADDR.ARPA |
|                         |                               QTYPE=PTR                   |
|<------------------------------------------------------------------------------------|
|                         |                              9.Send standard query response|
|                         |                               QNAME                       |
|                         |                                =10.1.168.192.IN-ADDR.ARPA |
|                         |                               QTYPE=PTR                   |
|                         |                               ANSWER Name                 |
|                         |                                = 10.1.168.192.IN-ADDR.ARPA |
|                         |                               ANSWER Ptrdname             |
|                         |                                = A.example.org            |
|                         |                               AUTHORITY Name              |
|                         |                                = 1.168.192.IN-ADDR.ARPA   |
|                         |                               AUTHORITY Nsdname           |
|                         |                                = NS5.example.org          |
|                         |                               ADDITIONAL Name             |
|                         |                                = NS5.example.org          |
|                         |                               ADDITIONAL Address          |
|                         |                                = 192.168.1.50             |
```

```
|<-------------------------|                                                  |
|10.Recv Standard query response|                                             |
| QNAME                    |                                                  |
| =10.1.168.192.IN-ADDR.ARPA|                                                 |
| QTYPE=PTR                |                                                  |
| ANSWER Name              |                                                  |
| =10.1.168.192.IN-ADDR.ARPA|                                                 |
| ANSWER Ptrdname          |                                                  |
|  = A.example.org         |                                                  |
| AUTHORITY Name           |                                                  |
|  = 1.168.192.IN-ADDR.ARPA |                                                 |
| AUTHORITY Nsdname        |                                                  |
|  = NS5.example.org       |                                                  |
| ADDITIONAL Name          |                                                  |
|  = NS5.example.org       |                                                  |
| ADDITIONAL Address       |                                                  |
|  = 192.168.1.50          |                                                  |
v                          v                                                  v
```

1. TN send standard query QNAME=10.1.168.192.IN-ADDR.ARPA, QTYPE=PTR to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=192.IN-ADDR.ARPA, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=10.1.168.192.IN-ADDR.ARPA, QTYPE=PTR to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=168.192.IN-ADDR.ARPA, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=10.1.168.192.IN-ADDR.ARPA, QTYPE=PTR to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to NUT w/ AUTHORITY Name=1.168.192.IN-ADDR.ARPA, AUTHORITY Name Server=NS5.example.org.
8. NUT transmits standard query QNAME=10.1.168.192.IN-ADDR.ARPA, QTYPE=PTR to DNS Server5 (TN: NS5.example.org) (Judgment *8)
9. TN send query response to NUT w/ ANSWER Name=10.1.168.192.IN-ADDR.ARPA, ANSWER Ptrdname=A.example.org to NUT.
10. NUT transmits query response to DNS Client1 (TN) (Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	10.1.168.192.IN-ADDR.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	Any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	10.1.168.192.IN-ADDR.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	10.1.168.192.IN-ADDR.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	192.IN-ADDR.ARPA (Pointer 0xC015)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	Any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	10.1.168.192.IN-ADDR.ARPA

	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	10.1.168.192.IN-ADDR.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	168.192.IN-ADDR.ARPA (Pointer 0xC011)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS4.example.org
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY

UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	Any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	10.1.168.192.IN-ADDR.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	10.1.168.192.IN-ADDR.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)
DNS Authority	NAME	1.168.192.IN-ADDR.ARPA (Pointer 0xC00F)

section	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS5.example.org
DNS Additional section	NAME	NS5.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.50

8th packet.

Standard query from DNS Server1 (NUT) to Server5 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV5_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	Any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	10.1.168.192.IN-ADDR.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)

9th packet.

Standard query response from DNS Server5 (TN) to Server1 (NUT)		
IP Header	Source Address	SV5_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses

	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	10.1.168.192.IN-ADDR.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	10.1.168.192.IN-ADDR.ARPA
	TYPE	PTR (0x000C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	15
	NSDNAME	A.example.org
DNS Authority section	NAME	1.168.192.IN-ADDR.ARPA (Pointer 0xC00F)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS5.example.org
DNS Additional section	NAME	NS5.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.50

10th packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1

	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	Any
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	10.1.168.192.IN-ADDR.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	10.1.168.192.IN-ADDR.ARPA
	TYPE	PTR (0x000C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	15
	NSDNAME	A.example.org
DNS Authority section	NAME	1.168.192.IN-ADDR.ARPA (Pointer 0xC00F)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS5.example.org
DNS Additional section	NAME	NS5.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.50

- Termination
  None

Judgment

2. Received standard query including QNAME=10.1.168.192.IN-ADDR.ARPA, QTYPE=PTR.
4. Received standard query including QNAME=10.1.168.192.IN-ADDR.ARPA, QTYPE=PTR.
6. Received standard query including QNAME=10.1.168.192.IN-ADDR.ARPA, QTYPE=PTR.
8. Received standard query including QNAME=10.1.168.192.IN-ADDR.ARPA, QTYPE=PTR.
10. Received standard query response including correct <domain-name> in the PTRDNAME field.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
3.2.1 Format
3.2.2 TYPE values
3.3.12. PTR RDATA format

5.11. SOA type

Purpose

Verify that a NUT transmits correct message including SOA type in the QTYPE field.

- Query type SOA.
  Header section field has the following value.

QR	0
QDCOUNT	1
ANCOUNT	0
NSCOUNT	0

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	A.example.org
QTYPE	SOA (0x0006)
QCLASS	IN (0x0001)

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 2 Topology No.2".
  AP server1 has a domain name "www.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

Example of root server list:

```
For IPv4:
 .                        3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.              3600000                   A        192.168.1.20

For IPv6
 .                        3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL  86400               ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600          ; serial
      3600                ; refresh every 1 hr
      900                 ; retry every 15 min
      604800              ; expire after a week
      3600                ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)     DNS Server1 (NUT)        DNS Server2 (TN)           DNS Server3 (TN)       DNS Server4 (TN)
 |                        |                        |                        |                        |
 |------------------------>|                        |                        |                        |
 |1.Send standard query    |                        |                        |                        |
 | QNAME=example.org       |                        |                        |                        |
 | QTYPE=SOA               |                        |                        |                        |
 |                         |------------------------>|                        |                        |
 |                         |2.Send standard query   |                        |                        |
 |                         | QNAME=example.org      |                        |                        |
 |                         | QTYPE=SOA              |                        |                        |
 |                         |<------------------------|                        |                        |
 |                         |3.Send standard response|                        |                        |
 |                         | QNAME=example.org      |                        |                        |
 |                         | QTYPE=SOA              |                        |                        |
 |                         | AUTHORITY Name=org     |                        |                        |
 |                         | AUTHORITY Type=NS      |                        |                        |
 |                         | AUTHORITY Name Server  |                        |                        |
 |                         |      =NS3.example.org  |                        |                        |
 |                         | ADDITIONAL Name        |                        |                        |
 |                         |      =NS3.example.org  |                        |                        |
 |                         | ADDITIONAL Type=A      |                        |                        |
 |                         | ADDITIONAL Address     |                        |                        |
 |                         |      =192.168.1.30     |                        |                        |
 |                         |------------------------------------------------------------------>|                        |
 |                         |                        |4.Send standard query   |                        |
 |                         |                        | QNAME=example.org      |                        |
 |                         |                        | QTYPE=SOA              |                        |
```

```
|                        |<-----------------------------------------------|                        |
|                        |                        |5.Send standard response|                        |
|                        |                        | QNAME=example.org      |                        |
|                        |                        | QTYPE=SOA              |                        |
|                        |                        | AUTHORITY Name         |                        |
|                        |                        |      =example.org      |                        |
|                        |                        | AUTHORITY Nsdname      |                        |
|                        |                        |      =NS4.example.org  |                        |
|                        |                        | ADDITIONAL Name        |                        |
|                        |                        |      =NS4.example.org  |                        |
|                        |                        | ADDITIONAL Type=A      |                        |
|                        |                        | ADDITIONAL Address     |                        |
|                        |                        |      =192.168.1.40     |                        |
|------------------------------------------------------------------------------------------------->|
|                        |                        |                        |6.Send standard query   |
|                        |                        |                        | QNAME=example.org      |
|                        |                        |                        | QTYPE=SOA              |
|<-------------------------------------------------------------------------------------------------|
|                        |                        |                        |7.Send standard response|
|                        |                        |                        | QNAME=example.org      |
|                        |                        |                        | QTYPE=SOA              |
|                        |                        |                        | ANSWER Name=example.org|
|                        |                        |                        | ANSWER Type=SOA        |
|                        |                        |                        | ANSWER Mname           |
|                        |                        |                        |      =NS4.example.org  |
|                        |                        |                        | ANSWER Rname           |
|                        |                        |                        |   =root.NS4.example.org|
|                        |                        |                        | ANSWER Serial=1        |
|                        |                        |                        | ANSWER Refresh=3600    |
|                        |                        |                        | ANSWER Retry=600       |
|                        |                        |                        | ANSWER Expire=86400    |
|                        |                        |                        | ANSWER Minimum=3600    |
|                        |                        |                        | AUTHORITY Name         |
|                        |                        |                        |      =example.org      |
|                        |                        |                        | AUTHORITY Type=NS      |
|                        |                        |                        | AUTHORITY Nsdname      |
|                        |                        |                        |      =NS4.example.org  |
|                        |                        |                        | ADDITIONAL Name        |
|                        |                        |                        |      =NS4.example.org  |
|                        |                        |                        | ADDITIONAL Type=A      |
|                        |                        |                        | ADDITIONAL Address     |
|                        |                        |                        |      =192.168.1.40     |
|<-----------------------|                        |                        |                        |
|8.Standard query response|                        |                        |                        |
| QNAME=example.org      |                        |                        |                        |
| QTYPE=SOA              |                        |                        |                        |
| ANSWER Name=example.org |                        |                        |                        |
| ANSWER Type=SOA        |                        |                        |                        |
| ANSWER Mname           |                        |                        |                        |
|      =NS3.example.org  |                        |                        |                        |
| ANSWER Rname           |                        |                        |                        |
|   =root.NS3.example.org |                        |                        |                        |
| ANSWER Serial=1        |                        |                        |                        |
| ANSWER Refresh=3600    |                        |                        |                        |
| ANSWER Retry=600       |                        |                        |                        |
| ANSWER Expire=86400    |                        |                        |                        |
| ANSWER Minimum=3600    |                        |                        |                        |
|  AUTHORITY Name        |                        |                        |                        |
|      =example.org      |                        |                        |                        |
| AUTHORITY Type=NS      |                        |                        |                        |
| AUTHORITY Nsdname      |                        |                        |                        |
|      =NS4.example.org  |                        |                        |                        |
v                        v                        v                        v                        v
```

1. TN send standard query QNAME=example.org, QTYPE=SOA to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=example.org, QTYPE=SOA to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=example.org, QTYPE=SOA to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=example.org, ANSWER SOA record to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.org
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0

	AA	Any
	TC	0
	RD	0
	RA	Any
	Z	Any
	RCODE	Any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	Any
DNS Question section	QNAME	example.org
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC014)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)

DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	1
	OPCODE	0
	AA	Any
	TC	0
	RD	0
	RA	Any
	Z	Any
	RCODE	Any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	Any
DNS Question section	QNAME	example.org
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00C)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	1
	OPCODE	0
	AA	Any
	TC	0
	RD	0
	RA	Any
	Z	Any
	RCODE	Any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	Any

DNS Question section	QNAME	example.org
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.org (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	37
	MNAME	NS4.example.org (NS4 + Pointer 0xC00C)
	RNAME	root.NS4.example.org (root + Pointer 0xC029)
	SERIAL	1
	REFRESH	3600
	RETRY	3600
	EXPIRE	8600
	MINIMUM	3600
DNS Authority section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC029)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.org (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	37
	MNAME	NS4.example.org (NS4 + Pointer 0xC010)
	RNAME	root.NS4.example.org (root + Pointer 0xC010)
	SERIAL	1
	REFRESH	3600
	RETRY	3600
	EXPIRE	8600

	MINIMUM	3600
DNS Authority section	NAME	example.org (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC010)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=www.example.org, QTYPE=SOA.
4. Received standard query including QNAME=www.example.org, QTYPE=SOA.
6. Received standard query including QNAME=www.example.org, QTYPE=SOA.
8. Received standard query response including correct parameters in the SOA resource record.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
  3.2.2 TYPE values
  3.3.13 SOA RDATA format

5.12. IN class

Purpose

Verify that a NUT transmits correct message including IN class in the QCLASS field of Question section.

- Query class IN.
  Header section field has the following value.

QR	0
QDCOUNT	1
ANCOUNT	0
NSCOUNT	0
ARCOUNT	0

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	A.example.org
QTYPE	A (0x0001)
QCLASS	IN (0x0001)

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

Example of root server list:

```
For IPv4:
 .                        3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.              3600000                   A        192.168.1.20

For IPv6
 .                        3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL  86400               ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600          ; serial
      3600                ; refresh every 1 hr
      900                 ; retry every 15 min
      604800              ; expire after a week
      3600                ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
 Client1 (TN)      DNS Server1 (NUT)          DNS Server2 (TN)               DNS Server3 (TN)           DNS Server4 (TN)
  |                        |                          |                              |                          |
  |------------------------>|                          |                              |                          |
  |1.Send standard query    |                          |                              |                          |
  | QNAME=A.example.org     |                          |                              |                          |
  | QTYPE=A                 |                          |                              |                          |
  | QCLASS=IN               |                          |                              |                          |
  |                         |--------------------------->|                              |                          |
  |                         |2.Send standard query      |                              |                          |
  |                         | QNAME=A.example.org       |                              |                          |
  |                         | QTYPE=A                   |                              |                          |
  |                         | QCLASS=IN                 |                              |                          |
  |                         |<---------------------------|                              |                          |
  |                         |3.Send standard response   |                              |                          |
  |                         | QNAME=A.example.org       |                              |                          |
  |                         | QTYPE=A                   |                              |                          |
  |                         | QCLASS=IN                 |                              |                          |
  |                         | AUTHORITY Name=org        |                              |                          |
  |                         | AUTHORITY Name Server     |                              |                          |
  |                         |      =NS3.example.org     |                              |                          |
  |                         | ADDITIONAL Name = NS3.example.org|                       |                          |
  |                         | ADDITIONAL Address = 192.168.1.30 |                      |                          |
  |                         |-------------------------------------------------------------->|                          |
  |                         |                           |4.Send standard query         |                          |
  |                         |                           | QNAME=A.example.org          |                          |
  |                         |                           | QTYPE=A                      |                          |
  |                         |                           | QCLASS=IN                    |                          |
  |                         |<-------------------------------------------------------------|                          |
  |                         |                           |5.Send standard response      |                          |
  |                         |                           | QNAME=A.example.org          |                          |
  |                         |                           | QTYPE=A                      |                          |
  |                         |                           | QCLASS=IN                    |                          |
  |                         |                           | AUTHORITY Name = example.org|                          |
  |                         |                           | AUTHORITY Name Server =NS4.example.org                 |
  |                         |                           | ADDITIONAL Name = NS4.example.org |                    |
  |                         |                           | ADDITIONAL Address = 192.168.1.40 |                    |
  |------------------------------------------------------------------------------------------------------------------>|
  |                         |                           |                              |6.Send standard query     |
  |                         |                           |                              | QNAME=example.org        |
  |                         |                           |                              | QTYPE=A                  |
  |                         |                           |                              | QCLASS=IN                |
  |<------------------------------------------------------------------------------------------------------------------|
  |                         |                           |                              |7.Send standard response  |
  |                         |                           |                              | QNAME=A.example.org      |
  |                         |                           |                              | QTYPE=A                  |
  |                         |                           |                              | QCLASS=IN                |
  |                         |                           |                              | ANSWER Name = A.example.org|
  |                         |                           |                              | ANSWER Address = 192.168.1.10 |
  |                         |                           |                              | AUTHORITY Name = example.org|
  |                         |                           |                              | AUTHORITY Name Server    |
  |                         |                           |                              |      =NS4.example.org    |
  |                         |                           |                              | ADDITIONAL Name = NS4.example.org |
  |                         |                           |                              | ADDITIONAL Address =192.168.1.40 |
  |<------------------------|                           |                              |                          |
  |8.Standard query response|                           |                              |                          |
  | QNAME=A.example.org     |                           |                              |                          |
  | QTYPE=A                 |                           |                              |                          |
  | QCLASS=IN               |                           |                              |                          |
  | ANSWER Name = A.example.org |                       |                              |                          |
  | ANSWER Address = 192.168.1.10|                      |                              |                          |
  | AUTHORITY Name = example.org|                       |                              |                          |
  | AUTHORITY Name Server   |                           |                              |                          |
  |      =NS4.example.org   |                           |                              |                          |
  v                         v                           v                              v                          v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A and QCLASS=IN to NUT.
2. NUT transmits standard query QNAME=A.example.org, QTYPE=A and QCLASS=IN to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A and QCLASS=IN to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A and QCLASS=IN to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10 to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0

	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses

	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0

	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A and QCLASS=IN.
4. Received standard query including QNAME=A.example.org, QTYPE=A and QCLASS=IN.
6. Received standard query including QNAME=A.example.org, QTYPE=A and QCLASS=IN.
8. Received standard query response including correct address in the ADDRESS field.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1. Format
  3.2.4. CLASS values
  3.2.5. QCLASS values

5.13. Resource record A type

Purpose

Verify that a NUT transmits correct message including A resource record.

- Single host address case.
  Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	1

- Hosts that have multiple Internet addresses will have multiple A records.
  Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	2

- A RDATA format

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    ADDRESS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

ADDRESS	A 32 bit Internet address

Category

Server (Content Server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL  86400                ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600           ; serial
      3600                 ; refresh every 1 hr
      900                  ; retry every 15 min
      604800               ; expire after a week
      3600                 ; Minimum TTL of a 1 hr
)
```

```
;
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
A       IN      A       192.168.1.10
A1      IN      A       192.168.1.11
                A       192.168.1.12
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                    DNS Server1 (NUT)
    |                                   |
    |----------------------------------->|
    |   1. Send standard query          |
    |       QNAME=A.example.com         |
    |       QTYPE=A                     |
    |<-----------------------------------|
    |   2. Standard query response      |
    |       A=192.168.1.10              |
    |----------------------------------->|
    |   3. Send standard query to NUT   |
    |       QNAME=A1.example.com        |
    |       QTYPE=A                     |
    |<-----------------------------------|
    |   4. Standard query response      |
    |       A=192.168.1.11              |
    |       A=192.168.1.12              |
    v                                   v

1. TN send standard query QNAME=A.example.com, QTYPE=A to NUT.
2. NUT reply query response w/ A=192.168.1.10 to TN (Judgment *2)
3. TN send standard query QNAME=A1.example.com, QTYPE=A to NUT.
4. NUT reply query response w/ A=192.168.1.11 and A=192.168.1.12 to TN (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2001
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A1.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0

	AA	ANY
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A1.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A1.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Answer section	NAME	A1.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.12
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**

  None

Judgment

2. Received standard query response including A type record.
4. Received standard query response including multiple A type records.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
3.2.1 Format
3.2.2 TYPE values
3.4.1 A RDATA format

5.14. Resource record of CNAME type

Purpose

Verify that a NUT transmits correct message including CNAME resource record.

- Single canonical or primary name for the owner case.
  Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	1

- CNAME RDATA format

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
/                     CNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

CNAME	A <domain-name> which specifies the canonical or primary name for the owner. The owner name is an alias.

Category

Server (Content Server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 21 Topology No.21".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL  86400                ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600           ; serial
      3600                 ; refresh every 1 hr
      900                  ; retry every 15 min
      604800               ; expire after a week
      3600                 ; Minimum TTL of a 1 hr
)
;
          IN        NS            NS1.example.com.
NS1       IN        A             192.168.0.10
;
```

```
A2          IN          A           192.168.1.12
B1          IN          CNAME       A2
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
    |                                     |
    |------------------------------------>|
    |   1. Send standard query            |
    |       QNAME=B1.example.com          |
    |       QTYPE=A                       |
    |<------------------------------------|
    |   2. Standard query response        |
    |       CNAME=A2.example.com          |
    |       A=192.168.1.12                |
    |------------------------------------>|
    |   3. Send standard query to NUT     |
    |       QNAME=B1.example.com          |
    |       QTYPE=CNAME                   |
    |<------------------------------------|
    |   4. Standard query response        |
    |       CNAME=A2.example.com          |
    v                                     v

1. TN send standard query QNAME=B1.example.com, QTYPE=A to NUT.
2. NUT reply query response including CNAME=A2.example.com, A=192.168.1.12 to TN (Judgment *2)
3. TN send standard query QNAME=B1.example.com, QTYPE=CNAME to NUT.
4. NUT reply query response including CNAME=A2.example.com to TN(Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B1.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B1.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B1.example.com (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	5
	CNAME	A2.example.com (A2 + Pointer 0xC00F)
DNS Answer section	NAME	A2.example.com (Pointer 0xC02C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.12
DNS Authority section	NAME	example.com (Pointer 0xC00F)
	TYPE	NS (0x0002)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00F)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC04D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2001
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B1.example.com
	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1

	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B1.example.com
	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B1.example.com (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	5
	CNAME	A2.example.com (A2 + Pointer 0xC00F)
DNS Authority section	NAME	example.com (Pointer 0xC00F)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03d)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.11

- **Termination**
  None

Judgment

2. Received standard query response including CNAME and A resource record.
4. Received standard query response including CNAME resource record.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
- 3.6 Resource Records
- 4.3.2. Algorithm

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
- 3.2.1 Format
- 3.2.2 TYPE values
- 3.3.1 CNAME RDATA format

RFC2181 Clarifications to the DNS Specification
- 10.1. CNAME resource records

5.15. Resource record of HINFO

Purpose

Verify that a NUT transmits correct message including HINFO resource record.

- Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	1

- HINFO RDATA format

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
/                      CPU                      /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
/                       OS                      /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

CPU	A <character-string> which specifies the CPU type.
OS	A <character-string> which specifies the operating system type.

Category

Server (Content Server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 4 Topology No.4".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL  86400                ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600           ; serial
      3600                 ; refresh every 1 hr
      900                  ; retry every 15 min
      604800               ; expire after a week
      3600                 ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

```
A        IN      A       192.168.1.10
         IN      HINFO   IBM-PC/ATUNIX
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
    |                                     |
    |------------------------------------>|
    |   1. Send standard query            |
    |       QNAME=A.example.com           |
    |       QTYPE=*                       |
    |<------------------------------------|
    |   2. Standard query response        |
    |       A=192.168.1.10                |
    |       HINFO="IBM-PC/AT UNIX"        |
    |------------------------------------>|
    |   3. Send standard query            |
    |       QNAME=A.example.com           |
    |       QTYPE=HINFO                   |
    |<------------------------------------|
    |   4. Standard query response        |
    |       HINFO="IBM-PC/AT UNIX"        |
    |                                     |
    v                                     v

1. TN send standard query QNAME=A.example.com, QTYPE=* to NUT.
2. NUT reply query response including HINFO=IBM-PC/AT UNIX at answer section to TN (Judgment *2)
3. TN send standard query QNAME=A.example.com, QTYPE=HINFO to NUT.
4. NUT reply query response including HINFO=IBM-PC/AT UNIX at answer section to TN (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	ANY (0x00FF)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	ANY (0x00FF)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	HINFO (0x000D)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	15
	CPU	IBM-PC/AT
	OS	UNIX

DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC056)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000

DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	HINFO (0x000D)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	15
	CPU	IBM-PC/AT
	OS	UNIX
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC046)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response including HINFO and A type record.
4. Received standard query response including HINFO type record only.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
3.2.1 Format
3.2.2 TYPE values
3.3.2 HINFO RDATA format

5.16. Resource record of MX

Purpose

Verify that a NUT transmits correct message including MX resource record.

- A <domain-name> have single MX resource record case.
  Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	1

- A <domain-name> will have multiple MX resource records.
  Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	2

- MX RDATA format

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                  PREFERENCE                   |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
/                   EXCHANGE                    /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

PREFERENCE	A 16 bit integer which specifies the preference given to this RR among others at the same owner. Lower values are preferred.
EXCHANGE	A <domain-name> which specifies a host willing to act as a mail exchange for the owner name.

Category

Server (Content Server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  A. Example of example.com zone file:

```
$TTL 86400              ; TTL of 1 day
@ IN SOA NS1.example.com. root.example.com. (
```

```
      2005081600          ; serial
      3600                ; refresh every 1 hr
      900                 ; retry every 15 min
      604800              ; expire after a week
      3600                ; Minimum TTL of a 1 hr
)
;
        IN        NS      NS1.example.com.
        IN        MX      10        MAIL1
;
NS1     IN        A       192.168.0.10
MAIL1   IN        A       192.168.1.11
```

B. Example of example.com zone file:

```
$TTL  86400               ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081601          ; serial
      3600                ; refresh every 1 hr
      900                 ; retry every 15 min
      604800              ; expire after a week
      3600                ; Minimum TTL of a 1 hr
)
;
        IN        NS      NS1.example.com.
        IN        MX      10        MAIL1
        IN        MX      20        MAIL2
;
NS1     IN        A       192.168.0.10
MAIL1   IN        A       192.168.1.11
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |--------------------------------------->|
    |   1. Send standard query              |
    |       QNAME=example.com               |
    |       QTYPE=MX                        |
    |<---------------------------------------|
    |   2. Standard query response          |
    |       MX=10 MAIL1.example.com         |
    |                                       |
    |(Change zone file on DNS Server1(NUT)  |
    |       from A to B.)                   |
    |--------------------------------------->|
    |   3. Send standard query to NUT       |
    |       QNAME=example.com               |
    |       QTYPE=MX                        |
    |<---------------------------------------|
    |   4. Standard query response          |
    |       MX=10 MAIL1.example.com         |
    |       MX=20 MAIL2.example.com        |
    v                                       v

1. TN send standard query QNAME=example.com, QTYPE=MX to NUT.
2. NUT reply query response w/ MX=10 MAIL1.example.com to TN (Judgment *2)
3. TN send standard query QNAME=mail.example.com, QTYPE=MX to NUT.
4. NUT reply query response w/ MX=10 MAIL1.example.com and MX=20
   MAIL2.example.com to TN (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.com
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	example.com
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.com (Pointer 0xC00C)
	TYPE	MX (0x000F)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	10
	PREFERENCE	10
	EXCHANGE	MAIL1.example.com (MAIL1 + Pointer 0xC00C)
DNS Authority section	NAME	example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00C)
DNS Additional	NAME	MAIL1.example.com (Pointer 0xC02B)

section	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03F)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2001
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.com
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)

4th packet.

Any order of DNS Answer section 1 and 2 is acceptable.
Any order of DNS Additional section 1, 2 and 3 is acceptable.
If DNS Answer section order is opposite, DNS Additional section 1's NAME pointer is 0xC041, and 2's NAME pointer is 0xC02B.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53

	Dst Port	2001
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	3
DNS Question section	QNAME	example.com
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)
DNS Answer section 1	NAME	example.com (Pointer 0xC00C)
	TYPE	MX (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	10
	PREFERENCE	10
	EXCHANGE	MAIL1.example.com (MAIL1 + Pointer 0xC00C)
DNS Answer section 2	NAME	example.com (Pointer 0xC00C)
	TYPE	MX (0x000F)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	10
	PREFERENCE	20
	EXCHANGE	MAIL2.example.com (MAIL1 + Pointer 0xC00C)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00C)
Additional section 1	NAME	MAIL1.example.com (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4

	ADDRESS	192.168.1.11
Additional section 2	NAME	MAIL2.example.com (Pointer 0xC041)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.12
DNS Additional section	NAME	NS1.example.com (Pointer 0xC055)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response including MX type record.
4. Received standard query response including multiple MX type records.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
  3.2.2 TYPE values
  3.3.9 MX RDATA format

5.17. Resource record of NS

Purpose

Verify that a NUT transmits correct message including NS resource record

- A <domain-name> have single NS resource record case.
  Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	1

- A <domain-name> have multiple NS record will have multiple NS resource records.
  Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	2

- NS RDATA format

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
/                    NSDNAME                    /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

NSDNAME	A <domain-name> which specifies a host which should be authoritative for the specified class and domain.

Category

Server (Content Server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 5 Topology No.5".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  A. Example of example.com zone file:

```
$TTL  86400                ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600           ; serial
      3600                 ; refresh every 1 hr
      900                  ; retry every 15 min
      604800               ; expire after a week
      3600                 ; Minimum TTL of a 1 hr
```

```
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
```

B. Example of example.com zone file:

```
$TTL  86400               ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081601       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
        IN       NS       NS1.example.com.
        IN       NS       NS2.example.com.
NS1     IN       A        192.168.0.10
NS2     IN       A        192.168.0.11
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
    |                                     |
    |------------------------------------->|
    |   1. Send standard query            |
    |       QNAME=example.com             |
    |       QTYPE=NS                      |
    |<-------------------------------------|
    |   2. Standard query response        |
    |       NS=NS1.example.com            |
    |(Change zone file on DNS Server1(NUT) |
    |       from A to B.)                 |
    |------------------------------------->|
    |   3. Send standard query to NUT     |
    |       QNAME=example.com             |
    |       QTYPE=NS                      |
    |<-------------------------------------|
    |   4. Standard query response        |
    |       NS=NS1.example.com            |
    |       NS=NS2.example.com            |
    v                                     v

 1. TN send standard query QNAME=example.com, QTYPE=NS to NUT.
 2. NUT reply query response w/ NS=NS1.example.com to TN (Judgment *2)
 3. TN send standard query QNAME=example.com, QTYPE=NS to NUT.
 4. NUT reply query response w/ NS=NS1.example.com and NS=NS2.example.com to TN (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0

DNS Question section	QNAME	example.com
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	0
	ARCOUNT	1
DNS Question section	QNAME	example.com
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00C)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ

	Destination Address	NUT_NETZ
UDP Header	Src Port	2001
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.com
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

4th packet.

Any order of DNS Answer section 1 and 2 is acceptable.
Also any order of DNS Additional section 1 and 2 is acceptable.
If DNS Answer section order is opposite, DNS Additional section 1's NAME pointer is 0xC03B, and 2's NAME pointer is 0xC029.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2001
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	0
	ARCOUNT	2
DNS Question section	QNAME	example.com

	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Answer section 1	NAME	example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00C)
DNS Answer section 2	NAME	example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS2.example.com (NS2 + Pointer 0xC00C)
Additional section 1	NAME	NS1.example.com (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10
Additional section 2	NAME	NS2.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.11

- **Termination**
  None

Judgment

2. Received standard query response including NS type record.
4. Received standard query response with multiple NS type records.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
  3.2.2 TYPE values
  3.3.11 NS RDATA format

5.18. Resource record of PTR type

Purpose

Verify that a NUT transmits correct message including PTR resource record

- A <domain-name> have single PTR resource record case.
  Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	1

- PTR RDATA format

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
/                    PTRDNAME                    /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

PTRDNAME	A <domain-name> which points to some location in the domain name space.

Category

Server (Content Server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
```

```
CL1      IN      A        192.168.0.20
```

Example of 1.168.192.IN-ADDR.ARPA domain zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com. root.example.com. (
         2005081600       ; serial
         3600             ; refresh after 1 hr
         900              ; retry after 15 min
         604800           ; expire after 1 week
         3600             ; Minimum TTL of 1 hr
)
;
         IN      NS       NS1.example.com.
;
10       IN      PTR      A.example.com.
```

Procedure

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |-------------------------------------->|
    |   1. Send standard query              |
    |      QNAME=10.1.168.192.IN-ADDR.ARPA  |
    |      QTYPE=PTR                        |
    |<--------------------------------------|
    |   2. Standard query response          |
    |                                       |
    v                                       v

1. TN send standard query QNAME=10.1.168.192.IN-ADDR.ARPA, QTYPE=PTR to NUT.
2. NUT reply query response w/ PTR=A.example.com to TN (Judgment *2)
```

This test sequence is following.
Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0

	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	10.1.168.192.IN-ADDR.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	10.1.168.192.IN-ADDR.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	10.1.168.192.IN-ADDR.ARPA (Pointer 0xC00C)
	TYPE	PTR (0x000C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	15
	PTRDNAME	A.example.com
DNS Authority section	NAME	1.168.192.IN-ADDR.ARPA (Pointer 0xC00F)
	TYPE	NS (0x0002)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC039)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC052)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

Termination

None

Judgment

2. Received standard query response including PTR resource record.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
3.2.1 Format
3.2.2 TYPE values
3.3.12 PTR RDATA format

5.19. Resource record of SOA

Purpose

Verify that a NUT transmits correct message including SOA resource record

- A <domain-name> have single SOA resource record.
  Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	1

- SOA RDATA format

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
/                     MNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
/                     RNAME                     /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    SERIAL                     |
|                                               |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    REFRESH                    |
|                                               |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     RETRY                     |
|                                               |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    EXPIRE                     |
|                                               |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    MINIMUM                    |
|                                               |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

MNAME	**The <domain-name> of the name server that was the original or primary source of data for this zone.**
RNAME	**The <domain-name> which specifies the mailbox of the person responsible for this zone.**
SERIAL	**The unsigned 32 bit version number of the original copy of the zone. Zone transfers preserve this value. This value wraps and should be compared using sequence space arithmetic**
REFRESH	**A 32 bit time interval before the zone should be refreshed.**
RETRY	**A 32 bit time interval that should elapse before a failed refresh should be retried.**
EXPIRE	**A 32 bit time value that specifies the upper limit on the time interval that can elapse before the zone is no longer authoritative.**

All times are in units of seconds.

Category

Server (Content Server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 1　Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL  86400                ; TTL 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
        2005081600         ; Serial
        3600               ; Refresh every 1 hr
        900                ; Retry every 15 min
        604800             ; Expire after a week
        3600               ; Minimum TTL 1 hr
)
;
        IN       NS       NS1.example.com.
NS1     IN       A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
    DNS Client1 (TN)                        DNS Server1 (NUT)
        |                                       |
        |--------------------------------------->|
        |   1. Send standard query              |
        |       QNAME=example.com               |
        |       QTYPE=SOA                       |
        |<---------------------------------------|
        |   2. Standard query response          |
        |       SOA=NS1.example.com             |
        v                                       v

    1. TN send standard query QNAME=example.com, QTYPE=SOA to NUT.
    2. NUT reply query response w/ SOA=NS1.example.com to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ

	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

DNS Answer section	NAME	example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	33
	MNAME	NS1.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.example.com (root + Pointer 0xC00C)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour
DNS Authority section	NAME	example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	2
	NSDNAME	NS1.example.com (Pointer 0xC029)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response including SOA resource record.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
  3.2.2 TYPE values
  3.3.13 SOA RDATA format

5.20. Zero TTL prohibits caching

Purpose

Verify that a NUT prohibits caching with zero TTL

- While short TTLs can be used to minimize caching, and a zero TTL prohibits caching, the realities of Internet performance suggest that these times should be on the order of days for the typical host.
- All DNS name servers and resolvers MUST properly handle RRs with a zero TTL: return the RR to the client but do not cache it.

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
 .                    3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.          3600000               A      192.168.1.20
```

For IPv6

```
 .                    3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.          3600000        AAAA   3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL  86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600       ; serial
      3600             ; refresh every 1 hr
      900              ; retry every 15 min
      604800           ; expire after a week
      3600             ; Minimum TTL of a 1 hr
)
;
        IN     NS     NS1.example.com.
NS1     IN     A      192.168.0.10
```

Procedure

This test sequence is following.

```
Client1 (TN)     DNS Server1 (NUT)        DNS Server2 (TN)           DNS Server3 (TN)       DNS Server4 (TN)
 |                        |                        |                        |                        |
 |------------------------>|                        |                        |                        |
 |1.Send standard query    |                        |                        |                        |
 | QNAME=A.example.org     |                        |                        |                        |
 | QTYPE=A                 |                        |                        |                        |
 |                         |------------------------>|                        |                        |
 |                         |2.Send standard query   |                        |                        |
 |                         | QNAME=A.example.org    |                        |                        |
 |                         | QTYPE=A                |                        |                        |
 |                         |<------------------------|                        |                        |
 |                         |3.Send standard response|                        |                        |
 |                         | QNAME=A.example.org    |                        |                        |
 |                         | QTYPE=A                |                        |                        |
 |                         | AUTHORITY Name=org     |                        |                        |
 |                         | AUTHORITY Name Server  |                        |                        |
 |                         |      =NS3.example.org  |                        |                        |
 |                         | ADDITIONAL Name        |                        |                        |
 |                         |      =NS3.example.org  |                        |                        |
 |                         | ADDITIONAL Address     |                        |                        |
 |                         |      =192.168.1.30     |                        |                        |
 |                         |------------------------------------------------>|                        |
 |                         |                        |4.Send standard query   |                        |
 |                         |                        | QNAME=A.example.org    |                        |
 |                         |                        | QTYPE=A                |                        |
 |                         |<------------------------------------------------|                        |
 |                         |                        |5.Send standard response|                        |
 |                         |                        | QNAME=A.example.org    |                        |
 |                         |                        | QTYPE=A                |                        |
 |                         |                        | AUTHORITY Name         |                        |
 |                         |                        |      =example.org      |                        |
 |                         |                        | AUTHORITY Name Server  |                        |
 |                         |                        |      =NS4.example.org  |                        |
 |                         |                        | ADDITIONAL Name        |                        |
 |                         |                        |      =NS4.example.org  |                        |
 |                         |                        | ADDITIONAL Address     |                        |
 |                         |                        |      =192.168.1.40     |                        |
 |                         |------------------------------------------------------------------------->|
 |                         |                        |                        |6.Send standard query   |
 |                         |                        |                        | QNAME=A.example.org    |
 |                         |                        |                        | QTYPE=A                |
 |                         |<-------------------------------------------------------------------------|
 |                         |                        |                        |7.Send standard response|
 |                         |                        |                        | QNAME=A.example.org    |
 |                         |                        |                        | QTYPE=A                |
 |                         |                        |                        | ANSWER Name            |
 |                         |                        |                        |      =A.example.org    |
 |                         |                        |                        | ANSWER Address         |
 |                         |                        |                        |      =192.168.1.10     |
 |                         |                        |                        | ANSWER TTL=0           |
 |                         |                        |                        | AUTHORITY Name         |
 |                         |                        |                        |      =example.org      |
 |                         |                        |                        | AUTHORITY Name Server  |
 |                         |                        |                        |      =NS4.example.org  |
 |                         |                        |                        | ADDITIONAL Name        |
 |                         |                        |                        |      =NS4.example.org  |
 |                         |                        |                        | ADDITIONAL Address     |
 |                         |                        |                        |      =192.168.1.40     |
```

```
|<-------------------------|                        |                        |                        |
|8.Standard query response|                        |                        |                        |
| QNAME=A.example.org      |                        |                        |                        |
| QTYPE=A                  |                        |                        |                        |
| ANSWER Name =A.example.org |                      |                        |                        |
| ANSWER Address = 192.168.1.10 |                   |                        |                        |
| AUTHORITY Name           |                        |                        |                        |
|       =example.org       |                        |                        |                        |
| AUTHORITY Name Server    |                        |                        |                        |
|       =NS4.example.org   |                        |                        |                        |
|------------------------->|                        |                        |                        |
|9.Send Standard query     |                        |                        |                        |
| QNAME=A.example.org      |                        |                        |                        |
| QTYPE=A                  |                        |                        |                        |
|                          |------------------------------------------------------------------------->|
|                          |10.Send Standard query  |                        |                        |
|                          |  QNAME=A.example.org   |                        |                        |
|                          |  QTYPE=A               |                        |                        |
v                          v                        v                        v                        v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10 to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)
9. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
10. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	1
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org

	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY

UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)

	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	0
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	0
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org.
4. Received standard query including QNAME=A.example.org.
6. Received standard query including QNAME=A.example.org.
8. Received standard query response including correct address in the ADDRESS field.
10. Received standard query including QNAME=A.example.org.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
3.6. Resource Records
RFC1123 Requirements for Internet Hosts -- Application and Support
6.1.2.1 Resource Records with Zero TTL: RFC-1035 Section 3.2.1

5.21. CNAME RR is present at a node, no other data should be present

Purpose

Verify that a NUT does not transmit response including multiple CNAME RR.

- If a CNAME RR is present at a node, no other data should be present; this ensures that the data for a canonical name and its aliases cannot be different. This rule also insures that a cached CNAME can be used without checking with an authoritative server for other RR types.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig.6 Topology No.6".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN     NS       NS1.example.com.
NS1      IN     A        192.168.0.10
A1       IN     A        192.168.1.10
A2       IN     A        192.168.1.11
;
B        IN     CNAME    A1.example.com.
B        IN     CNAME    A2.example.com.
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |--------------------------------------->|
    |   1. Send standard query              |
    |       QNAME=B.example.com             |
    |       QTYPE=CNAME                     |
    | X <-----------------------------------|
    |   2. Standard query response          |
    |       QNAME=B.example.com             |
    |       QTYPE=CNAME                     |
    |       ANSWER Name=B.example.com       |
    |       ANSWER Type=CNAME               |
    |       ANSWER CNAME=A1.example.com     |
    |       ANSWER Name=B.example.com       |
    |       ANSWER Type=CNAME               |
    |       ANSWER CNAME=A2.example.com     |
    v                                       v

 1. TN send standard query QNAME=B1.example.com, QTYPE=A to NUT.
 2. NUT reply query response including CNAME=A1.example.com, CNAME=A2.example.com to TN
   (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.com

	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Not received standard query response including CNAME.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
3.6.2. Aliases and canonical names

5.22. * query should return just the CNAME

Purpose

Verify that a NUT transmits just CNAME when receive * query.

- CNAME or * query should return just the CNAME

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig.7 Topology No.7".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL   86400              ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
        IN       NS       NS1.example.com.
NS1     IN       A        192.168.0.10
;
A2      IN       A        192.168.1.12
B1      IN       CNAME    A2.example.com.
;
```

Procedure

This test sequence is following.

```
    DNS Client1 (TN)                        DNS Server1 (NUT)
        |                                       |
        |-------------------------------------->|
        |   1. Send standard query to NUT       |
        |       QNAME=B1.example.com            |
        |       QTYPE=*                         |
        |<--------------------------------------|
        |   2. Standard query response          |
        |       CNAME=A2.example.com            |
        v                                       v
    1. TN send standard query QNAME=B1.example.com, QTYPE=CNAME to NUT.
    2. NUT reply query response including CNAME=A2.example.com to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B1.example.com
	QTYPE	* (0x00FF)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1

	ARCOUNT	1
DNS Question section	QNAME	B1.example.com
	QTYPE	* (0x00FF)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B1.example.com (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	5
	CNAME	A2.example.com (A2 + Pointer 0xC00F)
DNS Authority section	NAME	example.com (Pointer 0xC00F)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.11

- **Termination**
  None

Judgment

2. Received standard query response including CNAME resource record(Not include A resource record).

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
3.6.2. Aliases and canonical names

5.23. Carried in TCP

Purpose

Verify that a NUT transmits messages in TCP

- In the Internet, queries are carried in UDP datagrams or over TCP connections
- DNS resolvers and recursive servers MUST support UDP, and SHOULD support TCP, for sending (non-zone-transfer) queries. Specifically, a DNS resolver or server that is sending a non-zone-transfer query MUST send a UDP query first. If the Answer section of the response is truncated and if the requester supports TCP, it SHOULD try the query again using TCP.
- The Internet supports name server access using TCP [RFC-793] on server port 53 (decimal).
- Messages sent over TCP connections use server port 53 (decimal).The message is prefixed with a two byte length field which gives the message length, excluding the two byte length field.
- If the Answer section of the response is truncated and if the requester supports TCP, it SHOULD try the query again using TCP.

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig.8 Topology No.8".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                    3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.          3600000               A      192.168.1.20

For IPv6
 .                    3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.          3600000        AAAA   3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
```

```
        604800          ; expire after a week
        3600            ; Minimum TTL of a 1 hr
)
;
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)     DNS Server1 (NUT)        DNS Server2 (TN)          DNS Server3 (TN)       DNS Server4 (TN)
 |                       |                        |                        |                        |
 |----------------------->|                        |                        |                        |
 |1.Send standard query   |                        |                        |                        |
 | QNAME=A.example.org    |                        |                        |                        |
 | QTYPE=A                |                        |                        |                        |
 |                        |------------------------>|                        |                        |
 |                        |2.Send standard query   |                        |                        |
 |                        | QNAME=A.example.org    |                        |                        |
 |                        | QTYPE=A                |                        |                        |
 |                        |<------------------------|                        |                        |
 |                        |3.Send standard response|                        |                        |
 |                        | QNAME=A.example.org    |                        |                        |
 |                        | QTYPE=A                |                        |                        |
 |                        | AUTHORITY Name=org     |                        |                        |
 |                        | AUTHORITY Name Server  |                        |                        |
 |                        |      =NS3.example.org  |                        |                        |
 |                        | ADDITIONAL Name        |                        |                        |
 |                        |      =NS3.example.org  |                        |                        |
 |                        | ADDITIONAL Address     |                        |                        |
 |                        |      =192.168.1.30     |                        |                        |
 |                        |------------------------------------------------------>|                        |
 |                        |                        |4.Send standard query   |                        |
 |                        |                        | QNAME=A.example.org    |                        |
 |                        |                        | QTYPE=A                |                        |
 |                        |<------------------------------------------------------|                        |
 |                        |                        |5.Send standard response|                        |
 |                        |                        | QNAME=A.example.org    |                        |
 |                        |                        | QTYPE=A                |                        |
 |                        |                        | AUTHORITY Name         |                        |
 |                        |                        |      =example.org      |                        |
 |                        |                        | AUTHORITY Name Server  |                        |
 |                        |                        |      =NS4.example.org  |                        |
 |                        |                        | ADDITIONAL Name        |                        |
 |                        |                        |      =NS4.example.org  |                        |
 |                        |                        | ADDITIONAL Address     |                        |
 |                        |                        |      =192.168.1.40     |                        |
 |                        |------------------------------------------------------------------------------>|
 |                        |                        |                        |6.Send standard query   |
 |                        |                        |                        | QNAME=A.example.org    |
 |                        |                        |                        | QTYPE=A                |
```

```
|                        |<-------------------------------------------------------------------------|
|                        |                        |                        |7.Send standard response|
|                        |                        |                        | TC bit is set          |
|                        |                        |                        | QNAME=A.example.org    |
|                        |                        |                        | QTYPE=A                |
|                        |                        |                        | ANSWER Name            |
|                        |                        |                        |      =A.example.org    |
|                        |                        |                        | ANSWER Address         |
|                        |                        |                        |      =192.168.1.100    |
|                        |                        |                        |          to            |
|                        |                        |                        |       192.168.1.129    |
|                        |------------------------------------------------------------------------->|
|                        |                        |                        |8.Send standard query   |
|                        |                        |                        |                  in TCP |
|                        |                        |                        | QNAME=A.example.org    |
|                        |                        |                        | QTYPE=A                |
|                        |<-------------------------------------------------------------------------|
|                        |                        |                        |9.  Send standard       |
|                        |                        |                        |        response in TCP |
|                        |                        |                        | QNAME=A.example.org    |
|                        |                        |                        | QTYPE=A                |
|                        |                        |                        | ANSWER Name            |
|                        |                        |                        |      =A.example.org    |
|                        |                        |                        | ANSWER Address         |
|                        |                        |                        |      =192.168.1.100    |
|                        |                        |                        |          to            |
|                        |                        |                        |       192.168.1.130    |
|<------------------------|                        |                        |                        |
|10.Standard query response |                      |                        |                        |
| TC bit is set          |                        |                        |                        |
| QNAME=A.example.org    |                        |                        |                        |
| QTYPE=A                |                        |                        |                        |
| ANSWER Name            |                        |                        |                        |
|      =A.example.org    |                        |                        |                        |
| ANSWER Address         |                        |                        |                        |
|      =192.168.1.100    |                        |                        |                        |
|          to            |                        |                        |                        |
|       192.168.1.129    |                        |                        |                        |
|------------------------>|                        |                        |                        |
|11.Send Standard query  |                        |                        |                        |
|                  in TCP |                        |                        |                        |
| QNAME=A.example.org    |                        |                        |                        |
| QTYPE=A                |                        |                        |                        |
|<------------------------|                        |                        |                        |
|12.Standard query       |                        |                        |                        |
|               response |                        |                        |                        |
| QNAME=A.example.org    |                        |                        |                        |
| QTYPE=A                |                        |                        |                        |
| ANSWER Name            |                        |                        |                        |
|         =A.example.org |                        |                        |                        |
| ANSWER Address         |                        |                        |                        |
|        =192.168.1.100  |                        |                        |                        |
|          to            |                        |                        |                        |
|         192.168.1.130  |                        |                        |                        |
v                        v                        v                        v                        v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.100 - 192.168.1.129 to NUT.
8. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) in TCP (Judgment *8)
9. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.100 - 192.168.1.130 to NUT in TCP.
10. NUT transmits query response to DNS Client1 (TN) (Judgment *10)
11. TN send standard query QNAME=A.example.org, QTYPE=A to NUT in TCP.
12. NUT transmits query response to DNS Client1 (TN) in TCP(Judgment *12)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY

	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ

UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0

	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	1
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	30
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.100

DNS Answer section X 28 ADDRESS 192.168.1.101 - 192.168.1.128	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.129

8th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN) in TCP		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
TCP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT) in TCP		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ

TCP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	31
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.100
DNS Answer section X 28 ADDRESS 192.168.1.101 - 192.168.1.129	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.130
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)

DNS Additional section	NAME	NS4.example.org (Pointer 0xC21B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	1
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	30
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.100
DNS Answer section X 25 ADDRESS 192.168.1.101 - 192.168.1.128	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)

	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.129

11th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT) in TCP		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
TCP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

12th packet.

Standard query response from DNS Server1 (NUT) to Clinet1 (TN) in TCP		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
TCP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	ANY

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	31
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.100
DNS Answer section X 28 ADDRESS 192.168.1.101 - 192.168.1.129	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.130
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC221)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org in UDP.
4. Received standard query including QNAME=A.example.org in UDP.
6. Received standard query including QNAME=A.example.org in UDP.
8. Received standard query including QNAME=A.example.org in TCP.
10. Received standard query response(TC bit is set).
12. Received standard query response from Cache in TCP.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.7. Queries
  4.2. Transport
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  4.2. Transport
  4.2.2. TCP usage
RFC1123 Requirements for internet Hosts -- Application and Support
  6.1.3.2 Transport Protocols

5.24. Standard message format

Purpose

Verify that a NUT transmits correct standard message format

- Header section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                      ID                       |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|QR|   Opcode  |AA|TC|RD|RA|   Z    |   RCODE   |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    QDCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    ANCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    NSCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    ARCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QR	**Query (0)**
Opcode	**A standard query(QUERY) (0)**
Z	**Must be zero**
QDCOUNT	**1**
ANCOUNT	**0**
NSCOUNT	**0**
ARCOUNT	**0**

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	**A.example.org**
QTYPE	**A type (1)**
QCLASS	**IN class (1)**

- Answer section format
  Must be empty
- Authority section format
  Must be empty
- Additional section format
  Must be empty

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20

For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
```

Procedure

This test sequence is following.

```
Client1 (TN)            DNS Server1 (NUT)                DNS Server2 (TN)
     |                          |                                |
     |----------------------------->|                            |
     | 1. Send standard query   |                                |
     |    QNAME=A.example.org   |                                |
     |    QTYPE=A               |                                |
     |                          |--------------------------------->|
     |                          | 2. Send standard query         |
     |                          |  QNAME=A.example.org           |
     |                          |  QTYPE=A                       |
     v                          v                                v

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	1
	RA	any/TD>
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Standard query including QNAME=A.example.org must be based on above Verification Points.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.7. Queries
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  4.1. Format

5.25. Opcode (standard query)

Purpose

Verify that a NUT transmits correct Opcode in standard query

- Header section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                      ID                       |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|QR|   Opcode  |AA|TC|RD|RA|   Z    |   RCODE   |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    QDCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    ANCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    NSCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    ARCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

Opcode	**A standard query(QUERY) (0)**

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
.                    3600000        IN      NS      A.ROOT.NET.
A.ROOT.NET.          3600000                A       192.168.1.20
```

For IPv6

```
.                    3600000        IN      NS      A.ROOT.NET.
A.ROOT.NET.          3600000        AAAA    3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL    86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
        2005081600      ; serial
        3600            ; refresh every 1 hr
        900             ; retry every 15 min
        604800          ; expire after a week
        3600            ; Minimum TTL of a 1 hr
)
;
         IN     NS      NS1.example.com.
NS1      IN     A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
   Client1 (TN)            DNS Server1 (NUT)                DNS Server2 (TN)
        |                           |                               |
        |---------------------------->|                               |
        | 1. Send standard query      |                               |
        |    QNAME=A.example.org      |                               |
        |    QTYPE=A                  |                               |
        |                             |-------------------------------->|
        |                             | 2. Send standard query         |
        |                             |  QNAME=A.example.org           |
        |                             |  QTYPE=A                       |
        v                             v                               v

  1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
  2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	any
	OPCODE	0
	AA	any
	TC	any
	RD	any
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	any
	QTYPE	any
	QCLASS	any

- **Termination**
  None

Judgment

2. Standard query must be based on above Verification Points.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.7. Queries
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  4.1.1. Header section format

5.26. Question section format

Purpose

Verify that a NUT transmits correct question section format.

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	**A.example.org**
QTYPE	**A type (1)**
QCLASS	**IN class (1)**

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig.2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                    3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.          3600000                A       192.168.1.20

For IPv6
 .                    3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.          3600000        AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL    86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
```

```
        2005081600      ; serial
        3600            ; refresh every 1 hr
        900             ; retry every 15 min
        604800          ; expire after a week
        3600            ; Minimum TTL of a 1 hr
)
;
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
 Client1 (TN)   DNS Server1 (NUT)    DNS Server2 (TN) DNS Server3 (TN) DNS Server4 (TN)
  |                      |                       |           |            |
  |----------------------->|                      |           |            |
  | 1.Send standard query |                       |           |            |
  |   QNAME=A.example.org |                       |           |            |
  |    QTYPE=A            |                       |           |            |
  |                       |----------------------->|          |            |
  |                       | 2.Send standard query |           |            |
  |                       |  QNAME=A.example.org  |           |            |
  |                       |  QTYPE=A              |           |            |
  v                       v                       v           v            v

  1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
  2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	any
	OPCODE	any
	AA	any
	TC	any
	RD	any
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	any
	NSCOUNT	any
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Standard query including QNAME=A.example.org must be based on above Verification Points.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
3.7.1. Standard queries
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
4.1. Format
4.1.2. Question section format

5.27. Resource record * qtype for query

Purpose

Verify that a NUT transmits correct message including * qtype in the QTYPE field.

- Query type *.
  Header section field has the following value.

QR	0
QDCOUNT	1
ANCOUNT	0
NSCOUNT	0
ARCOUNT	0

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	A.example.org
QTYPE	* (0x00ff)
QCLASS	IN (0x0001)

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig.2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
.                       3600000          IN       NS       A.ROOT.NET.
```

```
 A.ROOT.NET.              3600000                    A        192.168.1.20
For IPv6
 .                        3600000          IN        NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA      3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL    86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
        2005081600       ; serial
        3600             ; refresh every 1 hr
        900              ; retry every 15 min
        604800           ; expire after a week
        3600             ; Minimum TTL of a 1 hr
)
;
        IN      NS       NS1.example.com.
NS1     IN      A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)     DNS Server1 (NUT)        DNS Server2 (TN)           DNS Server3 (TN)       DNS Server4 (TN)
 |                        |                        |                          |                        |
 |------------------------>|                        |                          |                        |
 |1.Send standard query    |                        |                          |                        |
 | QNAME=A.example.org     |                        |                          |                        |
 | QTYPE=*                 |                        |                          |                        |
 |                         |------------------------>|                          |                        |
 |                         |2.Send standard query   |                          |                        |
 |                         | QNAME=A.example.org    |                          |                        |
 |                         | QTYPE=*                |                          |                        |
 |                         |<------------------------|                          |                        |
 |                         |3.Send standard response|                          |                        |
 |                         | QNAME=A.example.org    |                          |                        |
 |                         | QTYPE=*                |                          |                        |
 |                         | AUTHORITY Name=org     |                          |                        |
 |                         | AUTHORITY Name Server  |                          |                        |
 |                         |      =NS3.example.org  |                          |                        |
 |                         | ADDITIONAL Name        |                          |                        |
 |                         |      =NS3.example.org  |                          |                        |
 |                         | ADDITIONAL Address     |                          |                        |
 |                         |      =192.168.1.30     |                          |                        |
 |                         |------------------------------------------------------------------------>|
 |                         |                        |4.Send standard query     |                        |
 |                         |                        | QNAME=A.example.org      |                        |
 |                         |                        | QTYPE=*                  |                        |
```

```
|                        |<-----------------------------------------------|                        |
|                        |                        |5.Send standard response|                        |
|                        |                        | QNAME=A.example.org    |                        |
|                        |                        | QTYPE=*                |                        |
|                        |                        | AUTHORITY Name         |                        |
|                        |                        |      =example.org      |                        |
|                        |                        | AUTHORITY Name Server  |                        |
|                        |                        |      =NS4.example.org  |                        |
|                        |                        | ADDITIONAL Name        |                        |
|                        |                        |      =NS4.example.org  |                        |
|                        |                        | ADDITIONAL Address     |                        |
|                        |                        |      =192.168.1.40     |                        |
|-------------------------------------------------------------------------------------------------->|
|                        |                        |                        |6.Send standard query   |
|                        |                        |                        | QNAME=example.org      |
|                        |                        |                        | QTYPE=*                |
|<--------------------------------------------------------------------------------------------------|
|                        |                        |                        |7.Send standard response|
|                        |                        |                        | QNAME=A.example.org    |
|                        |                        |                        | QTYPE=*                |
|                        |                        |                        | ANSWER Name            |
|                        |                        |                        |      =A.example.org    |
|                        |                        |                        | ANSWER Address         |
|                        |                        |                        |      =192.168.1.10     |
|                        |                        |                        | AUTHORITY Name         |
|                        |                        |                        |      =example.org      |
|                        |                        |                        | AUTHORITY Name Server  |
|                        |                        |                        |      =NS4.example.org  |
|                        |                        |                        | ADDITIONAL Name        |
|                        |                        |                        |      =NS4.example.org  |
|                        |                        |                        | ADDITIONAL Address     |
|                        |                        |                        |      =192.168.1.40     |
|<-------------------------|                        |                        |                        |
|8.Standard query response|                        |                        |                        |
| QNAME=A.example.org    |                        |                        |                        |
| QTYPE=*                |                        |                        |                        |
| ANSWER Name            |                        |                        |                        |
|      =A.example.org    |                        |                        |                        |
| ANSWER Address         |                        |                        |                        |
|      =192.168.1.10     |                        |                        |                        |
| AUTHORITY Name         |                        |                        |                        |
|      =example.org      |                        |                        |                        |
| AUTHORITY Name Server  |                        |                        |                        |
|      =NS4.example.org  |                        |                        |                        |
v                        v                        v                        v                        v
```

1. TN send standard query QNAME=A.example.org, QTYPE=* to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=* to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=* to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10 to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	* (0x00ff)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	1
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	* (0x00ff)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	* (0x00ff)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x00001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	* (0x00ff)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	A.example.org
	QTYPE	* (0x00ff)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	* (0x00ff)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	* (0x00ff)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ

UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	* (0x00ff)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**

  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=*.
4. Received standard query including QNAME=A.example.org, QTYPE=*.
6. Received standard query including QNAME=A.example.org, QTYPE=*.
8. Received standard query response including correct answer.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.7.1. Standard queries
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.3. QTYPE values

5.28. Resource record * qtype for response

Purpose

Verify that a NUT transmits correct response including * qtype in the QTYPE field.

- matches all RR types.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
A        IN      TXT      "DNS TEST"
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
    |                                     |
    |------------------------------------>|
    |   1. Send standard query            |
    |       QNAME=A.example.com           |
    |       QTYPE=A                       |
    |       QCLASS=*                      |
    |<------------------------------------|
    |   2. Standard query response        |
    |       A=192.168.1.10                |
    |       TXT=DNS TEST                  |
    v                                     v

 1. TN send standard query QNAME=A.example.com, QTYPE=A, QCLASS=* to NUT.
 2. NUT reply query response w/ A=192.168.1.10 TXT=DNS TEST to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	* (0x00FF)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	* (0x00FF)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	TXT (0x0010)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	9
	TXT-DATA	DNS TEST
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC050)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- Termination
  None

Judgment

2. Received standard query response w/ A=192.168.1.10 TXT=DNS TEST.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.7.1. Standard queries
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.3. QTYPE values

5.29. ＊qclass in standard query

Purpose

Verify that a NUT transmits correct message including＊qclass in the QCLASS field.

- Query class ＊.
  Header section field has the following value.

QR	0
QDCOUNT	1
ANCOUNT	0
NSCOUNT	0

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	A.example.org
QTYPE	A (0x0001)
QCLASS	＊ (0x00ff)

Category

Server (Recursive)

Initialization

- **Network Topology**
  Refer the topology "Fig.2　Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.
  Example of root server list:

For IPv4:

```
.                    3600000        IN    NS    A.ROOT.NET.
A.ROOT.NET.          3600000              A     192.168.1.20
```

For IPv6

```
 .                        3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
       IN     NS    NS1.example.com.
NS1    IN     A     192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)     DNS Server1 (NUT)        DNS Server2 (TN)           DNS Server3 (TN)       DNS Server4 (TN)
  |                        |                        |                        |                        |
  |------------------------>|                        |                        |                        |
  |1.Send standard query    |                        |                        |                        |
  | QNAME=A.example.org     |                        |                        |                        |
  | QTYPE=A                 |                        |                        |                        |
  | QCLASS=*                |------------------------>|                        |                        |
  |                         |2.Send standard query   |                        |                        |
  |                         | QNAME=A.example.org    |                        |                        |
  |                         | QTYPE=A                |                        |                        |
  |                         | QCLASS=*               |                        |                        |
  |                         |<------------------------|                        |                        |
  |                         |3.Send standard response|                        |                        |
  |                         | QNAME=A.example.org    |                        |                        |
  |                         | QTYPE=A                |                        |                        |
  |                         | QCLASS=*               |                        |                        |
  |                         | AUTHORITY Name=org     |                        |                        |
  |                         | AUTHORITY Name Server  |                        |                        |
  |                         |      =NS3.example.org  |                        |                        |
  |                         | ADDITIONAL Name        |                        |                        |
  |                         |      =NS3.example.org  |                        |                        |
  |                         | ADDITIONAL Address     |                        |                        |
  |                         |      =192.168.1.30     |                        |                        |
  |                         |------------------------------------------------>|                        |
  |                         |                        |4.Send standard query   |                        |
  |                         |                        | QNAME=A.example.org    |                        |
  |                         |                        | QTYPE=A                |                        |
  |                         |                        | QCLASS=*               |                        |
```

```
|                        |<-----------------------------------------------|                      |
|                        |                        |5.Send standard response|                      |
|                        |                        | QNAME=A.example.org    |                      |
|                        |                        | QTYPE=A                |                      |
|                        |                        | QCLASS=*               |                      |
|                        |                        | AUTHORITY Name         |                      |
|                        |                        |      =example.org      |                      |
|                        |                        | AUTHORITY Name Server  |                      |
|                        |                        |      =NS4.example.org  |                      |
|                        |                        | ADDITIONAL Name        |                      |
|                        |                        |      =NS4.example.org  |                      |
|                        |                        | ADDITIONAL Address     |                      |
|                        |                        |      =192.168.1.40     |                      |
|                        |-------------------------------------------------------------------->|
|                        |                        |                        |6.Send standard query |
|                        |                        |                        | QNAME=A.example.org  |
|                        |                        |                        | QTYPE=A              |
|                        |                        |                        | QCLASS=*             |
|                        |<--------------------------------------------------------------------|
|                        |                        |                        |7.Send standard response|
|                        |                        |                        | QNAME=A.example.org  |
|                        |                        |                        | QTYPE=A              |
|                        |                        |                        | QCLASS=*             |
|                        |                        |                        | ANSWER Name          |
|                        |                        |                        |      =www.example.org |
|                        |                        |                        | ANSWER Address       |
|                        |                        |                        |      =192.168.1.10   |
|                        |                        |                        | ANSWER TTL=0         |
|                        |                        |                        | AUTHORITY Name       |
|                        |                        |                        |      =example.org    |
|                        |                        |                        | AUTHORITY Name Server |
|                        |                        |                        |      =NS4.example.org |
|                        |                        |                        | ADDITIONAL Name      |
|                        |                        |                        |      =NS4.example.org |
|                        |                        |                        | ADDITIONAL Address   |
|                        |                        |                        |      =192.168.1.40   |
|<-----------------------|                        |                        |                      |
|8.Standard query response|                       |                        |                      |
| QNAME=A.example.org    |                        |                        |                      |
| QTYPE=A                |                        |                        |                      |
| QCLASS=*               |                        |                        |                      |
| ANSWER Name            |                        |                        |                      |
|      =A.example.org    |                        |                        |                      |
| ANSWER Address         |                        |                        |                      |
|      =192.168.1.10     |                        |                        |                      |
| AUTHORITY Name         |                        |                        |                      |
|      =example.org      |                        |                        |                      |
| AUTHORITY Name Server  |                        |                        |                      |
|      =NS4.example.org  |                        |                        |                      |
v                        v                        v                        v                      v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A, QCLASS=* to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A, QCLASS=* to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A, QCLASS=* to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10 to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	* (0x00ff)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	* (0x00ff)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	* (0x00ff)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	* (0x00ff)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	* (0x00ff)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	1
	OPCODE	0
	AA	Any
	TC	0
	RD	0
	RA	Any
	Z	Any
	RCODE	Any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	* (0x00ff)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	* (0x00ff)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ

UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	* (0x00ff)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**

  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A, QCLASS=*.
4. Received standard query including QNAME=A.example.org, QTYPE=A, QCLASS=*.
6. Received standard query including QNAME=A.example.org, QTYPE=A, QCLASS=*.
8. Received standard query response including correct answer.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.7.1. Standard queries
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.5. QCLASS values

5.30. The name server returns data w/ Authoritative Answer (AA) or not.

Purpose

Verify that a NUT marks Authoritative Answer bit when the response comes from authoritative data

- Authoritative Answer (AA) bit is set
- Header section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                      ID                       |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|QR|   Opcode  |AA|TC|RD|RA|   Z    |   RCODE   |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    QDCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    ANCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    NSCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    ARCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

Category

Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
.                    3600000      IN    NS    A.ROOT.NET.
A.ROOT.NET.          3600000            A     192.168.1.20
```

For IPv6

```
.                    3600000      IN    NS    A.ROOT.NET.
A.ROOT.NET.          3600000      AAAA  3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
```

Procedure

This test sequence is following.

```
                                                <-------------------- TN ---------------------------->
DNS Client1 (TN)     DNS Server1 (NUT)           DNS Server2 (TN) DNS Server3 (TN)  DNS Server4 (TN)
 |                          |                                |                 |                 |
 |-------------------------->|                                |                 |                 |
 |1.Send standard query     |                                |                 |                 |
 |  QNAME=A.example.com     |                                |                 |                 |
 |  QTYPE=A                 |                                |                 |                 |
 |<--------------------------|                                |                 |                 |
 |2.Standard query response |                                |                 |                 |
 |  QNAME=A.example.com     |                                |                 |                 |
 |  QTYPE=A                 |                                |                 |                 |
 |  ANSWER Name             |                                |                 |                 |
 |        =A.example.com    |                                |                 |                 |
 |  ANSWER Address          |                                |                 |                 |
 |        =192.168.1.10     |                                |                 |                 |
 |  AUTHORITY Name          |                                |                 |                 |
 |        =example.com      |                                |                 |                 |
 |  AUTHORITY Name Server   |                                |                 |                 |
 |        =NS1.example.com  |                                |                 |                 |
 |  ADDITIONAL Name         |                                |                 |                 |
 |        =NS1.example.com  |                                |                 |                 |
 |  ADDITIONAL Address      |                                |                 |                 |
 |        =192.168.0.10     |                                |                 |                 |
 |-------------------------->|                                |                 |                 |
 |3.Send standard query     |                                |                 |                 |
 |  QNAME=A.example.org     |                                |                 |                 |
 |  QTYPE=A                 |                                |                 |                 |
 |                          |------------------------------->|                 |                 |
 |                          |4.Recv standard query           |                 |                 |
 |                          |  QNAME=A.example.org           |                 |                 |
 |                          |  QTYPE=A                       |                 |                 |
 |                          |<-------------------------------|                 |                 |
 |                          |5.Send standard query response |                 |                 |
 |                          |  AA =0                         |                 |                 |
 |                          |  QNAME=A.example.org           |                 |                 |
 |                          |  QTYPE=A                       |                 |                 |
 |                          |  AUTHORITY Name=org            |                 |                 |
 |                          |  AUTHORITY Nsdname             |                 |                 |
 |                          |       =NS3.example.org         |                 |                 |
 |                          |  ADDITIONAL Name               |                 |                 |
 |                          |       =NS3.example.org         |                 |                 |
 |                          |  ADDITIONAL Address            |                 |                 |
 |                          |       =192.168.1.30            |                 |                 |
 |                          |                                v                 |                 |
 |                          |------------------------------------------------->|                 |
 |                          |                 6.Recv standard query            |                 |
 |                          |                  QNAME=A.example.org             |                 |
 |                          |                  QTYPE=A                         |                 |
 |                          |<-------------------------------------------------|                 |
 |                          |                 7.Send standard query response   |                 |
 |                          |                  AA =0                           |                 |
 |                          |                  QNAME=A.example.org             |                 |
 |                          |                  QTYPE=A                         |                 |
 |                          |                  AUTHORITY Name= example.org     |                 |
 |                          |                  AUTHORITY Nsdname =NS4.example.org |               |
 |                          |                  ADDITIONAL Name = NS4.example.org |                |
 |                          |                  ADDITIONAL Address = 192.168.1.40|                 |
 |                          |                                                  v                 |
```

```
 |                          |-------------------------------------------------------------->|
 |                          |                                8.Recv standard query            |
 |                          |                                 QNAME=A.example.org             |
 |                          |                                 QTYPE=A                         |
 |                          |-------------------------------------------------------------->|
 |                          |                                9.Send standard query response   |
 |                          |                                 AA =1                           |
 |                          |                                 QNAME=A.example.org             |
 |                          |                                 QTYPE=A                         |
 |                          |                                 ANSWER Name=A.example.org       |
 |                          |                                 ANSWER Address=192.168.1.10     |
 |                          |                                 AUTHORITY Name=example.org      |
 |                          |                                 AUTHORITY Nsdname=NS4.example.org|
 |                          |                                 ADDITIONAL Name=NS4.example.org |
 |                          |                                 ADDITIONAL Address=192.168.1.40 |
 |                          |                                                                 v
 |<-------------------------|
 |10.Standard query response|
 |  AA =0                   |
 |  QNAME=A.example.org     |
 |  QTYPE=A                 |
 |  ANSWER Name             |
 |        =A.example.org    |
 |  ANSWER Address          |
 |        =192.168.1.10     |
 |  AUTHORITY Name          |
 |        =example.org      |
 |  AUTHORITY Name Server   |
 |        =NS4.example.org  |
 |  ADDITIONAL Name         |
 |        =NS4.example.org  |
 |  ADDITIONAL Address      |
 |        =192.168.1.40     |
 v                          v

This test sequence is following.
 1. DNS Client1 (TN) send standard query QNAME=A.example.com, QTYPE=A to NUT.
 2. DNS Server1 (NUT) transmits standard query response to DNS Client1 (TN) with Authoritative Answer (AA)
    bit is set.(Judgment *2)
 3. DNS Client1 (TN) send standard query QNAME=A.example.org, QTYPE=A to DNS Server1 (NUT).
 4. DNS Server1 (NUT) transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server2 (TN). (Judgment
    *4)
 5. DNS Server2 (TN) send standard query response to DNS Server1 (NUT).
 6. DNS Server1 (NUT) transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN). (Judgment
    *6)
 7. DNS Server3 (TN) send standard query response to DNS Server1 (NUT).
 8. DNS Server1 (NUT) transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN). (Judgment
    *8)
 9. DNS Server4 (TN) send standard query response to DNS Server1 (NUT).
 10. DNS Server1 (NUT) transmits standard query response to DNS Client1 (TN) with Authoritative Answer (AA)
    bit is not set.(Judgment *10)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000

	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	**1**
	TC	0
	RD	1
	RA	1
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x2000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

4th packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

6th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0

	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)

	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x2000
	QR	1
	OPCODE	0
	AA	**0**
	TC	0
	RD	1
	RA	1
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query response with Authoritative Answer (AA) bit is set
10. Received standard query response with Authoritative Answer (AA) bit is not set

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
4. NAME SERVERS
4.3.1. Queries and responses

5.31. The name server implement non-recursive queries

Purpose

Verify that a NUT returns the response contains an error, the answer, or a referral to some other server 'closer' to the answer when server can answer queries using only local information.

Category

Authoritative Server (No-recursive)

Initialization

- **Network Topology**
  Refer the topology "Fig.9 Topology No.9".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Enable **non-recursive** mode

  Example of root server list:

```
For IPv4:
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                A       192.168.1.20

For IPv6
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000        AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
A        IN       A        192.168.1.10
```

Procedure

This test sequence is following.

```
    DNS Client1 (TN)                        DNS Server1 (NUT)
        |                                         |
        |----------------------------------------->|
        | 1. Send standard query                  |
        |    QNAME=A.example.com                  |
        |    QTYPE=A                              |
        |<-----------------------------------------|
        | 2. Standard query response              |
        |  RA = 0                                 |
        |  QNAME=A.example.com                    |
        |  QTYPE=A                                |
        |  ANSWER Name = A.example.com            |
        |  ANSWER Address = 192.168.1.10          |
        |  AUTHORITY Name = example.com           |
        |  AUTHORITY Name Server = NS1.example.com|
        |  ADDITIONAL Name = NS1.example.com      |
        |  ADDITIONAL Address = 192.168.0.10      |
        |----------------------------------------->|
        | 3. Send standard query                  |
        |  QNAME = A.example.org                  |
        |  QTYPE = A                              |
        |<-----------------------------------------|
        | 4. Standard query response              |
        |  RA = 0                                 |
        |  RCODE = 0                              |
        |  QNAME = A.example.org                  |
        |  QTYPE = A                              |
        |  AUTHORITY Name = <ROOT>                |
        |  AUTHORITY Name Server = A.ROOT.NET     |
        |            or                           |
        |  RA = 0                                 |
        |  RCODE = 3                              |
        |  QNAME = A.example.org                  |
        |  QTYPE = A                              |
        v                                         v

 This test sequence is following.
    1. DNS Client1 (TN) sends standard query QNAME=A.example.com, QTYPE=A to NUT.
    2. DNS Server1 (NUT) transmits standard query response to DNS Client1 (TN). (Judgment *2)
    3. DNS Client1 (TN) sends standard query QNAME=A.example.org, QTYPE=A to DNS Server1 (NUT).
    4. DNS Server1 (NUT) transmits standard query response to DNS Client1 (TN) with AUTHORITY Name=<ROOT>,
       AUTHORITY Name server A.ROOT.NET.
            or
    DNS Server1 (NUT) returns the response contains an error, the answer to DNS Client1 (TN).(Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ

UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	**0**
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)

	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x2000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x2000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	**0**
	Z	ANY
	RCODE	**0**
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	.
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	3600000 sec
	RDLENGTH	12
	NSDNAME	A.ROOT.NET

or

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x2000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	**0**

	Z	ANY
	RCODE	**3**
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query response with Recursion Available (RA) bit is set
4. Received standard query response containing a referral to other server 'closer'
   or
   Received standard query response containing a error (RCODE=3).

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
4. NAME SERVERS
4.3.1. Queries and responses

5.32. Name server acts in the role of a resolver

Purpose

Verify that if clients require recursive mode, name server acts in the role of a resolver and returns either an error or the answer, but never referrals. And the name server restricts the clients which can use recursive mode.

Category

Authoritative and Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig.2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.
  Restrict the client except 192.168.0./24 which can use recursive mode.
  Example of allowable client list.

```
allow-recursion {192.168.0./24};
```

Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20
For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN     NS      NS1.example.com.
NS1      IN     A       192.168.0.10
;
A        IN     A       192.168.1.10
```

Procedure

This test sequence is following.

```
AP Server1 (TN)                    DNS Server1 (NUT)
 |                                  |
 |----------------------------------->|
 |1.Send standard query               |
 | QNAME = A.example.com              |
 | QTYPE = A                          |
 |<-----------------------------------|
 |2.Standard query response           |
 | RA = 0                             |
 | QNAME = A.example.com              |
 | QTYPE = A                          |
 | ANSWER Name = A.example.com        |
 | ANSWER Address = 192.168.1.10      |
 | AUTHORITY Name = example.com       |
 | AUTHORITY Name Server              |
 |        = NS1.example.com           |
 | ADDITIONAL Name  = NS1.example.com |
 | ADDITIONAL Address = 192.168.0.10  |
 |----------------------------------->|
 |3.Send standard query               |
 |  QNAME = A.example.org             |
 |  QTYPE = A                         |
 |<-----------------------------------|
 |4.Standard query response           |
 |  RA = 0                            |
 |  RCODE = 0                         |
 |  QNAME = A.example.org             |
 |  QTYPE = A                         |
 |  AUTHORITY Name = <ROOT>           |
 |  AUTHORITY Name Server = A.ROOT.NET|
 |            or                      |
 |  RA = 0                            |
 |  RCODE = 3                         |
 |  QNAME = A.example.org             |
 |  QTYPE = A                         |
 v                                    v
                                                          <---------- TN ------------->
                                                          DNS Server2       DNS Server4
DNS Client1 (TN)               DNS Server1 (NUT)                  |   DNS Server3    |
 |----------------------------------->|                           |         |        |
 |5.Send standard query               |                           |         |        |
 |  QNAME = A.example.com             |                           |         |        |
 |  QTYPE = A                         |                           |         |        |
 |<-----------------------------------|                           |         |        |
 |6.Standard query response           |                           |         |        |
 |  RA = 0                            |                           |         |        |
 |  QNAME = A.example.com             |                           |         |        |
 |  QTYPE = A                         |                           |         |        |
 |  ANSWER Name = A.example.com       |                           |         |        |
 |  ANSWER Address = 192.168.1.10     |                           |         |        |
 |  AUTHORITY Name = example.com      |                           |         |        |
 |  AUTHORITY Name Server             |                           |         |        |
 |        = NS1.example.com           |                           |         |        |
 |  ADDITIONAL Name = NS1.example.com |                           |         |        |
 |  ADDITIONAL Address = 192.168.0.10 |                           |         |        |
 |                                    |                           |         |        |
```

```
|----------------------------------->|                                |         |         |
| 7. Send standard query             |                                |         |         |
|  QNAME = A.example.org             |                                |         |         |
|  QTYPE = A                         |                                |         |         |
|                                    |---------------------------------->|         |         |
|                                    |8.Recv standard query           |         |         |
|                                    |  QNAME = A.example.org         |         |         |
|                                    |  QTYPE = A                     |         |         |
|                                    |<----------------------------------|         |         |
|                                    |9.Send standard query response  |         |         |
|                                    |  AA = 0                        |         |         |
|                                    |  QNAME = A.example.org         |         |         |
|                                    |  QTYPE = A                     |         |         |
|                                    |  AUTHORITY Name = org          |         |         |
|                                    |  AUTHORITY Nsdname= NS3.example.org|         |         |
|                                    |  ADDITIONAL Name = NS3.example.org |         |         |
|                                    |  ADDITIONAL Address = 192.168.1.30 |         |         |
|                                    |                                v         |         |
|                                    |---------------------------------------------->|         |
|                                    |         10.Recv standard query         |         |
|                                    |           QNAME = A.example.org        |         |
|                                    |           QTYPE = A                    |         |
|                                    |<----------------------------------------------|         |
|                                    |         11.Send standard query response |         |
|                                    |           AA = 0                       |         |
|                                    |           QNAME = A.example.org        |         |
|                                    |           QTYPE = A                    |         |
|                                    |           AUTHORITY Name = example.org |         |
|                                    |           AUTHORITY Nsdname =NS4.example.org|         |
|                                    |           ADDITIONAL Name = NS4.example.org |         |
|                                    |           ADDITIONAL Address = 192.168.1.40 |         |
|                                    |                                        v         |
|                                    |-------------------------------------------------------->|
|                                    |                 12. Recv standard query                |
|                                    |                     QNAME = A.example.org              |
|                                    |                     QTYPE = A                          |
|                                    |<--------------------------------------------------------|
|                                    |                 13. Send standard query response       |
|                                    |                     AA = 1                             |
|                                    |                     QNAME = A.example.org              |
|                                    |                     QTYPE = A                          |
|                                    |                     ANSWER Name = A.example.org        |
|                                    |                     ANSWER Address=192.168.1.10        |
|                                    |                     AUTHORITY Name = example.org       |
|                                    |                     AUTHORITY Nsdname=NS4.example.org|
|                                    |                     ADDITIONAL Name = NS4.example.org|
|                                    |                     ADDITIONAL Address = 192.168.1.40|
|                                    |                                                        v
|<-----------------------------------|
|14.Standard query response          |
|  RA = 1                            |
|  QNAME = A.example.org             |
|  QTYPE = A                         |
|  ANSWER Name = A.example.org       |
|  ANSWER Address = 192.168.1.10     |
|  AUTHORITY Name = example.org      |
|  AUTHORITY Name Server             |
|         = NS4.example.org          |
|  ADDITIONAL Name = NS4.example.org |
|  ADDITIONAL Address = 192.168.1.40 |
v                                    v
```

```
AP Server1 (TN)        DNS Server1 (NUT)
 |                                   |
 |----------------------------------->|
 | 15. Send standard query            |
 |  QNAME = A.example.org             |
 |  QTYPE = A                         |
 |<-----------------------------------|
 |16.Standard query response          |
 |  RA = 0                            |
 |  QNAME = A.example.org             |
 |  QTYPE = A                         |
 |  ANSWER Name = A.example.org       |
 |  ANSWER Address = 192.168.1.10     |
 |  AUTHORITY Name = example.org      |
 |  AUTHORITY Name Server             |
 |         = NS4.example.org          |
 |  ADDITIONAL Name = NS3.example.org |
 |  ADDITIONAL Address = 192.168.1.40 |
 v                                    v
```

This test sequence is following.

1. AP Server1 (TN) send standard query QNAME=A.example.com, QTYPE=A to NUT.
2. DNS Server1 (NUT) transmits standard query response to AP Server1 (TN). (Judgment *2)
3. AP Server1 (TN) send standard query QNAME=A.example.org, QTYPE=A to DNS Server1 (NUT).
4. DNS Server1 (NUT) transmits response contain a error to AP Server1 (TN). (Judgment *4)
5. DNS Client1 (TN) send standard query QNAME=A.example.com, QTYPE=A to NUT.
6. DNS Server1 (NUT) transmits standard query response to DNS Client1 (TN). (Judgment *6)
7. DNS Client1 (TN) send standard query QNAME=A.example.org, QTYPE=A to DNS Server1 (NUT).
8. DNS Server1 (NUT) transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server2 (TN).
9. DNS Server2 (TN) send standard query response to DNS Server1 (NUT).
10. DNS Server1 (NUT) transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN).
11. DNS Server3 (TN) send standard query response to DNS Server1 (NUT).
12. DNS Server1 (NUT) transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN).
13. DNS Server4 (TN) send standard query response to DNS Server1 (NUT).
14. DNS Server1 (NUT) transmits standard query response to DNS Client1 (TN). (Judgment *14)
15. AP Server1 (TN) send standard query QNAME=A.example.org, QTYPE=A to DNS Server1 (NUT) again.
16. DNS Server1 (NUT) transmits standard query response to DNS Client1 (TN) from cache data. (Judgment *16)

    RA: Recursion Available

Packet Description

1st packet.

Standard query from AP Server1 (TN) to Server1 (NUT)		
IP Header	Source Address	AP1_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0

	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to AP Server1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	AP1_NETY
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	**0**
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)

	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	AP1_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x2000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x2000

	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	**0**
	Z	ANY
	RCODE	**0**
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	.
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	3600000 sec
	RDLENGTH	12
	NSDNAME	A.ROOT.NET

or

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	AP1_NETY
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x2000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	**0**
	Z	ANY
	RCODE	**3**
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org

	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	3000
	Dst Port	53
DNS Header	ID	0x3000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	3000
DNS Header	ID	0x3000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	1
	Z	ANY
	RCODE	0
	QDCOUNT	1

	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

7th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	4000
	Dst Port	53
DNS Header	ID	0x4000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

8th packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

10th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org

	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

11th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

12th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY

UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

13th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)

	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

14th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	4000
DNS Header	ID	0x4000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

15th packet.

Standard query from AP Server1 (TN) to Server1 (NUT)		
IP Header	Source Address	AP1_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	5000
	Dst Port	53
DNS Header	ID	0x5000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

16th packet.

Standard query response from Server1 (NUT) to AP Server1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	AP1_NETY
UDP Header	Src Port	53
	Dst Port	5000
DNS Header	ID	0x5000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	**0**
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query response with RA bit 0 to AP Server1.
4. Received error response containing a error (RCODE=3).
6. Received standard query response with RA bit 1 to DNS Client1
14. Received standard query response with RA bit 1 to DNS Client1
16. Received standard query response with RA bit 0 to AP Server1.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
4. NAME SERVERS
4.3.1. Queries and responses

5.33. Recursion Available (RA) bit is set or cleared by a name server in all responses

Purpose

Verify that whether NUT can set or clear RA bit in all responses.

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                      ID                       |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|QR|   Opcode  |AA|TC|RD|RA|   Z    |   RCODE   |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    QDCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    ANCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    NSCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    ARCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

Category

Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 10 Topology No.10".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  At first enable **non-recursive** mode.

  Example of root server list:

```
For IPv4:
 .                    3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.          3600000                A       192.168.1.20
For IPv6
 .                    3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.          3600000        AAAA    3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
NS1      IN        A         192.168.0.10
;
A        IN        A         192.168.1.10
```

Procedure

This test sequence is following.

```
   DNS Client1 (TN)                      DNS Server1 (NUT)
       |                                        |
       |---------------------------------------->|
       | 1. Send standard query                 |
       |    RD = 1                              |
       |    RA = 1                              |
       |    QNAME=A.example.com                 |
       |    QTYPE=A                             |
       |<----------------------------------------|
       | 2. Standard query response             |
       |    RD = 1                              |
       |    RA = 0                              |
       |  QNAME = A.example.com                 |
       |  QTYPE = A                             |
       |  ANSWER Name = A.example.com           |
       |  ANSWER Address = 192.168.1.10         |
       |  AUTHORITY Name = example.com          |
       |  AUTHORITY Name Server = NS1.example.com|
       |  ADDITIONAL Name = NS1.example.com     |
       |  ADDITIONAL Address = 192.168.0.10     |
       v                                        v
       3. Disable non-recursive mode on DNS Server1 (NUT)

       |                                        |
       |---------------------------------------->|
       | 4. Send standard query                 |
       |    RD = 1                              |
       |    RA = 0                              |
       |  QNAME = A.example.com                 |
       |  QTYPE = A                             |
       |<----------------------------------------|
       | 5. Standard query response             |
       |    RD = 1                              |
       |    RA = 1                              |
       |  QNAME = A.example.com                 |
       |  QTYPE = A                             |
       |  ANSWER Name = A.example.com           |
       |  ANSWER Address = 192.168.1.10         |
       |  AUTHORITY Name = example.com          |
       |  AUTHORITY Name Server = NS1.example.com|
       |  ADDITIONAL Name = NS1.example.com     |
       |  ADDITIONAL Address = 192.168.0.10     |
       v                                        v

This test sequence is following.
   1. DNS Client1 (TN) send standard query QNAME=A.example.com, QTYPE=A with RD=1, RA=1 to DNS Server1 (NUT).
   2. DNS Server1 (NUT) transmits standard query response from which RA bit is cleared to DNS Client1 (TN).
      (Judgment *2)
   3. Disable non-recursive mode on DNS Server1 (NUT) and restart DNS service.
   4. DNS Client1 (TN) send standard query QNAME=A.example.org, QTYPE=A with RD=1, RA=0 to DNS Server1 (NUT).
   5. DNS Server1 (NUT) transmits standard query response from which RA bit is set to DNS Client1 (TN).
      (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	**0**
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1

	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Nothing.

4th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x2000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x2000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	1
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response from which RA bit is cleared.
5. Received standard query response from which RA bit is set.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
4. NAME SERVERS
4.3.1. Queries and responses

5.34. Recursion desired (RD) in standard query

Purpose

Verify that a NUT transmits correct standard query message for Recursion desired (RD)

- Query type A.
  Header section field has the following value.

QR	0
RD	1
QDCOUNT	1
ANCOUNT	0
NSCOUNT	0
ARCOUNT	0

Category

Server (forwarder)

Initialization

- **Network Topology**
  Refer the topology "Fig. 2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the DNS server1(NUT) as a forwarder and set the DNS server4(TN) as destination of forward.

Procedure

This test sequence is following.

```
                                DNS Server2(TN)
 Client1(TN)       DNS Server1(NUT)   |   DNS Server3(TN)             DNS Server4(TN)
  |                         |         |         |                            |
  |------------------------>|         |         |                            |
  | 1.Send standard query   |         |         |                            |
  |   QNAME=A.example.org   |         |         |                            |
  |   QTYPE=A               |         |         |                            |
  |                         |------------------------------------------------>|
  |                         |         |         |2.Send standard query       |
  |                         |         |         |  RD = 1                    |
  |                         |         |         |  QNAME=A.example.org       |
  |                         |         |         |  QTYPE=A                   |
  |                         |<-----------------------------------------------|
  |                         |         |         | 3.Send standard response   |
  |                         |         |         |  QNAME=A.example.org       |
  |                         |         |         |  QTYPE=A                   |
  |                         |         |         |  ANSWER Name=A.example.org |
  |                         |         |         |  ANSWER Address=192.168.1.10|
  |                         |         |         |  AUTHORITY Name=example.org |
  |                         |         |         |  AUTHORITY Name Server     |
  |                         |         |         |            =NS4.example.org |
  |                         |         |         |  ADDITIONAL Name           |
  |                         |         |         |            =NS4.example.org |
  |<------------------------|         |         |  ADDITIONAL Address        |
  |4.Standard query response|         |         |            =192.168.1.40   |
  |  QNAME=A.example.org    |         |         |                            |
  |  QTYPE=A                |         |         |                            |
  |  ANSWER Name            |         |         |                            |
  |        =A.example.org   |         |         |                            |
  |  ANSWER Address         |         |         |                            |
  |        =192.168.1.10    |         |         |                            |
  |  AUTHORITY Name         |         |         |                            |
  |        =example.org     |         |         |                            |
  |  AUTHORITY Name Server  |         |         |                            |
  |        =NS4.example.org |         |         |                            |
  |                         |         |         |                            |
  v                         v         v         v                            v

  1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
  2. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS3.example.org)
     (Judgment *2)
  3. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10 to NUT.
  4. NUT transmits query response to DNS Client1 (TN) (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53

DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	1
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Standard query including QNAME=A.example.org, QTYPE=A (recursion desired) must be based on above Verification Points.
4. Received standard query response including correct address in the ADDRESS field.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  4.3.1. Queries and responses
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  4.1.1. Header section format

5.35. The answer with CNAME to the query

Purpose

Verify that a NUT answers with CNAME to the query, possibly preface by one or more CNAME RRs that specify aliases encountered on the way to an answer.

Category

Server

Initialization

- **Network Topology**
  Refer the topology "Fig.2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Enable recursive mode.

  Example of root server list:

```
For IPv4:
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                A       192.168.1.20

For IPv6
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000        AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
A        IN       A        192.168.1.10
```

Procedure

This test sequence is following.

```
                                                <---------- TN ------------->
                                                DNS Server2       DNS Server4
DNS Client1 (TN)     DNS Server1 (NUT)                   |   DNS Server3    |
 |-------------------------->|                           |          |       |
 |1.Send standard query      |                           |          |       |
 |  RD = 1                   |                           |          |       |
 |  QNAME = B.example.org    |                           |          |       |
 |  QTYPE = A                |                           |          |       |
 |                           |----------------------------->|       |       |
 |                           |2.Recv standard query      |          |       |
 |                           |  QNAME = B.example.org    |          |       |
 |                           |  QTYPE = A                |          |       |
 |                           |<-----------------------------|       |       |
 |                           |3.Send standard query response|       |       |
 |                           |  QNAME = B.example.org    |          |       |
 |                           |  QTYPE = A                |          |       |
 |                           |  AUTHORITY Name= org      |          |       |
 |                           |  AUTHORITY Nsdname        |          |       |
 |                           |         = NS3.example.org |          |       |
 |                           |  ADDITIONAL Name          |          |       |
 |                           |         = NS3.example.org |          |       |
 |                           |  ADDITIONAL Address       |          |       |
 |                           |         = 192.168.1.30    |          |       |
 |                           |                           v          |       |
 |                           |------------------------------------>|       |
 |                           |         4.Recv standard query        |       |
 |                           |           QNAME = B.example.org      |       |
 |                           |           QTYPE = A                  |       |
 |                           |<-------------------------------------|       |
 |                           |         5.Send standard query response |     |
 |                           |           QNAME = B.example.org      |       |
 |                           |           QTYPE = A                  |       |
 |                           |           AUTHORITY Name = example.org |     |
 |                           |           AUTHORITY Nsdname          |       |
 |                           |                 = NS4.example.org    |       |
 |                           |           ADDITIONAL Name            |       |
 |                           |                 = NS4.example.org    |       |
 |                           |           ADDITIONAL Address         |       |
 |                           |                 = 192.168.1.40       |       |
 |                           |                                      v       |
 |                           |----------------------------------------------->|
 |                           |                   6.Recv standard query        |
 |                           |                     QNAME = B.example.org      |
 |                           |                     QTYPE = A                  |
```

```
 |                         |<-----------------------------------------------|
 |                         |                    7.Send standard query response|
 |                         |                      AA = 1                      |
 |                         |                      QNAME = B.example.org       |
 |                         |                      QTYPE = A                   |
 |                         |                      ANSWER Name = B.example.org |
 |                         |                      ANSWER Type = CNAME         |
 |                         |                      ANSWER Primary Name         |
 |                         |                             = A.example.org      |
 |                         |                      ANSWER Name = A.example.org |
 |                         |                      ANSWER Type = A             |
 |                         |                      ANSWER Address              |
 |                         |                             = 192.168.1.10       |
 |                         |                      AUTHORITY Name = example.org|
 |                         |                      AUTHORITY Nsdname           |
 |                         |                             = NS4.example.org    |
 |                         |                      ADDITIONAL Name             |
 |                         |                             = NS4.example.org    |
 |                         |                      ADDITIONAL Address          |
 |                         |                             = 192.168.1.40       |
 |<------------------------|                                                  v
 |8.Standard query response |
 |  RD = 1                 |
 |  RA = 1                 |
 |  QNAME = B.example.org  |
 |  QTYPE = B              |
 |  ANSWER Name            |
 |        = B.example.org  |
 |  ANSWER Type = CNAME    |
 |  ANSWER Primary Name    |
 |        = A.example.org  |
 |  ANSWER Name            |
 |        = A.example.org  |
 |  ANSWER Type = A        |
 |  ANSWER Address         |
 |        = 192.168.1.10   |
 |  AUTHORITY Name         |
 |        = example.org    |
 |  AUTHORITY Name Server  |
 |        = NS4.example.org |
 |  ADDITIONAL Name        |
 |        = NS4.example.org |
 |  ADDITIONAL Address     |
 |        = 192.168.1.40   |
 v                         v
```

This test sequence is following.

1. DNS Client1 (TN) send standard query QNAME=B.example.com, QTYPE=A to NUT.
2. DNS Server1 (NUT) transmits standard query to DNS Server1 (TN). (Judgment *2)
5. DNS Server2 (TN) send standard query response to DNS Server1 (NUT).
4. DNS Server1 (NUT) transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server3 (TN).
5. DNS Server3 (TN) send standard query response to DNS Server1 (NUT).
6. DNS Server1 (NUT) transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server4 (TN).
7. DNS Server4 (TN) send standard query response witch ANSWER Type=CNAME to DNS Server1 (NUT).
8. DNS Server1 (NUT) transmits standard query response with ANSWER Type=CNAME to DNS Client1 (TN).(Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	Primary Name	A.example.org (A + Pointer 0xC00E)
DNS Answer section	NAME	A.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4

	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	Primary Name	A.example.org (Pointer 0xC00E)
DNS Answer section	NAME	A.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)

DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query to recursive.
8. Received standard query response from which RA bit is set and including CNAME.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
4. NAME SERVERS
4.3.1. Queries and responses

5.36. A name error indicating that the name does not exist

Purpose

Verify that a NUT answers a name error indicating that the name does not exist. This may include CNAME RRs that indicate that the original query name was an alias for a name which does not exist.

Category

Server

Initialization

- **Network Topology**
  Refer the topology "Fig.2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Enable recursive mode.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
A        IN       A        192.168.1.10
```

Procedure

This test sequence is following.

```
                                                <---------- TN ------------->
                                                DNS Server2       DNS Server4
DNS Client1 (TN)     DNS Server1 (NUT)                   |   DNS Server3    |
 |------------------------->|                            |         |        |
 |1.Send standard query     |                            |         |        |
 |  RD = 1                  |                            |         |        |
 |  QNAME = D.example.org   |                            |         |        |
 |  QTYPE = A               |                            |         |        |
 |                          |----------------------------->|       |        |
 |                          |2.Recv standard query       |         |        |
 |                          |  QNAME = D.example.org     |         |        |
 |                          |  QTYPE = A                 |         |        |
 |                          |<-----------------------------|       |        |
 |                          |3.Send standard query response|       |        |
 |                          |  QNAME = D.example.org     |         |        |
 |                          |  QTYPE = A                 |         |        |
 |                          |  AUTHORITY Name= org       |         |        |
 |                          |  AUTHORITY Nsdname         |         |        |
 |                          |         = NS3.example.org  |         |        |
 |                          |  ADDITIONAL Name           |         |        |
 |                          |         = NS3.example.org  |         |        |
 |                          |  ADDITIONAL Address        |         |        |
 |                          |         = 192.168.1.30     |         |        |
 |                          |                            v         |        |
 |                          |---------------------------------------->|     |
 |                          |         4.Recv standard query        |        |
 |                          |           QNAME = D.example.org      |        |
 |                          |           QTYPE = A                  |        |
 |                          |<----------------------------------------|     |
 |                          |         5.Send standard query response |      |
 |                          |           QNAME = D.example.org      |        |
 |                          |           QTYPE = A                  |        |
 |                          |           AUTHORITY Name = example.org |      |
 |                          |           AUTHORITY Nsdname          |        |
 |                          |                 = NS4.example.org    |        |
 |                          |           ADDITIONAL Name            |        |
 |                          |                 = NS4.example.org    |        |
 |                          |           ADDITIONAL Address         |        |
 |                          |                 = 192.168.1.40       |        |
 |                          |                                      v        |
 |                          |------------------------------------------------>|
 |                          |                   6.Recv standard query        |
 |                          |                     QNAME = D.example.org      |
 |                          |                     QTYPE = A                  |
```

```
 |                          |<-----------------------------------------------|
 |                          |                    7.Send standard query response|
 |                          |                      AA = 1                      |
 |                          |                      RCODE = Name Error (3)      |
 |                          |                      QNAME = D.example.org       |
 |                          |                      QTYPE = A                   |
 |                          |                      ANSWER Name = D.example.org |
 |                          |                      ANSWER Type = CNAME         |
 |                          |                      ANSWER Primary Name         |
 |                          |                             = C.example.org      |
 |                          |                      AUTHORITY Name = example.org|
 |                          |                      AUTHORITY Nsdname           |
 |                          |                             = NS4.example.org    |
 |                          |                      AUTHORITY Type              |
 |                          |                             = SOA (0x0006)       |
 |                          |                      AUTHORITY Mname             |
 |                          |                             = NS4.example.org    |
 |                          |                      AUTHORITY Rname             |
 |                          |                         = postmaster.example.org |
 |                          |                                               v
 |<-------------------------|
 |8.Standard query response |
 |  RD = 1                  |
 |  RA = 1                  |
 |  RCODE = Name Error (3)  |
 |  QNAME = D.example.org   |
 |  QTYPE = A               |
 |  ANSWER Name             |
 |        = D.example.org   |
 |  ANSWER Type = CNAME     |
 |  ANSWER Primary Name     |
 |        = C.example.org   |
 |  AUTHORITY Name          |
 |        = example.org     |
 |  AUTHORITY Nsdname       |
 |        = NS4.example.org |
 |  AUTHORITY Type          |
 |        =SOA (0x0006)     |
 |  AUTHORITY Mname         |
 |        = NS4.example.org |
 |  AUTHORITY Rname         |
 |  = postmaster.example.org|
 v                          v

This test sequence is following.
 1. DNS Client1 (TN) send standard query QNAME=D.example.com, QTYPE=A to NUT.
 2. DNS Server1 (NUT) transmits standard query to DNS Server1 (TN). (Judgment *2)
 5. DNS Server2 (TN) send standard query response to DNS Server1 (NUT).
 4. DNS Server1 (NUT) transmits standard query QNAME=D.example.org, QTYPE=A to DNS Server3 (TN).
 5. DNS Server3 (TN) send standard query response to DNS Server1 (NUT).
 6. DNS Server1 (NUT) transmits standard query QNAME=D.example.org, QTYPE=A to DNS Server4 (TN).
 7. DNS Server4 (TN) send a error response witch RCODE=3 (Name Error), ANSWER Name=D.example.org and
    TYPE=CNAME to DNS Server1 (NUT).
 8. DNS Server1 (NUT) transmits error response RCODE=3 to DNS Client1 (TN). It may include ANSWER
    Type=CNAME. (Judgment *8)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	D.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	ANY
DNS Question section	QNAME	D.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	D.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	D.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	D.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	D.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	D.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	D.example.org (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	Primary Name	C.example.org (C + Pointer 0xC00E)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	39
	MNAME	NS4.example.org (NS4 + Pointer 0xC00E)
	RNAME	postmaster.example.org (postmaster + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hr (3600)
	RETRY	5 min (300)
	EXPIRE	1 week (604800)
	MINIMUM	1 hr (3600)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ

UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	**1**
	Z	ANY
	RCODE	**3**
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	ANY
DNS Question section	QNAME	D.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	D.example.org (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	Primary Name	C.example.org (C + Pointer 0xC00E)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	39
	MNAME	NS4.example.org (NS4 + Pointer 0xC00E)
	RNAME	postmaster.example.org (postmaster + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hr (3600)
	RETRY	5 min (300)
	EXPIRE	1 week (604800)
	MINIMUM	1 hr (3600)

- **Termination**

  None

Judgment

2. Received a standard query to recursive.
8. Received a error response from which RCODE is 3 and may include ANSWER type=CNAME.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
4. NAME SERVERS
4.3.1. Queries and responses

5.37. A name error indicating

Purpose

Verify that a NUT answers a temporary error indicating that the name server got a temporary error response.

Category

Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 11 Topology No.11".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Enable recursive mode.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
A        IN       A        192.168.1.10
```

Procedure

This test sequence is following.

```
                                                          <--- TN --->
    DNS Client1 (TN)            DNS Server1 (NUT)             DNS Server2
        |                           |                              |
        |---------------------------->|                              |
        | 1. Send standard query    |                              |
        |  RD = 1                   |                              |
        |  QNAME = B.example.org    |                              |
        |  QTYPE = A                |                              |
        |                           |------------------------------->|
        |                           | 2. Recv standard query       |
        |                           |  QNAME = B.example.org       |
        |                           |  QTYPE = A                   |
        |                           |               X<-------------|
        |                           | 3. No standard query response |
        |                           |              :               |
        |                           |         Repeat 2 & 3         |
        |                           |              :               |
        |<----------------------------|                              |
        | 4. Standard query response |
        |  RD = 1                   |
        |  RA = 1                   |
        |  RCODE = Server Failure (2) |
        |  QNAME = B.example.org    |
        |  QTYPE = A                |
        |                           |
        v                           v

    This test sequence is following.

    1. DNS Client1 (TN) send standard query QNAME=B.example.com, QTYPE=A to NUT.
    2. DNS Server1 (NUT) transmits standard query to DNS Server1 (TN). (Judgment *2)
    3. DNS Server2 (TN) doesn't send standard query response.
    4. DNS Server1 (NUT) transmits error response RCODE=2 (Server Failure) to DNS Client1 (TN). It may
       include ANSWER Type=CNAME. (Judgment *8)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1

	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	**1**
	Z	ANY
	RCODE	**2**
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received a standard query to recursive.
4. Received a error response from which RCODE is 2.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
4. NAME SERVERS
4.3.1. Queries and responses

5.38. The non-recursive response is an authoritative name error indicating that the name does not exist.

Purpose

Verify that the non-recursive response is an authoritative name error indicating that the name does not exist, when recursive service is not requested or is not available.

Category

Server (Non-recursive)

Initialization

- **Network Topology**
  Refer the topology "Fig. 12 Topology No.12".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Enable **non-recursive** mode

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL  86400             ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600        ; serial
      3600              ; refresh every 1 hr
      900               ; retry every 15 min
      604800            ; expire after a week
      3600              ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
NS1      IN        A         192.168.0.10
;
A        IN        A         192.168.1.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                  DNS Server1 (NUT)
        |                                  |
        |------------------------------------->|
        | 1. Send standard query             |
        |  RD = 1                            |
        |  QNAME = B.example.com             |
        |  QTYPE = A                         |
        |<-------------------------------------|
        | 2. Standard query response         |
        |  RD = 1                            |
        |  RA = 0                            |
        |  RCODE = Name Error (3)            |
        |  QNAME = B.example.com             |
        |  QTYPE = A                         |
        |  AUTHORITY Name = example.com      |
        |  AUTHORITY Nsdname = NS1.example.com|
        |  AUTHORITY Type = SOA (0x0006)     |
        |  AUTHORITY Mname = NS1.example.com |
        |  AUTHORITY Rname = root.example.com |
        |------------------------------------->|
        | 3. Send standard query             |
        |  RD = 0                            |
        |  QNAME = B.example.com             |
        |  QTYPE = A                         |
        |<-------------------------------------|
        | 4. Standard query response         |
        |  RD = 0                            |
        |  RA = 0                            |
        |  RCODE = Name Error (3)            |
        |  QNAME = B.example.com             |
        |  QTYPE = A                         |
        |  AUTHORITY Name = example.com      |
        |  AUTHORITY Nsdname = NS1.example.com|
        |  AUTHORITY Type =SOA (0x0006)      |
        |  AUTHORITY Mname = NS1.example.com |
        |  AUTHORITY Rname = root.example.com |
        |                                    |
        v                                    v

    This test sequence is following.

    1. DNS Client1 (TN) sends standard query QNAME=A.example.com, QTYPE=A to DNS Server1 (NUT).
    2. DNS Server1 (NUT) transmits a error response to DNS Client1 (TN) with AUTHORITY. (Judgment *2)
    3. DNS Client1 (TN) sends standard query QNAME=A.example.com, QTYPE=A to DNS Server1 (NUT).
    4. DNS Server1 (NUT) transmits a error response to DNS Client1 (TN) with AUTHORITY. (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ

UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	**1**
	RA	**0**
	Z	ANY
	RCODE	**3**
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority	NAME	example.com (Pointer 0xC00E)

section	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	39
	MNAME	NS1.example.com (NS1 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hr (3600)
	RETRY	5 min (300)
	EXPIRE	1 week (604800)
	MINIMUM	1 hr (3600)

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x2000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x2000

	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	**0**
	RA	**0**
	Z	ANY
	RCODE	**3**
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	39
	MNAME	NS1.example.com (NS1 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hr (3600)
	RETRY	5 min (300)
	EXPIRE	1 week (604800)
	MINIMUM	1 hr (3600)

- Termination
  None

Judgment

2. Received an authoritative error response with RD=1, RA=0 and RCODE=3.
4. Received an authoritative error response with RD=0, RA=0 and RCODE=3.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
4. NAME SERVERS
4.3.1. Queries and responses

5.39. Recursion service is available and requested via the RD bit in the query

Purpose

Verify that whether NUT's behavior. Recursion service is available but not requested via the RD bit in the query. Search the available zones for the zone which is the nearest ancestor to QNAME. Such a zone is found and the whole of QNAME is matched, the data at the node is a CNAME, and QTYPE doesn't match CNAME case.

Category

Server

Initialization

- **Network Topology**
  Refer the topology "Fig.10 Topology No.10".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Enable **recursive** mode.

  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20

For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL  86400               ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600          ; serial
      3600                ; refresh every 1 hr
      900                 ; retry every 15 min
      604800              ; expire after a week
      3600                ; Minimum TTL of a 1 hr
)
;
        IN      NS      NS1.example.com.
NS1      IN     A       192.168.0.10
```

```
;
A        IN      A        192.168.1.10
B        IN      CNAME    A.example.com.
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                        |
    |---------------------------------------->|
    | 1. Send standard query                 |
    |  RD = 0                                |
    |  QNAME = B.example.com                 |
    |  QTYPE = A                             |
    |<----------------------------------------|
    | 2. Standard query response             |
    |  RD = 0                                |
    |  RA = 1                                |
    |  AA = 1                                |
    |  QNAME = B.example.com                 |
    |  QTYPE = A                             |
    |  ANSWER Name = B.example.com           |
    |  ANSWER Type = CNAME (0x0005)          |
    |  ANSWER Primary Name = A.example.com   |
    |  ANSWER Name = A.example.com           |
    |  ANSWER Type = A (0x0001)              |
    |  ANSWER Address = 192.168.1.10         |
    |  AUTHORITY Name = example.com          |
    |  AUTHORITY Type = NS (0x0002)          |
    |  AUTHORITY Name Server = NS1.example.com|
    |  ADDITIONAL Name = NS1.example.com     |
    |  ADDITIONAL Type = A (0x0001)          |
    |  ADDITIONAL Address = 192.168.0.10     |
    |                                        |
    v                                        v

1. DNS Client1 (TN) send standard query QNAME=B.example.com with RD=0 to DNS Server1 (NUT).
2. DNS Server1 (NUT) transmits standard query response from which RA bit is set to DNS Client1 (TN).
   (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0

	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	**0**
	RA	**1**
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.com (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	Primary Name	A.example.com (A + Pointer 0xC00E)

DNS Answer section	NAME	A.example.com (Pointer 0xC031)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	Address	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC053)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response from which RA bit is set and CNAME is included in Answer.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
4. NAME SERVERS
4.3.2. Algorithm

5.40. The data at the node is not CNAME or CNAME and QTYPE match CNAME.

Purpose

Verify that whether NUT's behavior. Recursion service is available but not requested via the RD bit in the query. Search the available zones for the zone which is the nearest ancestor to QNAME. Such a zone is found and the whole of QNAME is matched, the data at the node is not a CNAME, or the node is a CNAME and QTYPE match CNAME case.

Category

Server

Initialization

- **Network Topology**
  Refer the topology "Fig.10 Topology No.10".
  AP server1 has a domain name "A.example.com".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.
  Enable **recursive** mode.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20
For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL  86400             ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600        ; serial
      3600              ; refresh every 1 hr
      900               ; retry every 15 min
      604800            ; expire after a week
      3600              ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
NS1      IN        A         192.168.0.10
;
A        IN        A         192.168.1.10
```

```
        IN          AAAA        3ffe:501:ffff:101::10
C       IN          CNAME       A.example.com.
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
      |                                       |
      |---------------------------------------->|
      | 1. Send standard query                |
      |  RD = 0                               |
      |  QNAME = A.example.com                |
      |  QTYPE = ANY (0x00FF)                 |
      |<----------------------------------------|
      | 2. Standard query response            |
      |  RD = 0                               |
      |  RA = 1                               |
      |  AA = 1                               |
      |  QNAME = A.example.com                |
      |  QTYPE = A                            |
      |  ANSWER Name = A.example.com          |
      |  ANSWER Type = A (0x0001)             |
      |  ANSWER Address = 192.168.1.10        |
      |  ANSWER Name = A.example.com          |
      |  ANSWER Type = AAAA (0x001C)          |
      |  ANSWER Address = 3ffe:501:ffff:101::10 |
      |  AUTHORITY Name = example.com         |
      |  AUTHORITY Type = NS (0x0002)         |
      |  AUTHORITY Name Server = NS1.example.com|
      |  ADDITIONAL Name = NS1.example.com    |
      |  ADDITIONAL Type = A (0x0001)         |
      |  ADDITIONAL Address = 192.168.0.10    |
      |---------------------------------------->|
      | 3. Send standard query                |
      |  RD = 0                               |
      |  QNAME = C.example.com                |
      |  QTYPE = CNAME (0x0005)               |
      |<----------------------------------------|
      | 4. Standard query response            |
      |  RD = 0                               |
      |  RA = 1                               |
      |  AA = 1                               |
      |  QNAME = C.example.com                |
      |  QTYPE = A                            |
      |  ANSWER Name = C.example.com          |
      |  ANSWER Type = CNAME (0x0005)         |
      |  ANSWER Primary Name = A.example.com  |
      |  AUTHORITY Name = example.com         |
      |  AUTHORITY Type = NS (0x0002)         |
      |  AUTHORITY Name Server = NS1.example.com|
      |  ADDITIONAL Name = NS1.example.com    |
      |  ADDITIONAL Type = A (0x0001)         |
      |  ADDITIONAL Address = 192.168.0.10    |
      v                                       v
1. DNS Client1 (TN) send standard query QNAME=A.example.com, QTYPE=ANY with RD=0 to DNS Server1 (NUT).
2. DNS Server1 (NUT) transmits standard query response all RRs that match QTYPE to DNS Client1 (TN). (Judgment *2)
3. DNS Client1 (TN) send standard query QNAME=C.example.com, QTYPE=CNAME with RD=0 to DNS Server1 (NUT).
4. DNS Server1 (NUT) transmits standard query response all RRs that match QTYPE to DNS Client1 (TN). (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	ANY (0x00FF)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	**0**
	RA	**1**
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1

	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	ANY (0x00FF)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	Address	192.168.1.10
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	Address	3ffe:501:ffff:101::10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC058)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x2000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	C.example.com
	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x2000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	**0**
	RA	**1**
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	C.example.com
	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	C.example.com (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	CNAME	A.example.com (Pointer 0xC00C)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC041)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response which include all RRs in Answer section.
4. Received standard query response which include CNAME in Answer section.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
4. NAME SERVERS
4.3.2. Algorithm

5.41. And QNAME is found in the cache

Purpose

Verify that whether NUT's following behavior.
Recursion service is available but not requested via the RD bit in the query. Search the available zones for the zone which is the nearest ancestor to QNAME. Such a zone is found. A match take QNAME out of the authoritative data, QNAME has a referral. Copy the NS RRs for the subzone into the authority section of the reply. Start matching down in the cache. And QNAME is found in the cache. Copy all RRs attached to it that match QTYPE into the answer section.

Category

Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 13 Topology No.13".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Enable **recursive** mode.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
```

```
NS1       IN      A        192.168.0.10
;
sub       IN      NS       NS6.sub.example.com.
NS6.sub   IN      A        192.168.0.30
          IN      AAAA     3ffe:501:ffff:100::30
;
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)            DNS Server1 (NUT)              DNS Server6 (TN)
    |                            |                                |
    |----------------------------->|                               |
    | 1. Send standard query     |                                |
    |  RD = 1                    |                                |
    |  QNAME = A.sub.example.com |                                |
    |  QTYPE = A                 |                                |
    |                            |-------------------------------->|
    |                            | 2. Recv standard query         |
    |                            |  QNAME = A.sub.example.com     |
    |                            |  QTYPE = A                     |
    |                            |<--------------------------------|
    |                            | 3. Send standard query response |
    |                            |  QNAME = A.sub.example.com     |
    |                            |  QTYPE = A                     |
    |                            |  ANSWER Name = A.sub.example.com|
    |                            |  ANSWER Type = A (0x0001)      |
    |                            |  ANSWER Address = 192.168.1.10  |
    |                            |  AUTHORITY Name =sub.example.com|
    |                            |  AUTHORITY Type = NS (0x0002)   |
    |                            |  AUTHORITY Name Server         |
    |                            |        = NS6.sub.example.com   |
    |                            |                                v
    |<----------------------------|
    | 4. Standard query response |
    |  AA = 0                    |
    |  RD = 1                    |
    |  RA = 1                    |
    |  QNAME = A.sub.example.com |
    |  QTYPE = A                 |
    |  ANSWER Name               |
    |        = A.sub.example.com |
    |  ANSWER Type = A (0x0001)  |
    |  ANSWER Address =192.168.1.10|
    |  AUTHORITY Name            |
    |        = sub.example.com   |
    |  AUTHORITY Type = NS (0x0002)|
    |  AUTHORITY Name Server     |
    |        = NS6.sub.example.com |
    |                            |
    |        Wait 5 sec.         |
    |                            |
    |----------------------------->|
    | 5. Send standard query     |
    |  RD = 1                    |
    |  QNAME = A.sub.example.com |
    |  QTYPE = A                 |
```

```
|<----------------------------|
| 6. Standard query response   |
|  AA = 0                      |
|  RD = 1                      |
|  RA = 1                      |
|  QNAME = A.sub.example.com   |
|  QTYPE = A                   |
|  ANSWER Name                 |
|        = A.sub.example.com   |
|  ANSWER Type = A (0x0001)    |
|  ANSWER Address =192.168.1.10|
|  AUTHORITY Name              |
|        = sub.example.com     |
|  AUTHORITY Type = NS (0x0002)|
|  AUTHORITY Name Server       |
|        = NS6.sub.example.com |
v                              v
```

This test sequence is following.

1. DNS Client1 (TN) send standard query QNAME=A.sub.example.com, QTYPE=A with RD=1 to NUT.
2. DNS Server1 (NUT) transmits standard query QNAME=A.sub.example.com to DNS Server6 (TN).
3. DNS Server6 (TN) send standard query response to DNS Server1 (NUT).
4. DNS Server1 (NUT) transmits standard query response to DNS Client1 (TN). (Judgment *4)
5. Again, DNS Client1 (TN) send standard query QNAME=A.sub.example.com, QTYPE=A with RD=0 to NUT.
6. DNS Server1 (NUT) transmits standard query response from cache to DNS Client1 (TN). (Judgment *6)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.sub.example.com

	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV6_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.sub.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV6_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.sub.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.sub.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	Address	192.168.1.10
DNS Authority section	NAME	sub.example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS6.sub.example.com (NS6 + Pointer 0xC00E)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	**0**
	TC	0
	RD	**1**
	RA	**1**
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	A.sub.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.sub.example.com (Pointer 0xC00C)

	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	Address	192.168.1.10
DNS Authority section	NAME	sub.example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS6.sub.example.com (NS6 + Pointer 0xC00E)

5th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x2000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.sub.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000

	QR	1
	OPCODE	0
	AA	**0**
	TC	0
	RD	**0**
	RA	**1**
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	A.sub.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.sub.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	Less than 1 day (86400)
	RDLENGTH	4
	Address	192.168.1.10
DNS Authority section	NAME	sub.example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	Less than 1 day (86400)
	RDLENGTH	6
	NSDNAME	NS6.sub.example.com (NS6 + Pointer 0xC00E)

- Termination
  None

Judgment

4. Received standard query response which includes answer section and authority section.
6. Received standard query response which includes answer section and authority section from cache.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
4. NAME SERVERS
4.3.2. Algorithm

5.42. And QNAME is not found in the cache

Purpose

Verify that whether NUT's following behavior.

Recursion service is available but not requested via the RD bit in the query. Search the available zones for the zone which is the nearest ancestor to QNAME. Such a zone is found. A match take QNAME out of the authoritative data, QNAME has a referral. Copy the NS RRs for the subzone into the authority section of the reply. Starting matching down in the cache. And QNAME is not found in the cache.

Category

Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 14 Topology No.14".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology. Configure the Server1's (NUT) zone file to response query from TN.

  Enable **recursive** mode.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL  86400             ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600        ; serial
      3600              ; refresh every 1 hr
      900               ; retry every 15 min
      604800            ; expire after a week
      3600              ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
```

```
;
sub       IN      NS      NS6.sub.example.com.
NS6.sub   IN      A       192.168.0.30
          IN      AAAA    3ffe:501:ffff:100::30
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                              |
    |--------------------------------------------->|
    | 1. Send standard query                       |
    |  RD = 0                                      |
    |  QNAME = A.sub.example.com                   |
    |  QTYPE = A                                   |
    |<---------------------------------------------|
    | 2. Standard query response                   |
    |  AA = 0                                      |
    |  RD = 0                                      |
    |  RA = 1                                      |
    |  QNAME = A.sub.example.com                   |
    |  QTYPE = A                                   |
    |  AUTHORITY Name = sub.example.com            |
    |  AUTHORITY Type = NS (0x0002)                |
    |  AUTHORITY Name Server = NS6.sub.example.com|
    |  ADDITIONAL Name = NS6.sub.example.com       |
    |  ADDITIONAL Type = A (0x0001)                |
    |  ADDITIONAL Address = 192.168.0.30           |
    |  ADDITIONAL Name = NS6.sub.example.com       |
    |  ADDITIONAL Type = AAAA (0x001C)             |
    |  ADDITIONAL Address = 3ffe:501:ffff:101::30 |
    |                                              |
    v                                              v
```

This test sequence is following.

1. DNS Client1 (TN) send standard query QNAME=A.sub.example.com, QTYPE=A to NUT.
2. DNS Server1 (NUT) transmits error response which include NS RRs in authority section and all glue record of NS RRs in additional section. (Judgment *2)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0

	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.sub.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	**0**
	TC	0
	RD	**0**
	RA	**1**
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	A.sub.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sub.example.com (Pointer 0xC00D)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS6.sub.example.com (NS6 + Pointer 0xC00D)

DNS Additional section	NAME	NS6.sub.example.com (Pointer 0xC02F)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.30
DNS Additional section	NAME	NS6.sub.example.com (Pointer 0xC02F)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::30

- Termination
  None

Judgment

2. Received standard query response which include the NSs RRs in authority section and glue RRs in additional Section.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
4. NAME SERVERS
4.3.2. Algorithm

5.43. The "*" label does not exist, the name is original

Purpose

Verify that whether NUT's following behavior.

Recursion service is available but not requested via the RD bit in the query. Search the available zones for the zone which is the nearest ancestor to QNAME. Such a zone is found. A match is impossible look to see if the "*" label exists. If the "*" label does not exist, check whether the name we are looking for is the original QNAME in the query or a name we have followed due to a CNAME. If the name is original, set an authoritative name error in the response.

Category

Server

Initialization

- **Network Topology**
  Refer the topology "Fig.10 Topology No.10".
  AP server1 has a domain name "A.example.org".
- **Setup**

Set the DNS Server1's (NUT) address as above mentioned Network Topology.
Configure the Server1's (NUT) zone file to response query from TN.

Enable recursive mode.

Example of root server list:

```
For IPv4:
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                A       192.168.1.20

For IPv6
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000        AAAA    3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
```

```
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
A       IN      A       192.168.1.10
B       IN      CNAME   invalid.example.com.
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)            DNS Server1 (NUT)
    |                            |
    |---------------------------->|
    | 1. Send standard query      |
    |  RD = 0                     |
    |  QNAME = C.example.com      |
    |  QTYPE = A                  |
    |<----------------------------|
    | 2. Standard query response  |
    |  RD = 0                     |
    |  RA = 1                     |
    |  AA = 1                     |
    |  RCODE = 3 (NXDOMAIN)       |
    |  QNAME = C.example.com      |
    |  QTYPE = A                  |
    |---------------------------->|
    | 3. Send standard query      |
    |  RD = 0                     |
    |  QNAME = B.example.com      |
    |  QTYPE = A                  |
    |<----------------------------|
    | 4. Standard query response  |
    |  RD = 0                     |
    |  RA = 1                     |
    |  AA = 1                     |
    |  RCODE = 3 (NXDOMAIN)       |
    |  QNAME = B.example.com      |
    |  QTYPE = A                  |
    |  ANSWER Name = B.example.com |
    |  ANSWER Type = CNAME (0x0005)|
    |  ANSWER Primary Name        |
    |         = invalid.example.com|
    v                            v

1. DNS Client1 (TN) send standard query QNAME=C.example.com with RD=0 to DNS Server1 (NUT).
2. DNS Server1 (NUT) transmits standard query response (NXDOMAIN) from which RA bit is set to DNS Client1
   (TN). (Judgment *2)
3. DNS Client1 (TN) send standard query QNAME=B.example.com with RD=0 to DNS Server1 (NUT).
4. DNS Server1 (NUT) transmits standard query response (NXDOMAIN) from which RA bit is set to DNS Client1
   (TN). (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	C.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	**0**
	RA	**1**
	Z	ANY
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1

	ARCOUNT	0
DNS Question section	QNAME	C.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	**0**
	RA	**1**
	Z	ANY
	RCODE	3
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.com (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	10
	CNAME	invalid.example.com (invalid + Pointer 0xC00E)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

- **Termination**
  None

Judgment

2. Received standard query response (NXDOMAIN) from which RA bit is set.
4. Received standard query response (NXDOMAIN) from which RA bit is set.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
4. NAME SERVERS
4.3.2. Algorithm

5.44. Caching wildcards response

Purpose

Verify that a NUT prohibits caching wildcards response

- A * label appearing in a query name has no special effect, but can be used to test for wildcards in an authoritative zone; such a query is the only way to get a response containing RRs with an owner name with * in it. The result of such a query should not be cached.

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig.2 Topology No.2".
  AP server1 has a domain name "mail.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL  86400             ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600        ; serial
      3600              ; refresh every 1 hr
      900               ; retry every 15 min
      604800            ; expire after a week
      3600              ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)    DNS Server1 (NUT)      DNS Server2 (TN)          DNS Server3 (TN)     DNS Server4 (TN)
 |                  |                      |                         |                    |
 |----------------->|                      |                         |                    |
 |1.Send standard query                    |                         |                    |
 | QNAME =*.example.org                    |                         |                    |
 | QTYPE=MX                                |                         |                    |
 |                  |----------------------->|                        |                    |
 |                  |2.Send standard query  |                         |                    |
 |                  | QNAME=*.example.org   |                         |                    |
 |                  | QTYPE=MX              |                         |                    |
 |                  |<-----------------------|                        |                    |
 |                  |3.Send standard response|                        |                    |
 |                  | QNAME=*.example.org   |                         |                    |
 |                  | QTYPE= MX             |                         |                    |
 |                  | AUTHORITY Name=org    |                         |                    |
 |                  | AUTHORITY Name Server |                         |                    |
 |                  |      =NS3.example.org |                         |                    |
 |                  | ADDITIONAL Name       |                         |                    |
 |                  |      =NS3.example.org |                         |                    |
 |                  | ADDITIONAL Address    |                         |                    |
 |                  |      =192.168.1.30    |                         |                    |
 |                  |------------------------------------------------------>|                |
 |                  |                      |4.Send standard query    |                    |
 |                  |                      | QNAME=*.example.org     |                    |
 |                  |                      | QTYPE=MX                |                    |
 |                  |<------------------------------------------------------|                |
 |                  |                      |5.Send standard response|                    |
 |                  |                      | QNAME=*.example.org     |                    |
 |                  |                      | QTYPE=MX                |                    |
 |                  |                      | AUTHORITY Name          |                    |
 |                  |                      |      =example.org       |                    |
 |                  |                      | AUTHORITY Name Server   |                    |
 |                  |                      |      =NS4.example.org   |                    |
 |                  |                      | ADDITIONAL Name         |                    |
 |                  |                      |      =NS4.example.org   |                    |
 |                  |                      | ADDITIONAL Address      |                    |
 |                  |                      |      =192.168.1.40      |                    |
 |                  |-------------------------------------------------------------------------->|
 |                  |                      |                         |6.Send standard query |
 |                  |                      |                         | QNAME=*.example.org  |
 |                  |                      |                         | QTYPE=MX             |
 |                  |<--------------------------------------------------------------------------|
 |                  |                      |                         |7.Send standard response|
 |                  |                      |                         | QNAME=*.example.org  |
 |                  |                      |                         | QTYPE=MX             |
 |                  |                      |                         | ANSWER Name          |
 |                  |                      |                         |      =*.example.org  |
 |                  |                      |                         | ANSWER Preference=10 |
 |                  |                      |                         | ANSWER Exchange      |
 |                  |                      |                         |      =mail.example.org |
 |                  |                      |                         | AUTHORITY Name       |
 |                  |                      |                         |      =example.org    |
 |                  |                      |                         | AUTHORITY Name Server |
 |                  |                      |                         |      =NS4.example.org |
 |                  |                      |                         | ADDITIONAL Name      |
 |                  |                      |                         |      =NS4.example.org |
 |                  |                      |                         | ADDITIONAL Address   |
 |                  |                      |                         |      =192.168.1.40   |
```

```
|<------------------------|                      |                      |                      |
|8.Standard query response|                      |                      |                      |
| QNAME=*.example.org     |                      |                      |                      |
| QTYPE=MX                |                      |                      |                      |
| ANSWER Name             |                      |                      |                      |
|      =*.example.org     |                      |                      |                      |
| ANSWER Preference=10    |                      |                      |                      |
| ANSWER Exchange         |                      |                      |                      |
|      =mail.example.org  |                      |                      |                      |
| AUTHORITY Name          |                      |                      |                      |
|      =example.org       |                      |                      |                      |
| AUTHORITY Name Server   |                      |                      |                      |
|      =NS4.example.org   |                      |                      |                      |
| Additional Name         |                      |                      |                      |
|      = NS4.example.org  |                      |                      |                      |
| Authority address       |                      |                      |                      |
|      =192.168.1.40      |                      |                      |                      |
|------------------------>|                      |                      |                      |
|9.Send Standard query    |                      |                      |                      |
| QNAME=*.example.org     |                      |                      |                      |
| QTYPE=MX                |                      |                      |                      |
|                         |----------------------------------------------------------------->|
|                         |10.Send Standard query |                      |                      |
|                         |  QNAME=*.example.org  |                      |                      |
|                         |  QTYPE=MX             |                      |                      |
v                         v                      v                      v                      v
```

1. TN send standard query QNAME=*.example.org, QTYPE=MX to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=*.example.org, QTYPE=MX to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS3.example.org.
6. NUT transmits standard query QNAME=*.example.org, QTYPE=MX to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=*.example.org, ANSWER Preference=10, EXCHANGE=mail.example.org to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)
9. TN send standard query QNAME=*.example.org, QTYPE=MX to NUT.
10. NUT transmits standard query QNAME=*.example.org, QTYPE=MX to DNS Server4 (TN: NS4.example.org) (Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	*.example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	1
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	*.example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1

	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	*.example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any

	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	*.example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	*.example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	*.example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	*.example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	*.example.org (Pointer 0xC00C)
	TYPE	MX (0x000F)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	9
	PREFERENCE	10
	EXCHANGE	mail.example.org (mail + Pointer 0xC00E)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC040)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	*.example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	*.example.org (Pointer 0xC00C)
	TYPE	MX (0x000F)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	9
	PREFERENCE	10
	EXCHANGE	mail.example.org (mail + Pointer 0xC00E)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03E)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0

DNS Question section	QNAME	*.example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	*.example.org
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=*.example.org, QTYPE=MX.
4. Received standard query including QNAME=*.example.org, QTYPE=MX.
6. Received standard query including QNAME=*.example.org, QTYPE=MX.
8. Received standard query response including correct answer.
10. Received standard query including QNAME=*.example.org, QTYPE=MX.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  4.3.3. Wildcards
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  7.4. Using the cache

5.45. Wildcards is not applied case

Purpose

Verify that a NUT does not apply Wildcard RRs.

Wildcard RRs do not apply:

- When the query is in another zone. That is, delegation cancels the wildcard defaults.
- When the query name or a name between the wildcard domain and the query name is know to exist.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 15 Topology No.15".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL      86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
          2005081600     ; serial
          3600           ; refresh every 1 hr
          900            ; retry every 15 min
          604800         ; expire after a week
          3600           ; Minimum TTL of a 1 hr
)
;
          IN        NS        NS1.example.com.
NS1       IN        A         192.168.0.10
A         IN        A         192.168.1.10
*         IN        MX        10        mail.example.com.
JP        IN        MX        10        JP-mail.example.com.
;
sub       IN        NS        NS6.sub.example.com.
NS6.sub   IN        A         192.168.0.30
;
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                    DNS Server1 (NUT)
    |                                       |
    |-------------------------------------->|
    |   1. Send standard query              |
    |       QNAME=*.example.com             |
    |       QTYPE=MX                        |
    |<--------------------------------------|
    |   2. Standard query response          |
    |   QNAME Name=*.example.com            |
    |   QTYPE=MX                            |
    |   ANSWER Name=*.example.com           |
    |   ANSWER Type=MX                      |
    |   ANSWER Exchange=mail.example.com    |
    |   AUTHORITY Name=example.com          |
    |   AUTHORITY Type=NS                   |
    |   AUTHORITY Nsdname =NS1.example.com  |
    |   ADDITIONAL Name=NS1.example.com     |
    |   ADDITIONAL Type=A                   |
    |   ADDITIONAL Address=192.168.0.10     |
    |-------------------------------------->|
    |   3. Send standard query              |
    |       QNAME=B.example.com             |
    |       QTYPE=MX                        |
    |<--------------------------------------|
    |   4. Standard query response          |
    |   QNAME Name=B.example.com            |
    |   QTYPE=MX                            |
    |   ANSWER Name=B.example.com           |
    |   ANSWER Type=MX                      |
    |   ANSWER Exchange=mail.example.com    |
    |   AUTHORITY Name=example.com          |
    |   AUTHORITY Type=NS                   |
    |   AUTHORITY Nsdname =NS1.example.com  |
    |   ADDITIONAL Name=NS1.example.com     |
    |   ADDITIONAL Type=A                   |
    |   ADDITIONAL Address=192.168.0.10     |
    |-------------------------------------->|
    |   5. Send standard query              |
    |       QNAME=A.example.com             |
    |       QTYPE=MX                        |
    |<--------------------------------------|
    |   6. Standard query response          |
    |   NODATA                              |
    |   QNAME Name=A.example.com            |
    |   QTYPE=MX                            |
    |   AUTHORITY Name=example.com          |
    |   AUTHORITY Type=SOA                  |
    |-------------------------------------->|
    |   7. Send standard query              |
    |       QNAME=example.com               |
    |       QTYPE=MX                        |
    |<--------------------------------------|
    |   8. Standard query response          |
    |   NXDOMAIN                            |
    |   QNAME Name=example.com              |
    |   QTYPE=MX                            |
    |   AUTHORITY Name=example.com          |
    |   AUTHORITY Type=SOA                  |
    v                                       v
```

1. TN send standard query QNAME=*.example.com, QTYPE=MX to NUT.
2. NUT reply query response QNAME=*.example.com, QTYPE=MX, ANSWER Exchange=mail.example.com to TN (Judgment *2)
3. TN send standard query QNAME=B.example.com, QTYPE=MX to NUT.
4. NUT reply query response QNAME=B.example.com, QTYPE=MX, ANSWER Exchange=mail.example.com to TN (Judgment *4)
5. TN send standard query QNAME=A.example.com, QTYPE=MX to NUT.
6. NUT reply query response(NODATA) to TN (Judgment *6)
7. TN send standard query QNAME=example.com, QTYPE=MX to NUT.
8. NUT reply query response(NXDOMAIN) to TN (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	*.example.com
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0

	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	*.example.com
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	*.example.com (Pointer 0xC00C)
	TYPE	MX (0x000F)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	9
	PREFERENCE	10
	EXCHANGE	mail.example.com (mail + Pointer 0xC00E)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC040)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0

	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.com
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.com (Pointer 0xC00C)
	TYPE	MX (0x000F)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	9
	PREFERENCE	10

	EXCHANGE	mail.example.com (mail + Pointer 0xC00E)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC040)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

5th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1002
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53

	Dst Port	2000
DNS Header	ID	0x1002
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

7th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1003
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.com
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1003
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	example.com
	QTYPE	MX (0x000F)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.example.com (root + Pointer 0xC00C)
	SERIAL	2005081600
	REFRESH	1 hour

	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

- Termination
  None

Judgment

2. Received standard query response QNAME=*.example.com, QTYPE=MX, ANSWER Exchange=mail.example.com.
4. Received standard query response QNAME=A.example.com, QTYPE=MX, ANSWER Exchange=mail.example.com.
6. Received standard query response (NODATA).
8. Received standard query response (NXDOMAIN).

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
4.3.3. Wildcards

5.46. Zone maintenance and transfers

Purpose

Verify that a NUT starts zone maintenance and transfers as follows:

- After editing, the administrator signals the master server to load the new zone.
  The other non-master or secondary servers for the zone periodically check for changes (at a selectable interval) and obtain new zone copies when changes have been made.
- To detect changes, secondaries just check the SERIAL field of the SOA for the zone.
- Whenever a new zone is loaded in a secondary, the secondary waits REFRESH seconds before checking with the primary for a new serial.
- If the serial field in the secondary's zone copy is equal to the serial returned by the primary, then no changes have occurred, and the REFRESH interval wait is restarted.

Category

Server (Secondary)

Initialization

- **Network Topology**
  Refer the topology "Fig. 16 Topology No.16".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as secondary server about sec.example.com zone.
  - ✧ disable notify function.

  Example of root server list:

```
For IPv4:
 .                    3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.          3600000               A      192.168.1.20

For IPv6
 .                    3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.          3600000        AAAA   3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL 86400            ; TTL of 1 day
@ IN SOA NS1.example.com. root.example.com. (
```

```
        2005081600          ; serial
        3600                ; refresh every 1 hr
        900                 ; retry every 15 min
        604800              ; expire after a week
        3600                ; Minimum TTL of a 1 hr
)
;
          IN      NS       NS1.example.com.
NS1       IN      A        192.168.0.10
;
A         IN      A        192.168.1.10
```

```
Example of DNS server configuration for secondary:
zone "sec.example.com" {
        type slave;
        masters {192.168.0.31;};
        file "s/sec.example.com";
};
```

Procedure

This test sequence is following.

```
   DNS Client1 (TN)            DNS Server1 (NUT)             DNS Server7 (TN)
        |                            |                             |
        |                            |----------------------------->|
        |                            | 1. Standard query            |
        |                            |  QNAME = sec.example.com     |
        |                            |  QTYPE = SOA (0x0006)        |
        |                            |<-----------------------------|
        |                            | 2. Standard query response   |
        |                            |  QNAME = sec.example.com     |
        |                            |  QTYPE = SOA (0x0006)        |
        |                            |  ANSWER Name= sec.example.com|
        |                            |  ANSWER Type = SOA (0x0006)  |
        |                            |  ANSWER TTL = 300            |
        |                            |  ANSWER Mname                |
        |                            |       = NS7.sec.example.com  |
        |                            |  ANSWER Rname                |
        |                            |       = root.sec.example.com |
        |                            |  ANSWER Serial = 1           |
        |                            |  ANSWER Refresh = 300sec     |
        |                            |  ANSWER Retry = 30sec        |
        |                            |  ANSWER Expire = 600sec      |
        |                            |  ANSWER Minimum = 300sec     |
        |                            |  AUTHORITY Name              |
        |                            |       = sec.example.com      |
        |                            |  AUTHORITY Type = NS (0x0002)|
        |                            |  AUTHORITY Name Server       |
        |                            |       = NS7.sec.example.com  |
        |                            |  ADDITIONAL Name             |
        |                            |       = NS7.sec.example.com  |
        |                            |  ADDITIONAL Type = A (0x0001)|
        |                            |  ADDITIONAL Address          |
        |                            |       = 192.168.0.31         |
```

```
|                                |----------------------------->|
|                                | 3. Standard query (using TCP)|
|                                |  QNAME = sec.example.com     |
|                                |  QTYPE = AXFR (0x00FC)       |
|                                |<-----------------------------|
|                                | 4. Standard query response   |
|                                |   (using TCP)                |
|                                |  QNAME = sec.example.com     |
|                                |  QTYPE = AXFR (0x00FC)       |
|                                |  ANSWER Name= sec.example.com|
|                                |  ANSWER Type = SOA (0x0006)  |
|                                |  ANSWER TTL = 300            |
|                                |  ANSWER Mname                |
|                                |       = NS7.sec.example.com  |
|                                |  ANSWER Rname                |
|                                |       = root.sec.example.com |
|                                |  ANSWER Serial = 1           |
|                                |  ANSWER Refresh = 300sec     |
|                                |  ANSWER Retry = 30sec        |
|                                |  ANSWER Expire = 600sec      |
|                                |  ANSWER Minimum = 300sec     |
|                                |  ANSWER Name =sec.example.com|
|                                |  ANSWER Type = NS (0x0002)   |
|                                |  ANSWER Name                 |
|                                |       = NS7.sec.example.com  |
|                                |  ANSWER Name                 |
|                                |       = CL2.sec.example.com  |
|                                |  ANSWER Type = A (0x0001)    |
|                                |  ANSWER Address =192.168.0.21|
|                                |  ANSWER Name                 |
|                                |       = CL2.sec.example.com  |
|                                |  ANSWER Type = AAAA (0x001C) |
|                                |  ANSWER Address              |
|                                |      = 3ffe:501:ffff:100::21 |
|                                |  ANSWER Name                 |
|                                |       = NS7.sec.example.com  |
|                                |  ANSWER Type = A (0x0001)    |
|                                |  ANSWER Address =192.168.0.31|
|                                |  ANSWER Name                 |
|                                |       = NS7.sec.example.com  |
|                                |  ANSWER Type = AAAA (0x001C) |
|                                |  ANSWER Address              |
|                                |      = 3ffe:501:ffff:100::31 |
|                                |  ANSWER Name                 |
|                                |       = sec.example.com      |
|                                |  ANSWER Type = SOA (0x0006)  |
|                                |  ANSWER TTL = 300            |
|                                |  ANSWER Mname                |
|                                |       = NS7.sec.example.com  |
|                                |  ANSWER Rname                |
|                                |       = root.sec.example.com |
|                                |  ANSWER Serial = 1           |
|                                |  ANSWER Refresh = 300sec     |
|                                |  ANSWER Retry = 30sec        |
|                                |  ANSWER Expire = 600sec      |
|                                |  ANSWER Minimum = 300sec     |
```

```
|----------------------------->|                              |
| 5. Send standard query       |                              |
|  RD = 0                      |                              |
|  QNAME = CL2.sec.example.com |                              |
|  QTYPE = A                   |                              |
|<-----------------------------|                              |
| 6. Standard query response   |                              |
|  AA = 0                      |                              |
|  RD = 0                      |                              |
|  RA = 1                      |                              |
|  QNAME = CL2.sec.example.com |                              |
|  QTYPE = A                   |                              |
|  ANSWER Name                 |                              |
|        = CL2.sec.example.com |                              |
|  ANSWER Type = A (0x0001)    |                              |
|  ANSWER Address =192.168.0.21|                              |
|  AUTHORITY Name              |                              |
|        = sec.example.com     |                              |
|  AUTHORITY Type = NS (0x0002)|                              |
|  AUTHORITY Name Server       |                              |
|        = NS7.sec.example.com |                              |
|  ADDITIONAL Name             |                              |
|        = NS7.sec.example.com |                              |
|  ADDITIONAL Type = A (0x0001)|                              |
|  ADDITIONAL Address          |                              |
|        = 192.168.0.31        |                              |
|  ADDITIONAL Name             |                              |
|        = NS7.sec.example.com |                              |
|  ADDITIONAL Type             |                              |
|        = AAAA (0x001C)       |                              |
|  ADDITIONAL Address          |                              |
|      = 3ffe:501:ffff:100::31 |                              |
|                              | (REFRESH (5 minutes) interval|
|                              | expired after sent zone      |
|                              | information)                 |
|                              |----------------------------->|
|                              | 7. Standard query            |
|                              |   same as above No.1         |
|                              |<-----------------------------|
|                              | 8. Standard query response   |
|                              |   same as above No.2         |
|                              |-------------> X              |
|                              | 9. Standard query            |
|                              |  QNAME = sec.example.com     |
|                              |  QTYPE = AXFR (0x00FC)       |
|                              |                              |
|                              | (After REFRESH (5 minutes)   |
|                              |  expired)                    |
|                              |----------------------------->|
|                              | 10. Standard query           |
|                              |   same as above No.1         |
|                              |<-----------------------------|
|                              | 11. Standard query response  |
|                              |   same as above No.2         |
|                              |   except serial number.      |
|                              |  ANSWER Serial = 2           |
|                              |----------------------------->|
|                              | 12. Standard query           |
|                              |   same as above No.3         |
```

```
|                              |<-----------------------------|
|                              | 13. Standard query response  |
|                              |  same as No.4 except         |
|                              |  serial number and CL2's     |
|                              |  type A address              |
|                              |  ANSWER Serial = 2           |
|                              |         and                  |
|                              |  ANSWER Name                 |
|                              |       = CL2.sec.example.com  |
|                              |  ANSWER Type = A (0x0001)    |
|                              |  ANSWER Address =192.168.0.22|
|----------------------------->|                              |
| 14. Send standard query      |                              |
|  same as above No.5          |                              |
|<-----------------------------|                              |
| 15. Standard query response  |                              |
|  AA = 0                      |                              |
|  RD = 0                      |                              |
|  RA = 1                      |                              |
|  QNAME = CL2.sec.example.com |                              |
|  QTYPE = A                   |                              |
|  ANSWER Name                 |                              |
|        = CL2.sec.example.com |                              |
|  ANSWER Type = A (0x0001)    |                              |
|  ANSWER Address =192.168.0.22|                              |
|  AUTHORITY Name              |                              |
|        = sec.example.com     |                              |
|  AUTHORITY Type = NS (0x0002)|                              |
|  AUTHORITY Name Server       |                              |
|        = NS7.sec.example.com |                              |
|  ADDITIONAL Name             |                              |
|        = NS7.sec.example.com |                              |
|  ADDITIONAL Type = A (0x0001)|                              |
|  ADDITIONAL Address          |                              |
|        = 192.168.0.31        |                              |
|  ADDITIONAL Name             |                              |
|        = NS7.sec.example.com |                              |
|  ADDITIONAL Type             |                              |
|        = AAAA (0x001C)       |                              |
|  ADDITIONAL Address          |                              |
|      = 3ffe:501:ffff:100::31 |                              |
|                              | (REFRESH (5 minutes) interval|
|                              | expired after sent zone      |
|                              | information)                 |
|                              |----------------------------->|
|                              | 16. Standard query           |
|                              |   same as above No.1         |
|                              |                              |
v                              v                              v
```

This test sequence is following.

1. DNS Server1 (NUT) transmits standard query QNAME = sec.example.com, Type = SOA to DNS Server7 (TN). (Judgment *1)
2. DNS Server7 (TN) sends standard query response with SOA RRs to DNS Server1 (NUT).
3. DNS Server1(NUT)transmits standard query with QNAME=sec.example.com, Type = AXFR using TCP to DNS Server7 (TN). (Judgment *3)
4. DNS Server7 (TN) sends standard query response including all RRs about sec.example.com zone using TCP to DNS Server1 (NUT).
5. DNS Client1 (TN) sends standard query QNAME = CL2.sec.example.com to DNS Server1 (NUT).
6. DNS Server1 (NUT) transmits standard query response ANSWER Address = 192.168.0.21 to DNS Client1 (TN). (Judgment *6)
7. After refresh time expired, DNS Server1 (NUT) transmits standard query as same as No.1. (Judgment *7)
8. DNS Server7 (TN) sends standard query response as same as No.2 to DNS Server1 (NUT).
9. DNS Server1 (NUT) doesn't sends standard query QNAME = sec.example.com, Type = AXFR to DNS Server7 (TN). (Judgment *9)
10. After refresh time expired, DNS Server1 (NUT) transmits standard query as same as No.1. (Judgment *10)
11. DNS Server7 (TN) sends standard query response incrementing SOA's serial number to DNS Server1 (NUT).
12. DNS Server1(NUT) transmits standard query with QNAME=sec.example.com, Type = AXFR using TCP to DNS Server7 (TN). (Judgment *12)
13. DNS Server7 (TN) sends standard query response including all RRs about sec.example.com zone differencing SOA's serial number and CL2.sec.example.com address using TCP to DNS Server1 (NUT).
14. DNS Client1 (TN) sends standard query as same as No.5.
15. DNS Server1 (NUT) transmits standard query response ANSWER Address = 192.168.0.22 to DNS Client1 (TN). (Judgment *15)
16. After refresh time expired, DNS Server1 (NUT) transmits standard as same as No.1. (Judgment *16)

Packet Description

1st packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	1
	REFRESH	300sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	300sec
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)

	TTL	300sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

3rd packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
TCP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	AXFR (0x00FC)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ

	Destination Address	SV7_NETZ
TCP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	0
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	7
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	AXFR (0x00FC)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	1
	REFRESH	300sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	300sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	4

	ADDRESS	192.168.0.21
DNS Answer section	NAME	CL2.sec.example.com (Pointer 0xC05C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::21
DNS Answer section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Answer section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	1
	REFRESH	300sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	300sec

5th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0

	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	CL2.sec.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Authority	NAME	sec.example.com (Pointer 0xC010)

section	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	6
	NSDNAME	NS7.sec.example.com (NS7 + Pointer 0xC010)
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC041)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	4
	ADDRESS	192.168.0.30
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC041)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

7th packet.
same as No.1 packet.

8th packet.
same as No.2 packet.

9th packet.
Nothing

10th packet.
same as No.1 packet.

11th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	**2**
	REFRESH	300sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	300sec
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	6
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

12th packet.

same as No.3 packet.

13th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
TCP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	0
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	7
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	AXFR (0x00FC)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	**2**
	REFRESH	300sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	300sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	4
	ADDRESS	**192.168.0.22**
DNS Answer section	NAME	CL2.sec.example.com (Pointer 0xC05C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::21
DNS Answer section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Answer section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	**2**
	REFRESH	300sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	300sec

14th packet.

same as No.5 packet, but ID=0x2000.

15th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53

	Dst Port	1000
DNS Header	ID	0x2000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	CL2.sec.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	4
	ADDRESS	**192.168.0.22**
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	6
	NSDNAME	NS7.sec.example.com (NS7 + Pointer 0xC010)
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC041)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC041)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

16th packet.
same as No.1 packet.

- **Termination**
  None

Judgment

1. Received standard query with Type=SOA.
3. Received standard query with Type=AXFR using TCP
6. Received standard query response including Answer address 192.168.0.21.
7. Received standard query with Type=SOA after REFRESH time expired.
9. Doesn't receive standard query with Type=SOA.
10. Received standard query with Type=SOA after REFRESH time expired.
12. Received standard query with Type=AXFR using TCP.
15. Received standard query response including Answer address 192.168.0.22.
16. Received standard query with Type=SOA after REFRESH time expired.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
4. NAME SERVERS
4.3.5. Zone maintenance and transfers

5.47. Zone transfer is not completed case

Purpose

Verify that a NUT starts zone maintenance and transfers as follows:

- Whenever a new zone is loaded in a secondary, the secondary waits REFRESH seconds before checking with the primary for a new serial.
- If this check cannot be completed, new checks are started every RETRY seconds. The check is a simple query to the primary for the SOA RR of the zone.
- If the secondary finds it impossible to perform a serial check for the EXPIRE interval, it must assume that its copy of the zone is obsolete an discard it.
- In spite of a server's best efforts, it may be unable to load zone data from a master file due to syntax errors, etc., or be unable to refresh a zone within the its expiration parameter. In this case, the name server should answer queries as if it were not supposed to possess the zone.

Category

Server (Secondary)

Initialization

- **Network Topology**
  Refer the topology "Fig. 17 Topology No.17".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as secondary server about sec.example.com zone

  Example of root server list:

```
For IPv4:
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                A       192.168.1.20

For IPv6
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000        AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
```

```
        604800          ; expire after a week
        3600            ; Minimum TTL of a 1 hr
)
;
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
A       IN      A       192.168.1.10
```

Example of DNS server configuration for secondary:

```
zone "sec.example.com" {
    type slave;
    masters {192.168.0.31;};
    file "s/sec.example.com";
};
```

Procedure

```
DNS Client1 (TN)                    DNS Server1 (NUT)                    DNS Server7 (TN)
      |                                     |                                     |
      |                                     |-------------------------------------->|
      |                                     | 1. Standard query                     |
      |                                     |  QNAME = sec.example.com              |
      |                                     |  QTYPE = SOA (0x0006)                 |
      |                                     |<--------------------------------------|
      |                                     | 2. Standard query response            |
      |                                     |  QNAME = sec.example.com              |
      |                                     |  QTYPE = SOA (0x0006)                 |
      |                                     |  ANSWER Name= sec.example.com         |
      |                                     |  ANSWER Type = SOA (0x0006)           |
      |                                     |  ANSWER TTL = 30                      |
      |                                     |  ANSWER Mname=sec.example.com         |
      |                                     |  ANSWER Rname                         |
      |                                     |       = root.sec.example.com          |
      |                                     |  ANSWER Serial = 1                    |
      |                                     |  ANSWER Refresh = 180sec              |
      |                                     |  ANSWER Retry = 30sec                 |
      |                                     |  ANSWER Expire = 360sec               |
      |                                     |  ANSWER Minimum = 30sec               |
      |                                     |  AUTHORITY Name = sec.example.com     |
      |                                     |  AUTHORITY Type = NS (0x0002)         |
      |                                     |  AUTHORITY Name Server = NS7.sec.example.com |
      |                                     |  ADDITIONAL Name = NS7.sec.example.com |
      |                                     |  AUTHORITY Type  = A (0x0001)         |
      |                                     |  AUTHORITY Address = 192.168.0.31     |
      |                                     |-------------------------------------->|
      |                                     | 3. Standard query (using TCP)         |
      |                                     |  QNAME = sec.example.com              |
      |                                     |  QTYPE = AXFR (0x00FC)                |
```

```
|                                       |<-------------------------------------|
|                                       | 4. Standard query response           |
|                                       |    (using TCP)                       |
|                                       |  QNAME = sec.example.com             |
|                                       |  QTYPE = AXFR (0x00FC)               |
|                                       |  ANSWER Name = sec.example.com       |
|                                       |  ANSWER Type = SOA (0x0006)          |
|                                       |  ANSWER TTL = 30                     |
|                                       |  ANSWER Mname = sec.example.com      |
|                                       |  ANSWER Rname = root.sec.example.com |
|                                       |  ANSWER Serial = 1                   |
|                                       |  ANSWER Refresh = 180sec             |
|                                       |  ANSWER Retry = 30sec                |
|                                       |  ANSWER Expire = 360sec              |
|                                       |  ANSWER Minimum = 30sec              |
|                                       |  ANSWER Name= sec.example.com        |
|                                       |  ANSWER Type = NS (0x0002)           |
|                                       |  ANSWER Name = NS7.sec.example.com   |
|                                       |  ANSWER Name = sec.example.com       |
|                                       |  ANSWER Type = MX (0x000F)           |
|                                       |  ANSWER Name = NS7.sec.example.com   |
|                                       |  ANSWER Name = CL1.sec.example.com   |
|                                       |  ANSWER Type = A (0x0001)            |
|                                       |  ANSWER Address = 192.168.0.21       |
|                                       |  ANSWER Name = CL1.sec.example.com   |
|                                       |  ANSWER Type = AAAA (0x001C)         |
|                                       |  ANSWER Address = 3ffe:501:ffff:100::20|
|                                       |  ANSWER Name = NS7.sec.example.com   |
|                                       |  ANSWER Type = A (0x0001)            |
|                                       |  ANSWER Address = 192.168.0.31       |
|                                       |  ANSWER Name = NS7.sec.example.com   |
|                                       |  ANSWER Type = AAAA (0x001C)         |
|                                       |  ANSWER Address = 3ffe:501:ffff:100::31|
|                                       |  ANSWER Name = sec.example.com       |
|                                       |  ANSWER Type = SOA (0x0006)          |
|                                       |  ANSWER TTL = 30                     |
|                                       |  ANSWER Mname=sec.example.com        |
|                                       |  ANSWER Rname = root.sec.example.com |
|                                       |  ANSWER Serial = 1                   |
|                                       |  ANSWER Refresh = 180sec             |
|                                       |  ANSWER Retry = 30sec                |
|                                       |  ANSWER Expire = 360sec              |
|                                       |  ANSWER Minimum = 30sec              |
|-------------------------------------->|                                      |
| 5. Send standard query                |                                      |
|  RD = 0                               |                                      |
|  QNAME = CL1.sec.example.com          |                                      |
|  QTYPE = A                            |                                      |
```

```
|<----------------------------------------|                                    |
| 6. Standard query response              |                                    |
|  AA = 0                                 |                                    |
|  RD = 0                                 |                                    |
|  RA = 1                                 |                                    |
|  QNAME = CL1.sec.example.com            |                                    |
|  QTYPE = A                              |                                    |
|  ANSWER Name = CL1.sec.example.com      |                                    |
|  ANSWER Type = A (0x0001)               |                                    |
|  ANSWER Address = 192.168.0.21          |                                    |
|  AUTHORITY Name = sec.example.com       |                                    |
|  AUTHORITY Type = NS (0x0002)           |                                    |
|  AUTHORITY Name Server = NS7.sec.example.com |                                |
|  ADDITIONAL Name = NS7.sec.example.com  |                                    |
|  ADDITIONAL Type = A (0x0001)           |                                    |
|  ADDITIONAL Address = 192.168.0.31      |                                    |
|  ADDITIONAL Name = NS7.sec.example.com  |                                    |
|  ADDITIONAL Type = AAAA (0x001C)        |                                    |
|  ADDITIONAL Address = 3ffe:501:ffff:100::31 |                                |
|                                         | (REFRESH (3 minutes) interval      |
|                                         | expired after sending zone         |
|                                         | information)                       |
|                                         |---------------------------------->|
|                                         | 7. Standard query                  |
|                                         |   same as above No.1               |
|                                         |            x <-------------------|
|                                         | 8. Doesn't send standard           |
|                                         |   query response                   |
|                                         |                                    |
|                                         | (RETRY (30 sec) interval expired   |
|                                         | after sending previous query)      |
|                                         |---------------------------------->|
|                                         | 9. Standard query same as above No.1 |
|                                         |  Repeat every RETRY seconds        |
|                                         |                                    |
|                                         | (EXPIRE (360 sec) interval passed  |
|                                         | after sending zone information)    |
|---------------------------------------->|                                    |
| 10. Send standard query                 |                                    |
|  same as above No.5                     |                                    |
|<----------------------------------------|                                    |
| 11. Standard query response             |                                    |
|  AA = 0                                 |                                    |
|  RD = 0                                 |                                    |
|  RA = 1                                 |                                    |
|  RCODE = 2 (Server failure)             |                                    |
|  QNAME = CL1.sec.example.com            |                                    |
|  QTYPE = A                              |                                    |
|                                         |                                    |
v                                         v                                    v
```

1. DNS Server1 (NUT) transmits standard query QNAME = sec.example.com, Type = SOA to DNS Server7 (TN). (Judgment *1)
2. DNS Server7 (TN) send standard query response with SOA RRs to DNS Server1 (NUT).
3. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = AXFR using TCP to DNS Server7 (TN). (Judgment *3)
4. DNS Server7 (TN) send standard query response including all RRs about sec.example.com zone using TCP to DNS Server1 (NUT).
5. DNS Client1 (TN) send standard query QNAME = CL1.sec.example.com to DNS Server1 (NUT).
6. DNS Server1 (NUT) transmits standard query response ANSWER Address = 192.168.0.21 to DNS Client1 (TN). (Judgment *6)
7. After REFRESH time expired, DNS Server1 (NUT) transmits standard query QNAME = sec.example.com, Type = SOA to DNS Server7 (TN). (Judgment *7)
8. DNS Server7 (TN) doesn't send standard query response to DNS Server1 (NUT).
9. Then DNS Server1 (NUT) transmits standard query QNAME = sec.example.com to DNS Server7 (TN) every RETRY seconds. (Judgment *9)
10. After EXPIRE time passed, DNS Client1 (TN) send standard query QNAME = CL1.sec.example.com to DNS Server1 (NUT).
11. DNS Server1 (NUT) transmits error response RCODE = 2 (Server failure) to DNS Client1 (TN). (Judgment *11)

Packet Description

1st packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	1
	REFRESH	30sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

3rd packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
TCP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	AXFR (0x00FC)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
TCP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	0

	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	7
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	AXFR (0x00FC)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	1
	REFRESH	30sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Answer section	NAME	CL1.sec.example.com (CL1 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Answer section	NAME	CL1.sec.example.com (Pointer 0xC05C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	30sec

	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::21
DNS Answer section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Answer section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	1
	REFRESH	30sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

5th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0

	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	CL1.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	CL1.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	CL1.sec.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	6
	NSDNAME	NS7.sec.example.com (NS7 + Pointer 0xC010)

DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC041)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	4
	ADDRESS	192.168.0.30
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC041)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

7th packet.

same as No.1 packet.

8th packet.

Doesn't send standard query response

9th packet.

same as No.1 packet.

10th packet.

same as No.5 packet, but ID=0x2000

11th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x2000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	1
	Z	ANY
	RCODE	**2**
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	CL1.sec.example.com

	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

1. Received standard query with Type=SOA.
3. Received standard query with Type=AXFR using TCP
6. Received standard query response including Answer address 192.168.0.21.
7. Received standard query with Type=SOA after REFRESH time expired.
9. Received standard query with Type=SOA every RETRY seconds.
11. Received error response including RCODE=2.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  4. NAME SERVERS
  4.3.5. Zone maintenance and transfers
RFC1035 Domain Implementation and Specification
  6.3. Zone refresh and reload processing

5.48. Distribute zone information to secondary

Purpose

Verify that a NUT distributes zone according to secondary's zone transfer request.

- Part of the job of a zone administrator is to maintain the zones at all of the name servers which are authoritative for the zone. When the inevitable changes are made, they must be distributed to all of the name servers.
- Changes are coordinated at the primary, typically by editing a master file for the zone. After editing, the administrator signals the master server to load the new zone.
- The periodic polling of the secondary servers is controlled by parameters in the SOA RR for the zone, which set the minimum acceptable polling intervals.
- When the poll shows that the zone has changed, then the secondary server must request a zone transfer via an AXFR request for the zone. The AXFR is answered by a sequence of response messages.
- The first and last messages must contain the data for the top authoritative node of the zone. Intermediate messages carry all of the other RRs from the zone, including both authoritative and non-authoritative RRs.
- an AXFR response requires the SOA record (always an RRSet containing a single RR) be both the first and last record of the reply. Where duplicates are required this way, the TTL transmitted in each case must be the same.

Category

Server (Primary)

Initialization

- **Network Topology**
  Refer the topology "Fig. 18 Topology No.18".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as primary server about example.com zone.
  - ✧ disable NOTIFY function.

  Example of root server list:

For IPv4:

.	3600000	IN	NS	A.ROOT.NET.
A.ROOT.NET.	3600000		A	192.168.1.20

For IPv6

.	3600000	IN	NS	A.ROOT.NET.

```
A.ROOT.NET.              3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     30              ; TTL of 30sec
@ IN SOA NS1.example.com.  root.example.com.  (
         1               ; serial
         180             ; refresh every 180sec
         60              ; retry every 60sec
         360             ; expire after 360sec
         30              ; Minimum TTL of 30sec
)
;
       IN     NS        NS1.example.com.
NS1    IN     A         192.168.0.10
       IN     AAAA      3ffe:501:ffff:100::10
;
A      IN     A         192.168.1.10
       IN     AAAA      3ffe:501:ffff:101::10
```

Procedure

This test sequence is following.

```
    DNS Server1 (NUT)                              DNS Server6 (TN)
        |                                                |
        |<-----------------------------------------------|
        | 1. Standard query                              |
        |  QNAME = example.com                           |
        |  QTYPE = SOA (0x0006)                          |
        |----------------------------------------------->|
        | 2. Standard query response                     |
        |  QNAME = example.com                           |
        |  QTYPE = SOA (0x0006)                          |
        |  ANSWER Name = example.com                     |
        |  ANSWER Type = SOA (0x0006)                    |
        |  ANSWER TTL = 30                               |
        |  ANSWER Mname = NS1.example.com                |
        |  ANSWER Rname = root.example.com               |
        |  ANSWER Serial = 1                             |
        |  ANSWER Refresh = 180sec                       |
        |  ANSWER Retry = 60sec                          |
        |  ANSWER Expire = 360sec                        |
        |  ANSWER Minimum = 30sec                        |
        |  AUTHORITY Name = example.com                  |
        |  AUTHORITY Type = NS (0x0002)                  |
        |  AUTHORITY Name Server = NS1.example.com       |
        |  ADDITIONAL Name = NS1.example.com             |
        |  ADDITIONAL Type = A (0x0001)                  |
        |  ADDITIONAL Address = 192.168.0.10             |
        |<-----------------------------------------------|
        | 3. Standard query (using TCP)                  |
        |  QNAME = example.com                           |
        |  QTYPE = AXFR (0x00FC)                         |
```

```
|---------------------------------------------->|
| 4. Standard query response (using TCP)         |
|  QNAME = example.com                           |
|  QTYPE = AXFR (0x00FC)                         |
|  ANSWER Name = example.com                     |
|  ANSWER Type = SOA (0x0006)                    |
|  ANSWER TTL = 30                               |
|  ANSWER Mname = NS1.example.com                |
|  ANSWER Rname = root.example.com               |
|  ANSWER Serial = 1                             |
|  ANSWER Refresh = 180sec                       |
|  ANSWER Retry = 60sec                          |
|  ANSWER Expire = 360sec                        |
|  ANSWER Minimum = 30sec                        |
|                                                |
|  ANSWER Name = example.com                     |
|  ANSWER Type = NS (0x0002)                     |
|  ANSWER Name = NS1.example.com                 |
|                                                |
|  ANSWER Name = A.example.com                   |
|  ANSWER Type = A (0x0001)                      |
|  ANSWER Address = 192.168.1.10                 |
|                                                |
|  ANSWER Name = A.example.com                   |
|  ANSWER Type = AAAA (0x001C)                   |
|  ANSWER Address = 3ffe:501:ffff:101::10        |
|                                                |
|  ANSWER Name = NS1.example.com                 |
|  ANSWER Type = A (0x0001)                      |
|  ANSWER Address = 192.168.0.10                 |
|                                                |
|  ANSWER Name = NS1.example.com                 |
|  ANSWER Type = AAAA (0x001C)                   |
|  ANSWER Address = 3ffe:501:ffff:100::10        |
|                                                |
|  ANSWER Name = example.com                     |
|  ANSWER Type = SOA (0x0006)                    |
|  ANSWER TTL = 30                               |
|  ANSWER Mname = NS1.example.com                |
|  ANSWER Rname = root.example.com               |
|  ANSWER Serial = 1                             |
|  ANSWER Refresh = 180sec                       |
|  ANSWER Retry = 60sec                          |
|  ANSWER Expire = 360sec                        |
|  ANSWER Minimum = 30sec                        |
|                                                |
| (REFRESH (3 minutes) interval                  |
| expired after sent zone information)           |
|<----------------------------------------------|
| 5. Standard query same as above No.1,          |
|   except ID=0x3000                             |
|---------------------------------------------->|
| 6. Standard query response same as above No.2  |
|                                                |
| 7.Editing zone on primary and reload zone file.|
|                                                |
|  SERIAL of SOA is 2                            |
|  A.example.com address is = 192.168.1.11       |
|                                                |
| (After REFRESH (3 minutes) expired)            |
```

```
        |<-----------------------------------------------|
        | 8. Standard query same as above No.1,          |
        |   except ID=0x4000                             |
        |----------------------------------------------->|
        | 9. Standard query response same as above No.2  |
        |   except serial number.                        |
        |   ANSWER Serial = 2                            |
        |<-----------------------------------------------|
        | 10. Standard query same as above No.3          |
        |   except ID=0x5000                             |
        |----------------------------------------------->|
        | 11. Standard query response same as No.4       |
        |   except serial number and A's type A address  |
        |                                                |
        |  ANSWER Serial = 2                             |
        |         and                                    |
        |  ANSWER Name = A.example.com                   |
        |  ANSWER Type = A (0x0001)                      |
        |  ANSWER Address = 192.168.1.11                 |
        |                                                |
        | (REFRESH (3 minutes) seconds expired after     |
        |  sent zone information)                        |
        |<-----------------------------------------------|
        | 12. Standard query same as above No.3,         |
        |   except ID=0x6000                             |
        |----------------------------------------------->|
        | 13. Standard query response same as above No.9 |
        |                                                |
        v                                                v
```

1. DNS Server6 (TN) sends standard query QNAME = example.com, Type = SOA to DNS Server1 (NUT).
2. DNS Server1 (NUT) transmits standard query response with SOA RRs to DNS Server1 (TN).(Judgment *2)
3. DNS Server6 (TN) sends standard query with QNAME = example.com, Type = AXFR using TCP to DNS Server1 (NUT).
4. DNS Server1 (NUT) transmits standard query response including all RRs about example.com zone using TCP to DNS Server6 (TN). (Judgment *4)
5. After REFRESH seconds expired, DNS Server6 (TN) sends standard query as same as No.1.
6. DNS Server1 (NUT) transmits standard query response as same as No.2 to DNS Server1 (NUT).(Judgment *7)
7. Editing zone on primary.
8. After REFRESH seconds expired, DNS Server6 (TN) sends standard query as same as No.1.
9. DNS Server1 (NUT) transmits standard query response incrementing SOA's serial number to DNS Server6 (TN). (Judgment *9)
10. DNS Server6 (TN) sends standard query with QNAME = example.com, Type = AXFR using TCP to DNS Server1 (NUT).
11. DNS Server1 (NUT) transmits standard query response including all RRs about example.com zone differencing SOA's serial number and A.example.com address using TCP to DNS Server6 (TN).(Judgment *11)
12. After REFRESH seconds expired, DNS Server6 (TN) sends standard query as same as No.1.
13. DNS Server1 (NUT) transmits standard query as same as No.9. (Judgment *13)

Packet Description

1st packet.

Standard query from DNS Server6 (TN) to Server1 (NUT)		
IP Header	Source Address	SV6_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000

	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Server6 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV6_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)

	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	33
	MNAME	NS1.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.example.com (root + Pointer 0xC00C)
	SERIAL	1
	REFRESH	180sec
	RETRY	60sec
	EXPIRE	360sec
	MINIMUM	30sec
DNS Authority section	NAME	example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	2
	NSDNAME	NS1.example.com (Pointer 0xC029)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.example.com (Pointer 0xC029)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10

3rd packet.

Standard query from DNS Server6 (TN) to Server1 (NUT)		
IP Header	Source Address	SV6_NETZ
	Destination Address	NUT_NETZ
TCP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x2000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.com
	QTYPE	AXFR (0x00FC)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Server6 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV6_NETZ
TCP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x2000
	QR	0
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	7
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.com
	QTYPE	AXFR (0x00FC)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	33
	MNAME	NS1.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.example.com (root + Pointer 0xC00C)
	SERIAL	1
	REFRESH	30sec
	RETRY	30sec

	EXPIRE	360sec
	MINIMUM	30sec
DNS Answer section	NAME	example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	2
	NSDNAME	NS1.example.com (Pointer 0xC029)
DNS Answer section	NAME	A.example.com (A + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Answer section	NAME	A.example.com (Pointer 0xC058)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::21
DNS Answer section	NAME	NS1.example.com (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Answer section	NAME	NS1.example.com (Pointer 0xC029)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::10
DNS Answer section	NAME	example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	24
	MNAME	NS1.example.com (Pointer 0xC029)
	RNAME	root.example.com (Pointer 0xC02F)
	SERIAL	1
	REFRESH	30sec
	RETRY	30sec

	EXPIRE	360sec
	MINIMUM	30sec

5th packet.
  same as No.1 packet, except ID=0x3000.

6th packet.
  same as No.2 packet, except ID=0x3000.

7th packet.
  Nothing

8th packet.
  same as No.1 packet, except ID=0x4000.

9th packet.

Standard query response from DNS Server1 (NUT) to Server6 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV6_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x4000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	33
	MNAME	NS1.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.example.com (root + Pointer 0xC00C)

	SERIAL	2
	REFRESH	30sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec
DNS Authority section	NAME	example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	6
	NSDNAME	NS1.example.com (Pointer 0xC029)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.example.com (Pointer 0xC029)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10

10th packet.

same as No.3 packet, except ID=0x5000.

11th packet.

Standard query response from DNS Server1 (NUT) to Server6 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV6_NETZ
TCP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x5000
	QR	0
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	0
	QDCOUNT	1

	ANCOUNT	7
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.com
	QTYPE	AXFR (0x00FC)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	33
	MNAME	NS1.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.example.com (root + Pointer 0xC00C)
	SERIAL	**2**
	REFRESH	30sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec
DNS Answer section	NAME	example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	2
	NSDNAME	NS1.example.com (Pointer 0xC029)
DNS Answer section	NAME	A.example.com (A + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	4
	ADDRESS	**192.168.1.11**
DNS Answer section	NAME	A.example.com (Pointer 0xC058)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::21
DNS Answer section	NAME	NS1.example.com (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	4
	ADDRESS	192.168.0.10

DNS Answer section	NAME	NS1.example.com (Pointer 0xC029)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Answer section	NAME	example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	30sec
	RDLENGTH	24
	MNAME	NS1.example.com (Pointer 0xC029)
	RNAME	root.example.com (Pointer 0xC02F)
	SERIAL	**2**
	REFRESH	30sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec

12th packet.

same as No.3 packet, but ID=0x6000.

13th packet.

same as No.9 packet, but ID=0x6000.

- Termination

  None

Judgment

2. Received standard query response with Answer Type=SOA.
9. Received standard query response with Answer Type=SOA, Serial=1.
4. Received standard query response with Answer Type=AXFR including all of zone RRs using TCP.
6. Received standard query response with Answer Type=SOA, Serial=1.
9. Received standard query response with Answer Type=SOA, Serial=2.
11. Received standard query response with Answer Type=AXFR including all of zone RRs using TCP.
13. Received standard query response with Answer Type=SOA, Serial=2.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES

4. NAME SERVERS

4.3.5. Zone maintenance and transfers

RFC2181 Clarifications to the DNS Specification

5.5. Sending RRSets (reprise)

5.49. Returning of answer

Purpose

Verify that a NUT transmits message including the returned RR to client.

- When the resolver performs the indicated function, it usually has one of the following results to pass back to the client:
  - ✧ One or more RRs giving the requested data

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600      ; serial
         3600            ; refresh every 1 hr
         900             ; retry every 15 min
         604800          ; expire after a week
         3600            ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)    DNS Server1 (NUT)      DNS Server2 (TN)          DNS Server3 (TN)      DNS Server4 (TN)
 |                        |                        |                        |                        |
 |------------------------>|                        |                        |                        |
 |1.Send standard query    |                        |                        |                        |
 | QNAME =A.example.org    |                        |                        |                        |
 | QTYPE=A                 |                        |                        |                        |
 |                         |------------------------>|                        |                        |
 |                         |2.Send standard query   |                        |                        |
 |                         | QNAME=A.example.org    |                        |                        |
 |                         | QTYPE=A                |                        |                        |
 |                         |<------------------------|                        |                        |
 |                         |3.Send standard response|                        |                        |
 |                         | QNAME=A.example.org    |                        |                        |
 |                         | QTYPE= A               |                        |                        |
 |                         | AUTHORITY Name=org     |                        |                        |
 |                         | AUTHORITY Name Server  |                        |                        |
 |                         |      =NS3.example.org  |                        |                        |
 |                         | ADDITIONAL Name        |                        |                        |
 |                         |      =NS3.example.org  |                        |                        |
 |                         | ADDITIONAL Address     |                        |                        |
 |                         |      =192.168.1.30     |                        |                        |
 |                         |------------------------------------------------>|                        |
 |                         |                        |4.Send standard query   |                        |
 |                         |                        | QNAME=A.example.org    |                        |
 |                         |                        | QTYPE=A                |                        |
 |                         |<------------------------------------------------|                        |
 |                         |                        |5.Send standard response|                        |
 |                         |                        | QNAME=A.example.org    |                        |
 |                         |                        | QTYPE=A                |                        |
 |                         |                        | AUTHORITY Name         |                        |
 |                         |                        |      =example.org      |                        |
 |                         |                        | AUTHORITY Name Server  |                        |
 |                         |                        |      =NS4.example.org  |                        |
 |                         |                        | ADDITIONAL Name        |                        |
 |                         |                        |      =NS4.example.org  |                        |
 |                         |                        | ADDITIONAL Address     |                        |
 |                         |                        |      =192.168.1.40     |                        |
 |                         |------------------------------------------------------------------------>|
 |                         |                        |                        |6.Send standard query   |
 |                         |                        |                        | QNAME=A.example.org    |
 |                         |                        |                        | QTYPE=A                |
 |                         |<------------------------------------------------------------------------|
 |                         |                        |                        |7.Send standard response|
 |                         |                        |                        | QNAME=A.example.org    |
 |                         |                        |                        | QTYPE=A                |
 |                         |                        |                        | ANSWER Name            |
 |                         |                        |                        |      =A.example.org    |
 |                         |                        |                        | ANSWER Address         |
 |                         |                        |                        |      =192.168.1.10     |
 |                         |                        |                        | AUTHORITY Name         |
 |                         |                        |                        |      =example.org      |
 |                         |                        |                        | AUTHORITY Name Server  |
 |                         |                        |                        |      =NS4.example.org  |
 |                         |                        |                        | ADDITIONAL Name        |
 |                         |                        |                        |      =NS4.example.org  |
 |                         |                        |                        | ADDITIONAL Address     |
 |                         |                        |                        |      =192.168.1.40     |
```

```
|<------------------------|                      |                      |                      |
|8.Standard query response|                      |                      |                      |
| QNAME=A.example.org     |                      |                      |                      |
| QTYPE=A                 |                      |                      |                      |
| ANSWER Name             |                      |                      |                      |
|      =A.example.org     |                      |                      |                      |
| ANSWER Address          |                      |                      |                      |
|      =192.168.1.10      |                      |                      |                      |
| AUTHORITY Name          |                      |                      |                      |
|      =example.org       |                      |                      |                      |
| AUTHORITY Name Server   |                      |                      |                      |
|      =NS4.example.org   |                      |                      |                      |
|                         |                      |                      |                      |
v                         v                      v                      v                      v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10 to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	1
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	1
	OPCODE	0
	AA	any

	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)

	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response including correct RR.

References

RFC1035 DOMAIN NAMES - CONCEPTS AND FACILITIES
5.2.1. Typical functions

5.50. Returning of name error

Purpose

Verify that a NUT transmits message including the name error to client.

- When the resolver performs the indicated function, it usually has one of the following results to pass back to the client:
  - ✧ A name error (NE)

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig.2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                A       192.168.1.20

For IPv6
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000        AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)      DNS Server1 (NUT)          DNS Server2 (TN)           DNS Server3 (TN)        DNS Server4 (TN)
 |------------------------->|                          |                          |                          |
 |1.Send standard query     |                          |                          |                          |
 | QNAME=invalid.example.org|                          |                          |                          |
 | QTYPE=A                  |                          |                          |                          |
 |                          |-------------------------->|                          |                          |
 |                          |2.Send standard query      |                          |                          |
 |                          | QNAME =invalid.example.org|                          |                          |
 |                          | QTYPE=A                   |                          |                          |
 |                          |<--------------------------|                          |                          |
 |                          |3.Send standard response   |                          |                          |
 |                          | QNAME=invalid.example.org |                          |                          |
 |                          | QTYPE= A                  |                          |                          |
 |                          | AUTHORITY Name=org        |                          |                          |
 |                          | AUTHORITY Name Server     |                          |                          |
 |                          |      =NS3.example.org     |                          |                          |
 |                          | ADDITIONAL Name           |                          |                          |
 |                          |      =NS3.example.org     |                          |                          |
 |                          | ADDITIONAL Address        |                          |                          |
 |                          |      =192.168.1.30        |                          |                          |
 |                          |---------------------------------------------------->|                          |
 |                          |                           |4.Send standard query     |                          |
 |                          |                           | QNAME=invalid.example.org|                          |
 |                          |                           | QTYPE=A                  |                          |
 |                          |<----------------------------------------------------|                          |
 |                          |                           |5.Send standard response  |                          |
 |                          |                           | QNAME=invalid.example.org|                          |
 |                          |                           | QTYPE=A                  |                          |
 |                          |                           | AUTHORITY Name = example.org                        |
 |                          |                           | AUTHORITY Name Server    |                          |
 |                          |                           |      =NS4.example.org    |                          |
 |                          |                           | ADDITIONAL Name          |                          |
 |                          |                           |      =NS4.example.org    |                          |
 |                          |                           | ADDITIONAL Address       |                          |
 |                          |                           |      =192.168.1.40       |                          |
 |                          |-------------------------------------------------------------------------------->|
 |                          |                           |                          |6.Send standard query     |
 |                          |                           |                          | QNAME =invalid.example.org
 |                          |                           |                          | QTYPE=A                  |
 |                          |<--------------------------------------------------------------------------------|
 |                          |                           |                          |7.Send standard response  |
 |                          |                           |                          | NXDOMAIN                 |
 |                          |                           |                          | QNAME=invalid.example.org|
 |                          |                           |                          | QTYPE=A                  |
 |                          |                           |                          | AUTHORITY Name =example.org
 |                          |                           |                          | AUTHORITY Type = SOA     |
 |<-------------------------|                           |                          |                          |
 |8.Standard query response |                           |                          |                          |
 | NXDOMAIN                 |                           |                          |                          |
 | QNAME= invalid.example.org                           |                          |                          |
 | QTYPE=A                  |                           |                          |                          |
 | AUTHORITY Name = example.org                         |                          |                          |
 | AUTHORITY Type = SOA     |                           |                          |                          |
 v                          v                           v                          v                          v
```

1. TN send standard query QNAME=invalid.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=invalid.example.org, QTYPE=A to DNS Server3(TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=invalid.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to NXDOMAIN to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	invalid.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	1
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	any
DNS Question section	QNAME	invalid.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	invalid.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC01C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC014)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC031)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	invalid.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	invalid.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC014)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC014)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC031)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	invalid.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	invalid.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org(Pointer 0xC014)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour
	RDLENGTH	33
	MNAME	NS4.example.org (NS4 + Pointer 0xC014)
	RNAME	root.example.org (root + Pointer 0xC014)
	SERIAL	2005080300
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0

	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	invalid.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC014)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour
	RDLENGTH	33
	MNAME	NS4.example.org (NS4 + Pointer 0xC014)
	RNAME	root.example.org (root + Pointer 0xC014)
	SERIAL	2005080300
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour

- **Termination**
  None

Judgment

2. Received standard query including QNAME=invalid.example.org, QTYPE=A.
4. Received standard query including QNAME=invalid.example.org, QTYPE=A.
6. Received standard query including QNAME=invalid.example.org, QTYPE=A.
8. Received standard query response including the name error(NXDOMAIN).

References

RFC1035 DOMAIN NAMES - CONCEPTS AND FACILITIES
5.2.1. Typical functions

5.51. Returning of data not found error

Purpose

Verify that a NUT transmits message including the data not found error

- When the resolver performs the indicated function, it usually has one of the following results to pass back to the client:
  - ✧ A data not found error

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig.2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.            3600000               A      192.168.1.20

For IPv6
 .                      3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.            3600000        AAAA   3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN     NS     NS1.example.com.
NS1      IN     A      192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)    DNS Server1 (NUT)      DNS Server2 (TN)          DNS Server3 (TN)      DNS Server4 (TN)
 |                        |                       |                       |                       |
 |------------------------>|                       |                       |                       |
 |1.Send standard query    |                       |                       |                       |
 | QNAME=A.example.org     |                       |                       |                       |
 | QTYPE=HINFO             |                       |                       |                       |
 |                         |------------------------>|                       |                       |
 |                         |2.Send standard query   |                       |                       |
 |                         | QNAME=A.example.org    |                       |                       |
 |                         | QTYPE=HINFO            |                       |                       |
 |                         |<------------------------|                       |                       |
 |                         |3.Send standard response|                       |                       |
 |                         | QNAME=A.example.org    |                       |                       |
 |                         | QTYPE=HINFO            |                       |                       |
 |                         | AUTHORITY Name=org     |                       |                       |
 |                         | AUTHORITY Name Server  |                       |                       |
 |                         |      =NS3.example.org  |                       |                       |
 |                         | ADDITIONAL Name        |                       |                       |
 |                         |      =NS3.example.org  |                       |                       |
 |                         | ADDITIONAL Address     |                       |                       |
 |                         |      =192.168.1.30     |                       |                       |
 |                         |------------------------------------------------>|                       |
 |                         |                        |4.Send standard query   |                       |
 |                         |                        | QNAME=A.example.org    |                       |
 |                         |                        | QTYPE=HINFO            |                       |
 |                         |<------------------------------------------------|                       |
 |                         |                        |5.Send standard response|                       |
 |                         |                        | QNAME=A.example.org    |                       |
 |                         |                        | QTYPE=HINFO            |                       |
 |                         |                        | AUTHORITY Name         |                       |
 |                         |                        |      =example.org      |                       |
 |                         |                        | AUTHORITY Name Server  |                       |
 |                         |                        |      =NS4.example.org  |                       |
 |                         |                        | ADDITIONAL Name        |                       |
 |                         |                        |      =NS4.example.org  |                       |
 |                         |                        | ADDITIONAL Address     |                       |
 |                         |                        |      =192.168.1.40     |                       |
 |                         |------------------------------------------------------------------------>|
 |                         |                        |                       |6.Send standard query   |
 |                         |                        |                       | QNAME=A.example.org    |
 |                         |                        |                       | QTYPE=HINFO            |
 |                         |<------------------------------------------------------------------------|
 |                         |                        |                       |7.Send standard response|
 |                         |                        |                       | NODATA                 |
 |                         |                        |                       | QNAME=A.example.org    |
 |                         |                        |                       | QTYPE=HINFO            |
 |                         |                        |                       | AUTHORITY Name         |
 |                         |                        |                       |      =example.org      |
 |                         |                        |                       | AUTHORITY Type=SOA     |
 |<------------------------|                        |                       |                       |
 |8.Standard query response|                        |                       |                       |
 | NODATA                  |                        |                       |                       |
 | QNAME=A.example.org     |                        |                       |                       |
 | QTYPE=HINFO             |                        |                       |                       |
 | AUTHORITY Name          |                        |                       |                       |
 |      =example.org       |                        |                       |                       |
 | AUTHORITY Type=SOA      |                        |                       |                       |
 |                         |                        |                       |                       |
 v                         v                        v                       v                       v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)(Judgment *6)
7. TN send query response to the data not found error to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any

	TC	0
	RD	1
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)

	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org

	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org(Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (86400)
	RDLENGTH	33
	MNAME	NS4.example.org (NS4 + Pointer 0xC00C)
	RNAME	root.example.org (root + Pointer 0xC00C)
	SERIAL	2005080300
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ

UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (86400)
	RDLENGTH	33
	MNAME	NS4.example.org (NS4 + Pointer 0xC00C)
	RNAME	root.example.org (root + Pointer 0xC00C)
	SERIAL	2005080300
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=HINFO.
4. Received standard query including QNAME=A.example.org, QTYPE=HINFO.
6. Received standard query including QNAME=A.example.org, QTYPE=HINFO.
8. Received standard query response including the data not found error(NODATA).

References

RFC1035 DOMAIN NAMES - CONCEPTS AND FACILITIES
5.2.1. Typical functions

5.52. Encounters a CNAME

Purpose

Verify that a NUT restarts the query when it encounters a CNAME

- In most cases a resolver simply restarts the query at the new name when it encounters a CNAME.
- If the response contains a CNAME, the search is restarted at the CNAME unless the response has the data for the canonical name or if the CNAME is the answer itself.

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
 .                    3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.          3600000               A      192.168.1.20
```

For IPv6

```
 .                    3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.          3600000        AAAA   3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL      86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
          2005081600     ; serial
          3600           ; refresh every 1 hr
          900            ; retry every 15 min
          604800         ; expire after a week
          3600           ; Minimum TTL of a 1 hr
 )
 ;
          IN     NS     NS1.example.com.
 NS1      IN     A      192.168.0.10
```

Procedure

This test sequence is following.

```
Client1 (TN)    DNS Server1 (NUT)      DNS Server2 (TN)          DNS Server3 (TN)       DNS Server4 (TN)
 |                          |                       |                     |                        |
 |-------------------------->|                       |                     |                        |
 |1.Send standard query     |                       |                     |                        |
 | QNAME=B.example.org      |                       |                     |                        |
 | QTYPE=A                  |                       |                     |                        |
 |                          |----------------------->|                     |                        |
 |                          |2.Send standard query  |                     |                        |
 |                          | QNAME=B.example.org   |                     |                        |
 |                          | QTYPE=A               |                     |                        |
 |                          |<-----------------------|                     |                        |
 |                          |3.Send standard response|                     |                        |
 |                          | QNAME=B.example.org   |                     |                        |
 |                          | QTYPE=A               |                     |                        |
 |                          | AUTHORITY Name=org    |                     |                        |
 |                          | AUTHORITY Name Server |                     |                        |
 |                          |      =NS3.example.org |                     |                        |
 |                          | ADDITIONAL Name       |                     |                        |
 |                          |      =NS3.example.org |                     |                        |
 |                          | ADDITIONAL Address    |                     |                        |
 |                          |      =192.168.1.30    |                     |                        |
 |                          |----------------------------------------------->|                        |
 |                          |                       |4.Send standard query |                        |
 |                          |                       | QNAME=B.example.org  |                        |
 |                          |                       | QTYPE=A              |                        |
 |                          |<-----------------------------------------------|                        |
 |                          |                       |5.Send standard       |                        |
 |                          |                       |             response |                        |
 |                          |                       | QNAME=B.example.org  |                        |
 |                          |                       | QTYPE=A              |                        |
 |                          |                       | AUTHORITY Name       |                        |
 |                          |                       |      =example.org    |                        |
 |                          |                       | AUTHORITY Name Server|                        |
 |                          |                       |      =NS4.example.org|                        |
 |                          |                       | ADDITIONAL Name      |                        |
 |                          |                       |      =NS4.example.org|                        |
 |                          |                       | ADDITIONAL Address   |                        |
 |                          |                       |      =192.168.1.40   |                        |
 |                          |-------------------------------------------------------------------------->|
 |                          |                       |                     |6.Send standard query   |
 |                          |                       |                     | QNAME=B.example.org    |
 |                          |                       |                     | QTYPE=A                |
 |                          |<--------------------------------------------------------------------------|
 |                          |                       |                     |7.Send standard response|
 |                          |                       |                     | QNAME=B.example.org    |
 |                          |                       |                     | QTYPE=A                |
 |                          |                       |                     | ANSWER Name            |
 |                          |                       |                     |       =B.example.org   |
 |                          |                       |                     | ANSWER Type=CNAME      |
 |                          |                       |                     | ANSWER CNAME           |
 |                          |                       |                     |       =A.example.org   |
 |                          |                       |                     | AUTHORITY Name         |
 |                          |                       |                     |       =example.org     |
 |                          |                       |                     | AUTHORITY Name Server  |
 |                          |                       |                     |       =NS4.example.org |
 |                          |                       |                     | ADDITIONAL Name        |
 |                          |                       |                     |       =NS4.example.org |
 |                          |                       |                     | ADDITIONAL Address     |
 |                          |                       |                     |       =192.168.1.40    |
```

```
|                         |-------------------------------------------------------------------------->|
|                         |                      |                     |8.Send standard query   |
|                         |                      |                     | QNAME=A.example.org    |
|                         |                      |                     | QTYPE=A                |
|                         |<--------------------------------------------------------------------------|
|                         |                      |                     |9.Send standard response|
|                         |                      |                     | QNAME=A.example.org    |
|                         |                      |                     | QTYPE=A                |
|                         |                      |                     | ANSWER Name            |
|                         |                      |                     |       =A.example.org   |
|                         |                      |                     | ANSWER Address         |
|                         |                      |                     |       =192.168.1.10    |
|                         |                      |                     | AUTHORITY Name         |
|                         |                      |                     |       =example.org     |
|                         |                      |                     | AUTHORITY Name Server  |
|                         |                      |                     |       =NS4.example.org |
|                         |                      |                     | ADDITIONAL Name        |
|                         |                      |                     |       =NS4.example.org |
|                         |                      |                     | ADDITIONAL Address     |
|                         |                      |                     |       =192.168.1.40    |
|<-------------------------|                      |                     |                        |
|10.Standard query response|                      |                     |                        |
| QNAME=B.example.org      |                      |                     |                        |
| QTYPE=A                  |                      |                     |                        |
| ANSWER Name=B.example.org|                      |                     |                        |
| ANSWER Type=CNAME        |                      |                     |                        |
| ANSWER CNAME             |                      |                     |                        |
|         =A.example.org   |                      |                     |                        |
| ANSWER Name=A.example.org|                      |                     |                        |
| ANSWER Address           |                      |                     |                        |
|          =192.168.1.10   |                      |                     |                        |
| AUTHORITY Name           |                      |                     |                        |
|          =example.org    |                      |                     |                        |
| AUTHORITY Name Server    |                      |                     |                        |
|          =NS4.example.org|                      |                     |                        |
|                          |                      |                     |                        |
v                         v                      v                     v                        v
```

1. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=B.example.org, ANSWER type=CNAME, CNAME=A.example.com.
8. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *8)
9. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10 to NUT.
10. NUT transmits query response to DNS Client1 (TN) (Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ

UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	1
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any

	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	1
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1

	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	CNAME	A.example.com (A + Pointer 0xC00E)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	1
	OPCODE	0
	AA	any
	TC	0

	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	CNAME	A.example.com (A + Pointer 0xC00E)
DNS Answer section	NAME	A.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=B.example.org, QTYPE=A.
4. Received standard query including QNAME=B.example.org, QTYPE=A.
6. Received standard query including QNAME=B.example.org, QTYPE=A.
8. Received standard query including QNAME=A.example.org, QTYPE=A.
10. Received standard query response including correct two Answer section.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  5.2.2. Aliases
  5.3.3. Algorithm
RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
  2.2.1 Special Handling of No Data

5.53. Multiple levels of aliases should be avoided, but should not be signaled as an error

Purpose

Verify that a NUT does not signal as an error when defined multiple levels of aliases.

- Several special conditions can occur with aliases. Multiple levels of aliases should be avoided due to their lack of efficiency, but should not be signaled as an error.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 6 Topology No.6".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
NS1      IN        A         192.168.0.10
A        IN        A         192.168.0.10
;
B        IN        CNAME     C.example.com.
C        IN        CNAME     A.example.com.
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
      |                                       |
      |--------------------------------------->|
      |   1. Send standard query              |
      |       QNAME=B.example.com             |
      |       QTYPE=CNAME                     |
      |<---------------------------------------|
      |   2. Standard query response          |
      |       QNAME=B.example.com             |
      |       QTYPE=CNAME                     |
      |       ANSWER Name=B.example.com       |
      |       ANSWER Type=CNAME               |
      |       ANSWER CNAME=C.example.com      |
      | *at lease include this Answer section|
      |--------------------------------------->|
      |   3. Send standard query              |
      |       QNAME=C.example.com             |
      |       QTYPE=CNAME                     |
      |<---------------------------------------|
      |   4. Standard query response          |
      |       QNAME=C.example.com             |
      |       QTYPE=CNAME                     |
      |       ANSWER Name=C.example.com       |
      |       ANSWER Type=CNAME               |
      |       ANSWER CNAME=A.example.com      |
      |                                       |
      v                                       v

       1. TN send standard query QNAME=B.example.com, QTYPE=A to NUT.
       2. NUT reply query response including CNAME=C.example.com to TN (Judgment *2)
       3. TN send standard query QNAME=C.example.com, QTYPE=A to NUT.
       4. NUT reply query response including CNAME=A.example.com to TN (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.com
	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.com (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	CNAME	C.example.com (C + Pointer 0xC00E)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6

	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	C.example.com
	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	ANY
	TC	0

	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	C.example.com
	QTYPE	CNAME (0x0005)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	C.example.com (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	CNAME	A.example.com (A + Pointer 0xC00E)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response including CNAME for B.example.com.
4. Received standard query response including CNAME for C.example.com.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
5.2.2. Aliases

5.54. Cache data vs. authoritative data

Purpose

Verify that a NUT uses the authoritative data in preference to cached data

- If the resolver has direct access to a name server's zones, it should check to see if the desired data is present in authoritative form, and if so, use the authoritative data in preference to cached data.

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig.2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Enable the option that disregards the cached data.

  Example of root server list:

For IPv4:

```
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20
```

For IPv6

```
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
```

Procedure

This test sequence is following.

```
Client1 (TN)    DNS Server1 (NUT)       DNS Server2 (TN)        DNS Server3 (TN)     DNS Server4 (TN)
 |                      |                       |                       |                      |
 |---------------------->|                       |                       |                      |
 |1.Send standard query  |                       |                       |                      |
 | QNAME=A.example.org   |                       |                       |                      |
 | QTYPE=A               |                       |                       |                      |
 |                       |----------------------->|                       |                      |
 |                       |2.Send standard query   |                       |                      |
 |                       | QNAME=A.example.org    |                       |                      |
 |                       | QTYPE=A                |                       |                      |
 |                       |<-----------------------|                       |                      |
 |                       |3.Send standard response|                       |                      |
 |                       | QNAME=A.example.org    |                       |                      |
 |                       | QTYPE=A                |                       |                      |
 |                       | AUTHORITY Name=org     |                       |                      |
 |                       | AUTHORITY Name Server  |                       |                      |
 |                       |      =NS3.example.org  |                       |                      |
 |                       | ADDITIONAL Name        |                       |                      |
 |                       |      =NS3.example.org  |                       |                      |
 |                       | ADDITIONAL Address     |                       |                      |
 |                       |      =192.168.1.30     |                       |                      |
 |                       |------------------------------------------------>|                      |
 |                       |                       |4.Send standard query |                      |
 |                       |                       | QNAME=A.example.org  |                      |
 |                       |                       | QTYPE=A              |                      |
 |                       |<------------------------------------------------|                      |
 |                       |                       |5.Send standard       |                      |
 |                       |                       |              response|                      |
 |                       |                       | QNAME=A.example.org  |                      |
 |                       |                       | QTYPE=A              |                      |
 |                       |                       | AUTHORITY Name       |                      |
 |                       |                       |      =example.org    |                      |
 |                       |                       | AUTHORITY Name Server|                      |
 |                       |                       |      =NS4.example.org|                      |
 |                       |                       | ADDITIONAL Name      |                      |
 |                       |                       |      =NS4.example.org|                      |
 |                       |                       |  ADDITIONAL Address  |                      |
 |                       |                       |      =192.168.1.40   |                      |
 |                       |-------------------------------------------------------------------->|
 |                       |                       |                      |6.Send standard query |
 |                       |                       |                      | QNAME=A.example.org  |
 |                       |                       |                      | QTYPE=A              |
 |                       |<--------------------------------------------------------------------|
 |                       |                       |                      |7.Send standard       |
 |                       |                       |                      |              response |
 |                       |                       |                      | QNAME=A.example.org  |
 |                       |                       |                      | QTYPE=A              |
 |                       |                       |                      | ANSWER Name          |
 |                       |                       |                      |       =A.example.org |
 |                       |                       |                      | ANSWER Address       |
 |                       |                       |                      |       =192.168.1.10  |
 |                       |                       |                      | AUTHORITY Name       |
 |                       |                       |                      |     =example.org     |
 |                       |                       |                      | AUTHORITY Name Server|
 |                       |                       |                      |     =NS4.example.org |
 |                       |                       |                      | ADDITIONAL Name      |
 |                       |                       |                      |     =NS4.example.org |
 |                       |                       |                      | ADDITIONAL Address   |
 |                       |                       |                      |     =192.168.1.40    |
```

```
|<----------------------|                       |                     |                     |
|8.Standard query       |                       |                     |                     |
|               response|                       |                     |                     |
| QNAME=A.example.org   |                       |                     |                     |
| QTYPE=A               |                       |                     |                     |
| ANSWER Name           |                       |                     |                     |
|       =A.example.org  |                       |                     |                     |
| ANSWER Address        |                       |                     |                     |
|       =192.168.1.10   |                       |                     |                     |
| AUTHORITY Name        |                       |                     |                     |
|       =example.org    |                       |                     |                     |
| AUTHORITY Name Server |                       |                     |                     |
|       =NS4.example.org|                       |                     |                     |
|---------------------->|                       |                     |                     |
|9.Send standard query  |                       |                     |                     |
| QNAME=A.example.org   |                       |                     |                     |
| QTYPE=A               |                       |                     |                     |
|                       |*disregard the cached data                   |                     |
|                       |----------------------->|                    |                     |
|                       |10.Send standard query  |                    |                     |
|                       | QNAME=A.example.org    |                    |                     |
|                       | QTYPE=A                |                    |                     |
|                       |<-----------------------|                    |                     |
|                       |11.Send standard        |                    |                     |
|                       |               response |                    |                     |
|                       | QNAME=A.example.org    |                    |                     |
|                       | QTYPE=A                |                    |                     |
|                       | AUTHORITY Name=org     |                    |                     |
|                       | AUTHORITY Name Server  |                    |                     |
|                       |       =NS4.example.org |                    |                     |
|                       | ADDITIONAL Name        |                    |                     |
|                       |        =NS4.example.org|                    |                     |
|                       | ADDITIONAL Address     |                    |                     |
|                       |        =192.168.1.30   |                    |                     |
|                       |------------------------------------------->|                     |
|                       |                       |12.Send standard query|                  |
|                       |                       | QNAME=A.example.org  |                  |
|                       |                       | QTYPE=A              |                  |
|                       |<-------------------------------------------|                     |
|                       |                       |13.Send standard      |                  |
|                       |                       |              response |                  |
|                       |                       | QNAME=A.example.org  |                  |
|                       |                       | QTYPE=A              |                  |
|                       |                       | AUTHORITY Name       |                  |
|                       |                       |      =example.org    |                  |
|                       |                       | AUTHORITY Name Server|                  |
|                       |                       |      =NS4.example.org|                  |
|                       |                       | ADDITIONAL Name      |                  |
|                       |                       |      =NS4.example.org|                  |
|                       |                       | ADDITIONAL Address   |                  |
|                       |                       |      =192.168.1.40   |                  |
|                       |------------------------------------------------------------------>|
|                       |                       |                     |14.Send standard query|
|                       |                       |                     | QNAME=A.example.org  |
|                       |                       |                     | QTYPE=A              |
|                       |<------------------------------------------------------------------|
```

```
|                      |                      |                     |15.Send standard      |
|                      |                      |                     |            response  |
|                      |                      |                     | QNAME=A.example.org  |
|                      |                      |                     | QTYPE=A              |
|                      |                      |                     | ANSWER Name          |
|                      |                      |                     |      =A.example.org  |
|                      |                      |                     | ANSWER Address       |
|                      |                      |                     |      =192.168.1.10   |
|                      |                      |                     | AUTHORITY Name       |
|                      |                      |                     |      =example.org    |
|                      |                      |                     | AUTHORITY Name Server|
|                      |                      |                     |      =NS4.example.org|
|                      |                      |                     | ADDITIONAL Name      |
|                      |                      |                     |      =NS4.example.org|
|                      |                      |                     | ADDITIONAL Address   |
|                      |                      |                     |      =192.168.1.40   |
|<---------------------|                      |                     |                      |
|16.Standard query     |                      |                     |                      |
|               response|                      |                     |                      |
| QNAME=A.example.org  |                      |                     |                      |
| QTYPE=A              |                      |                     |                      |
| ANSWER Name          |                      |                     |                      |
|      =A.example.org  |                      |                     |                      |
| ANSWER Address       |                      |                     |                      |
|      =192.168.1.10   |                      |                     |                      |
| AUTHORITY Name       |                      |                     |                      |
|      =example.org    |                      |                     |                      |
| AUTHORITY Name Server |                      |                     |                      |
|      =NS4.example.org|                      |                     |                      |
|                      |                      |                     |                      |
v                      v                      v                     v                      v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10 to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)
9. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
10. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *10)
11. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
12. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *12)
13. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
14. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *14)
15. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10 to NUT.
16. NUT transmits query response to DNS Client1 (TN) (Judgment *16)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ

UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000

	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

11th packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

12th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any

	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

13th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

14th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

15th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1

	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

16th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0

	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response including correct address in the ADDRESS field.
10. Received standard query including QNAME=A.example.org, QTYPE=A.
12. Received standard query including QNAME=A.example.org, QTYPE=A.
14. Received standard query including QNAME=A.example.org, QTYPE=A.
16. Received standard query response including correct address in the ADDRESS field.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
5.3.2. Resources
5.3.3. Algorithm
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
7.4. Using the cache

5.55. Answer in local information

Purpose

Verify that a NUT uses the cached data

- Searches the cache for the desired data. If the data is in the cache, it is assumed to be good enough for normal use.
- The resolver MUST implement a local caching function to avoid repeated remote access for identical requests.

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig.2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600      ; serial
         3600            ; refresh every 1 hr
         900             ; retry every 15 min
         604800          ; expire after a week
         3600            ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)       DNS Server1 (NUT)      DNS Server2 (TN)       DNS Server3 (TN)      DNS Server4 (TN)
 |                        |                       |                      |                     |
 |------------------------>|                       |                      |                     |
 |1.Send standard query    |                       |                      |                     |
 | QNAME=A.example.org     |                       |                      |                     |
 | QTYPE=A                 |                       |                      |                     |
 |                         |------------------------>|                      |                     |
 |                         |2.Send standard query   |                      |                     |
 |                         | QNAME=A.example.org    |                      |                     |
 |                         | QTYPE=A                |                      |                     |
 |                         |<------------------------|                      |                     |
 |                         |3.Send standard response|                      |                     |
 |                         | QNAME=A.example.org    |                      |                     |
 |                         | QTYPE=A                |                      |                     |
 |                         | AUTHORITY Name=org     |                      |                     |
 |                         | AUTHORITY Name Server  |                      |                     |
 |                         |      =NS3.example.org  |                      |                     |
 |                         | ADDITIONAL Name        |                      |                     |
 |                         |      =NS3.example.org  |                      |                     |
 |                         | ADDITIONAL Address     |                      |                     |
 |                         |      =192.168.1.30     |                      |                     |
 |                         |------------------------------------------------>|                     |
 |                         |                        |4.Send standard query |                     |
 |                         |                        | QNAME=A.example.org  |                     |
 |                         |                        | QTYPE=A              |                     |
 |                         |<------------------------------------------------|                     |
 |                         |                        |5.Send standard       |                     |
 |                         |                        |              response |                     |
 |                         |                        | QNAME=A.example.org  |                     |
 |                         |                        | QTYPE=A              |                     |
 |                         |                        | AUTHORITY Name       |                     |
 |                         |                        |      =example.org    |                     |
 |                         |                        | AUTHORITY Name Server|                     |
 |                         |                        |      =NS4.example.org|                     |
 |                         |                        | ADDITIONAL Name      |                     |
 |                         |                        |      =NS4.example.org|                     |
 |                         |                        |  ADDITIONAL Address  |                     |
 |                         |                        |      =192.168.1.40   |                     |
 |                         |------------------------------------------------------------------------>|
 |                         |                        |                      |6.Send standard query |
 |                         |                        |                      | QNAME=A.example.org  |
 |                         |                        |                      | QTYPE=A              |
 |                         |<------------------------------------------------------------------------|
 |                         |                        |                      |7.Send standard response |
 |                         |                        |                      | QNAME=A.example.org  |
 |                         |                        |                      | QTYPE=A              |
 |                         |                        |                      | ANSWER Name = A.example.org|
 |                         |                        |                      | ANSWER Address       |
 |                         |                        |                      |      =192.168.1.10   |
 |                         |                        |                      | AUTHORITY Name       |
 |                         |                        |                      |      =example.org    |
 |                         |                        |                      | AUTHORITY Name Server|
 |                         |                        |                      |      =NS4.example.org|
 |                         |                        |                      | ADDITIONAL Name      |
 |                         |                        |                      |      =NS4.example.org|
 |                         |                        |                      | ADDITIONAL Address   |
 |                         |                        |                      |      =192.168.1.40   |
```

```
|<------------------------|                      |                     |                     |
|8.Standard query response|                      |                     |                     |
| QNAME=A.example.org     |                      |                     |                     |
| QTYPE=A                 |                      |                     |                     |
| ANSWER Name             |                      |                     |                     |
|       =A.example.org    |                      |                     |                     |
| ANSWER Address          |                      |                     |                     |
|       =192.168.1.10     |                      |                     |                     |
| AUTHORITY Name          |                      |                     |                     |
|       =example.org      |                      |                     |                     |
| AUTHORITY Name Server   |                      |                     |                     |
|       =NS4.example.org  |                      |                     |                     |
|------------------------>|                      |                     |                     |
|9.Send standard query    |                      |                     |                     |
| QNAME=A.example.org     |                      |                     |                     |
| QTYPE=A                 |                      |                     |                     |
|<------------------------|                      |                     |                     |
|10.Standard query response |                    |                     |                     |
| QNAME=A.example.org     |                      |                     |                     |
| QTYPE=A                 |                      |                     |                     |
| ANSWER Name = A.example.org|                   |                     |                     |
| ANSWER Address          |                      |                     |                     |
|        =192.168.1.10    |                      |                     |                     |
| AUTHORITY Name          |                      |                     |                     |
|       =example.org      |                      |                     |                     |
| AUTHORITY Name Server   |                      |                     |                     |
|       =NS4.example.org  |                      |                     |                     |
|                         |                      |                     |                     |
v                         v                      v                     v                     v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server)(Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10 to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)
9. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
10. NUT transmits query response to DNS Client1 (TN) (Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0

	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses

DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any

	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1

	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	any
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	any
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)

	TTL	Any
	RDLENGTH	4
	ADDRESS	192.168.1.40

- Termination
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response including correct address in the ADDRESS field.
10. Received standard query response including correct address in the ADDRESS field.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  5.3.3. Algorithm
RFC1123 Requirements for Internet Hosts -- Application and Support
  6.1.3.1 Resolver Implementation

5.56. Sending query to servers

Purpose

Verify that a NUT transmits standard query to multiple servers.

- Send out queries until a response is received. The strategy is to cycle around all of the addresses for all of the servers with a timeout between each transmission. Searches the cache for the desired data.

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 19 Topology No.19".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600      ; serial
         3600            ; refresh every 1 hr
         900             ; retry every 15 min
         604800          ; expire after a week
         3600            ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)    DNS Server1 (NUT)       DNS Server2 (TN)         DNS Server3 (TN)      DNS Server4 (TN)
 |                    |                       |                       |                       |
 |------------------->|                       |                       |                       |
 |1.Send standard query|                      |                       |                       |
 | QNAME=A.example.org |                      |                       |                       |
 | QTYPE=A            |                       |                       |                       |
 |                    |----------------------->|                       |                       |
 |                    |2.Send standard query   |                       |                       |
 |                    | QNAME=A.example.org    |                       |                       |
 |                    | QTYPE=A                |                       |                       |
 |                    |<-----------------------|                       |                       |
 |                    |3.Send standard response|                       |                       |
 |                    | QNAME=A.example.org    |                       |                       |
 |                    | QTYPE=A                |                       |                       |
 |                    | AUTHORITY Name=org     |                       |                       |
 |                    | AUTHORITY Name Server  |                       |                       |
 |                    |      =NS3.example.org  |                       |                       |
 |                    | AUTHORITY Name=org     |                       |                       |
 |                    | AUTHORITY Name Server  |                       |                       |
 |                    |      =NS3.example.org  |                       |                       |
 |                    | ADDITIONAL Name        |                       |                       |
 |                    |      =NS3.example.org  |                       |                       |
 |                    | ADDITIONAL Address     |                       |                       |
 |                    |      =192.168.1.30     |                       |                       |
 |                    | ADDITIONAL Name        |                       |                       |
 |                    |      =NS3.example.org  |                       |                       |
 |                    | ADDITIONAL Address     |                       |                       |
 |                    |      =192.168.1.40     |                       |                       |
 |                    |------------------------------------------------------->|                       |
 |                    |                       |4.Send standard query   |                       |
 |                    |                       | QNAME=A.example.org    |                       |
 |                    |                       | QTYPE=A                |                       |
 |                    | X <-------------------------------------------------|                       |
 |                    |                       |5.Send standard response|                       |
 |                    |                       | QNAME=A.example.org    |                       |
 |                    |                       | QTYPE=A                |                       |
 |                    |                       | AUTHORITY Name         |                       |
 |                    |                       |      =example.org      |                       |
 |                    |                       | AUTHORITY Name Server  |                       |
 |                    |                       |      =NS4.example.org  |                       |
 |                    |                       | ADDITIONAL Name        |                       |
 |                    |                       |      =NS4.example.org  |                       |
 |                    |                       | ADDITIONAL Address     |                       |
 |                    |                       |      =192.168.1.40     |                       |
 |                    |------------------------------------------------------------------------------->|
 |                    |                       |                       |6.Send standard query   |
 |                    |                       |                       | QNAME=A.example.org    |
 |                    |                       |                       | QTYPE=A                |
```

```
|                    | X <-------------------------------------------------------------------|
|                    |                       |                       |7.Send standard response|
|                    |                       |                       | QNAME=A.example.org    |
|                    |                       |                       | QTYPE=A                |
|                    |                       |                       | ANSWER Name            |
|                    |                       |                       |       =A.example.org   |
|                    |                       |                       | ANSWER Address         |
|                    |                       |                       |       =192.168.1.10    |
|                    |                       |                       | AUTHORITY Name         |
|                    |                       |                       |       =example.org     |
|                    |                       |                       | AUTHORITY Name Server  |
|                    |                       |                       |       =NS4.example.org |
|                    |                       |                       | ADDITIONAL Name        |
|                    |                       |                       |       =NS4.example.org |
|                    |                       |                       | ADDITIONAL Address     |
|                    |                       |                       |       =192.168.1.40    |
|                    |                       |                       |                        |
v                    v                       v                       v                        v

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org)
   (Judgment *4A)
5. TN doesn't send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name
   Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
   (Judgment *4B)
7. TN doesn't send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10 to NUT.
*Even if order is reverse, 4,5 and 6,7 are acceptable.
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	2
	ARCOUNT	2
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30
DNS Additional section	NAME	NS3.example.org (Pointer 0xC03D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0

	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

*Even if order is reverse, 4th and 5th packets are acceptable.

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.

*The order of 4. and 6. might become opposite.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
5.3.3. Algorithm

5.57. Analyze the response (delegation)

Purpose

Verify that a NUT uses better delegation servers

- If the delegation is valid the NS delegation RRs and any address RRs for the servers should be cached.

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.
  Example of root server list:

For IPv4:

```
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                A       192.168.1.20
```

For IPv6

```
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000        AAAA    3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)       DNS Server1 (NUT)    DNS Server2 (TN)   DNS Server3 (TN)        DNS Server4 (TN)
  |                    |                        |                  |                      |
  |------------------->|                        |                  |                      |
  |1.Send standard query |                      |                  |                      |
  |  QNAME=A.example.org |                      |                  |                      |
  |  QTYPE=A           |                        |                  |                      |
  |                    |------------------------>|                  |                      |
  |                    |2.Send standard query   |                  |                      |
  |                    |  QNAME=A.example.org   |                  |                      |
  |                    |  QTYPE=A               |                  |                      |
  |                    |<------------------------|                  |                      |
  |                    |3.Send standard response |                  |                      |
  |                    |  QNAME=A.example.org   |                  |                      |
  |                    |  QTYPE=A               |                  |                      |
  |                    |  AUTHORITY Name        |                  |                      |
  |                    |         =example.org   |                  |                      |
  |                    |  AUTHORITY Name Server |                  |                      |
  |                    |         =NS4.example.org|                  |                      |
  |                    |  ADDITIONAL Name       |                  |                      |
  |                    |         =NS4.example.org|                  |                      |
  |                    |  ADDITIONAL Address    |                  |                      |
  |                    |         =192.168.1.40  |                  |                      |
  |                    |-------------------------------------------------------------------->|
  |                    |                        |                  |4.Send standard query |
  |                    |                        |                  |  QNAME=A.example.org |
  |                    |                        |                  |  QTYPE=A             |
  |                    |                        |                  |                      |
  v                    v                        v                  v                      v

  1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
  2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
  3. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
  4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
     (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1

	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

4th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any

	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
5.3.3. Algorithm

5.58. Analyze the response (caching delegation)

Purpose

Verify that a NUT caches better delegation servers

- If the delegation is valid the NS delegation RRs and any address RRs for the servers should be cached.

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)    DNS Server1 (NUT)                DNS Server2 (TN)  DNS Server3 (TN)          DNS Server4 (TN)
 |                        |                              |                |                              |
 |------------------------>|                              |                |                              |
 |1.Send standard query    |                              |                |                              |
 | QNAME=A.example.org     |                              |                |                              |
 | QTYPE=A                 |                              |                |                              |
 |                         |------------------------------>|                |                              |
 |                         |2.Send standard query          |                |                              |
 |                         | QNAME=A.example.org           |                |                              |
 |                         | QTYPE=A                       |                |                              |
 |                         |<------------------------------|                |                              |
 |                         |3.Send standard response       |                |                              |
 |                         | QNAME=A.example.org           |                |                              |
 |                         | QTYPE=A                       |                |                              |
 |                         | AUTHORITY Name =example org   |                |                              |
 |                         | AUTHORITY Name Server         |                |                              |
 |                         |      =NS4.example.org         |                |                              |
 |                         | ADDITIONAL Name=NS4.example.org|               |                              |
 |                         | ADDITIONAL Address=192.168.1.40|               |                              |
 |                         |-------------------------------------------------------------------------------->|
 |                         |                              |                |4.Send standard query          |
 |                         |                              |                | QNAME=A.example.org           |
 |                         |                              |                | QTYPE=A                       |
 |                         |<--------------------------------------------------------------------------------|
 |                         |                              |                |5.Send standard response       |
 |                         |                              |                | QNAME=A.example.org           |
 |                         |                              |                | QTYPE=A                       |
 |                         |                              |                | ANSWER Name = A.example.org   |
 |                         |                              |                | ANSWER Address = 192.168.1.10 |
 |                         |                              |                | AUTHORITY Name = example.org  |
 |                         |                              |                | AUTHORITY Name Server         |
 |                         |                              |                |              =NS4.example.org |
 |                         |                              |                | ADDITIONAL Name=NS4.example.org|
 |                         |                              |                | ADDITIONAL Address=192.168.1.40|
 |<------------------------|                              |                |                              |
 |6.Standard query response|                              |                |                              |
 | QNAME=A.example.org     |                              |                |                              |
 | QTYPE=A                 |                              |                |                              |
 | ANSWER Name             |                              |                |                              |
 |        = A.example.org  |                              |                |                              |
 | ANSWER Address          |                              |                |                              |
 |        = 192.168.1.10   |                              |                |                              |
 | AUTHORITY Name          |                              |                |                              |
 |        = example.org    |                              |                |                              |
 | AUTHORITY Name Server   |                              |                |                              |
 |        =NS4.example.org |                              |                |                              |
 |------------------------>|                              |                |                              |
 |7. Send standard query   |                              |                |                              |
 | QNAME=B.example.org     |                              |                |                              |
 | QTYPE=A                 |                              |                |                              |
 |                         |-------------------------------------------------------------------------------->|
 |                         |                              |                |8. Send standard query         |
 |                         |                              |                | QNAME=B.example.org           |
 |                         |                              |                | QTYPE=A                       |
 v                         v                              v                v                              v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4(TN: NS4.example.org)(Judgment *4)
5. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10 to NUT.
6. NUT transmits query response to DNS Client1 (TN) (Judgment *6)
7. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
8. NUT transmits standard query QNAME=B.example.org,QTYPE=A to DNS Server4(TN: NS4.example.org)(Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

4th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org

	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

7th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)

	QCLASS	IN (0x0001)

8th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query response including correct address in the ADDRESS field.
8. Received standard query including QNAME=B.example.org, QTYPE=A.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
5.3.3. Algorithm

5.59. Analyze the response (caching CNAME)

Purpose

Verify that a NUT caches the query when it encounters a CNAME

- If the response shows a CNAME and that is not the answer itself, cache the CNAME.

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig.2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600      ; serial
         3600            ; refresh every 1 hr
         900             ; retry every 15 min
         604800          ; expire after a week
         3600            ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)    DNS Server1 (NUT)        DNS Server2 (TN)       DNS Server3 (TN)       DNS Server4 (TN)
 |                      |                       |                       |                       |
 |----------------------->|                       |                       |                       |
 |1.Send standard query  |                       |                       |                       |
 | QNAME=B.example.org   |                       |                       |                       |
 | QTYPE=A               |                       |                       |                       |
 |                       |------------------------>|                       |                       |
 |                       |2.Send standard query   |                       |                       |
 |                       | QNAME=B.example.org    |                       |                       |
 |                       | QTYPE=A                |                       |                       |
 |                       |<------------------------|                       |                       |
 |                       |3.Send standard response|                       |                       |
 |                       | QNAME=B.example.org    |                       |                       |
 |                       | QTYPE=A                |                       |                       |
 |                       | AUTHORITY Name = org   |                       |                       |
 |                       | AUTHORITY Name Server  |                       |                       |
 |                       |      =NS3.example.org  |                       |                       |
 |                       | ADDITIONAL Name        |                       |                       |
 |                       |      =NS3.example.org  |                       |                       |
 |                       | ADDITIONAL Address     |                       |                       |
 |                       |      =192.168.1.30     |                       |                       |
 |                       |------------------------------------------------>|                       |
 |                       |                       |4.Send standard query   |                       |
 |                       |                       | QNAME=B.example.org    |                       |
 |                       |                       | QTYPE=A                |                       |
 |                       |<------------------------------------------------|                       |
 |                       |                       |5.Send standard response|                       |
 |                       |                       | QNAME=B.example.org    |                       |
 |                       |                       | QTYPE=A                |                       |
 |                       |                       | AUTHORITY Name         |                       |
 |                       |                       |      =example.org      |                       |
 |                       |                       | AUTHORITY Name Server  |                       |
 |                       |                       |      =NS4.example.org  |                       |
 |                       |                       | ADDITIONAL Name        |                       |
 |                       |                       |      =NS4.example.org  |                       |
 |                       |                       | ADDITIONAL Address     |                       |
 |                       |                       |    =192.168.1.40       |                       |
 |                       |------------------------------------------------------------------------>|
 |                       |                       |                       |6.Send standard query   |
 |                       |                       |                       |  QNAME=B.example.org   |
 |                       |                       |                       |  QTYPE=A               |
 |                       |<------------------------------------------------------------------------|
 |                       |                       |                       |7.Send standard response|
 |                       |                       |                       | QNAME=B.example.org    |
 |                       |                       |                       | QTYPE=A                |
 |                       |                       |                       | ANSWER Name            |
 |                       |                       |                       |       = B.example.org  |
 |                       |                       |                       | ANSWER Type = CNAME    |
 |                       |                       |                       | ANSWER CNAME           |
 |                       |                       |                       |       =A.example.org   |
 |                       |                       |                       | AUTHORITY Name         |
 |                       |                       |                       |       =example.org     |
 |                       |                       |                       | AUTHORITY Name Server  |
 |                       |                       |                       |       =NS4.example.org |
 |                       |                       |                       | ADDITIONAL Name        |
 |                       |                       |                       |       =NS4.example.org |
 |                       |                       |                       | ADDITIONAL Address     |
 |                       |                       |                       |       =192.168.1.40    |
```

```
|                      |-------------------------------------------------------------------------->|
|                      |                      |                      |8.Send standard query   |
|                      |                      |                      | QNAME=B.example.org    |
|                      |                      |                      | QTYPE=A                |
|                      |<--------------------------------------------------------------------------|
|                      |                      |                      |9.Send standard response|
|                      |                      |                      | QNAME=A.example.org    |
|                      |                      |                      | QTYPE=A                |
|                      |                      |                      | ANSWER Name            |
|                      |                      |                      |       =A.example.org   |
|                      |                      |                      | ANSWER Address         |
|                      |                      |                      |       =192.168.1.10    |
|                      |                      |                      | AUTHORITY Name         |
|                      |                      |                      |       =example.org     |
|                      |                      |                      | AUTHORITY Name Server  |
|                      |                      |                      |       =NS4.example.org |
|                      |                      |                      | ADDITIONAL Name        |
|                      |                      |                      |       =NS4.example.org |
|                      |                      |                      | ADDITIONAL Address     |
|                      |                      |                      |       =192.168.1.40    |
|<---------------------|                      |                      |                        |
|10.Standard query     |                      |                      |                        |
|              response |                      |                      |                        |
| QNAME=B.example.org  |                      |                      |                        |
| QTYPE=A              |                      |                      |                        |
| ANSWER Name          |                      |                      |                        |
|        =B.example.org |                      |                      |                        |
| ANSWER Type=CNAME    |                      |                      |                        |
| ANSWER CNAME         |                      |                      |                        |
|        =A.example.org |                      |                      |                        |
| ANSWER Name          |                      |                      |                        |
|       =A.example.org |                      |                      |                        |
| ANSWER Address       |                      |                      |                        |
|       =192.168.1.10  |                      |                      |                        |
| AUTHORITY Name       |                      |                      |                        |
|       =example.org   |                      |                      |                        |
| AUTHORITY Name Server |                      |                      |                        |
|       =NS4.example.org|                      |                      |                        |
|---------------------->|                      |                      |                        |
|11.Send standard query |                      |                      |                        |
| QNAME=B.example.org  |                      |                      |                        |
| QTTYPEA              |                      |                      |                        |
|<---------------------|                      |                      |                        |
|12.Standard Query     |                      |                      |                        |
|              response |                      |                      |                        |
| QNAME=B.example.org  |                      |                      |                        |
| QTYPE=A              |                      |                      |                        |
| ANSWER Name          |                      |                      |                        |
|       =B.example.org |                      |                      |                        |
| ANSWER Type=CNAME    |                      |                      |                        |
| ANSWER CNAME         |                      |                      |                        |
|       =A.example.org |                      |                      |                        |
| ANSWER Name          |                      |                      |                        |
|       =A.example.org |                      |                      |                        |
| ANSWER Address       |                      |                      |                        |
|       =192.168.1.10  |                      |                      |                        |
| AUTHORITY Name       |                      |                      |                        |
|       =example.org   |                      |                      |                        |
| AUTHORITY Name Server |                      |                      |                        |
v       =NS4.example.orgv                      v                      v                        v
```

1. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=B.example.org, ANSWER type=CNAME, CNAME=A.example.com.
8. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *8)
9. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10 to NUT.
10. NUT transmits query response to DNS Client1 (TN) (Judgment *10)
11. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
12. NUT transmits query response to DNS Client1 (TN) (Judgment *12)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any

	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1

	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any

	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	CNAME	A.example.com (A + Pointer 0xC00E)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)

DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	CNAME	A.example.com (A + Pointer 0xC00E)
DNS Answer section	NAME	A.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

11th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0

	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

12th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	any
	RDLENGTH	4

	CNAME	A.example.com (A + Pointer 0xC00E)
DNS Answer section	NAME	A.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	any
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	any
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	any
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=B.example.org, QTYPE=A.
4. Received standard query including QNAME=B.example.org, QTYPE=A.
6. Received standard query including QNAME=B.example.org, QTYPE=A.
8. Received standard query including QNAME=A.example.org, QTYPE=A.
10. Received standard query response including correct two Answer section.
11. Received standard query including QNAME=A.example.org, QTYPE=A.
12. Received standard query response including correct two Answer section.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
5.3.3. Algorithm

5.60. Analyze the response (answer is invalid)

Purpose

Verify that a NUT checks the query which has invalid ID field.

- The resolver should be highly paranoid in its parsing of responses. It should also check that the response matches the query it sent using the ID field in the response.

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 2 Topology No.2".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)    DNS Server1 (NUT)      DNS Server2 (TN)         DNS Server3 (TN)      DNS Server4 (TN)
  |                     |                       |                       |                       |
  |---------------------->|                       |                       |                       |
  |1.Send standard query |                       |                       |                       |
  | QNAME=B.example.org  |                       |                       |                       |
  | QTYPE=A              |                       |                       |                       |
  |                      |------------------------>|                       |                       |
  |                      |2.Send standard query   |                       |                       |
  |                      | QNAME=B.example.org    |                       |                       |
  |                      | QTYPE=A                |                       |                       |
  |                      |<------------------------|                       |                       |
  |                      |3.Send standard response|                       |                       |
  |                      | QNAME=B.example.org    |                       |                       |
  |                      | QTYPE=A                |                       |                       |
  |                      | AUTHORITY Name = org   |                       |                       |
  |                      | AUTHORITY Name Server  |                       |                       |
  |                      |      =NS3.example.org  |                       |                       |
  |                      | ADDITIONAL Name        |                       |                       |
  |                      |      =NS3.example.org  |                       |                       |
  |                      | ADDITIONAL Address     |                       |                       |
  |                      |      =192.168.1.30     |                       |                       |
  |                      |------------------------------------------------>|                       |
  |                      |                        |4.Send standard query   |                       |
  |                      |                        | QNAME=B.example.org    |                       |
  |                      |                        | QTYPE=A                |                       |
  |                      |<------------------------------------------------|                       |
  |                      |                        |5.Send standard response|                       |
  |                      |                        | QNAME=B.example.org    |                       |
  |                      |                        | QTYPE=A                |                       |
  |                      |                        | AUTHORITY Name         |                       |
  |                      |                        |      =example.org      |                       |
  |                      |                        | AUTHORITY Name Server  |                       |
  |                      |                        |      =NS4.example.org  |                       |
  |                      |                        | ADDITIONAL Name        |                       |
  |                      |                        |      =NS4.example.org  |                       |
  |                      |                        | ADDITIONAL Address     |                       |
  |                      |                        |    =192.168.1.40       |                       |
  |                      |-------------------------------------------------------------------------->|
  |                      |                        |                        |6.Send standard query   |
  |                      |                        |                        |  QNAME=B.example.org   |
  |                      |                        |                        |  QTYPE=A               |
  |                      |<--------------------------------------------------------------------------|
  |                      |                        |                        |7.Send standard response|
  |                      |                        |                        |ID=Not same as 6's query|
  |                      |                        |                        | QNAME=B.example.org    |
  |                      |                        |                        | QTYPE=A                |
  |                      |                        |                        | ANSWER Name            |
  |                      |                        |                        |       = B.example.org  |
  |                      |                        |                        | ANSWER Type = CNAME    |
  |                      |                        |                        | ANSWER CNAME           |
  |                      |                        |                        |       =A.example.org   |
  |                      |                        |                        | AUTHORITY Name         |
  |                      |                        |                        |       =example.org     |
  |                      |                        |                        | AUTHORITY Name Server  |
  |                      |                        |                        |       =NS4.example.org |
  |                      |                        |                        | ADDITIONAL Name        |
  |                      |                        |                        |       =NS4.example.org |
  |                      |                        |                        | ADDITIONAL Address     |
  |                      |                        |                        |       =192.168.1.40    |
```

```
|                    |-------------------------------------------------------------------------->|
|                    |                      |                      |8.Send standard query   |
|                    |                      |                      | QNAME=A.example.org    |
|                    |                      |                      | QTYPE=A                |
|                    |                      |                      |                        |
v                    v                      v                      v                        v
```

1. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=B.example.org, ANSWER type=CNAME, CNAME=A.example.com.
8. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY

UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)

	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses

	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any

	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	0xffff (Not same as 6th Packet's ID)
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	CNAME	A.example.com (A + Pointer 0xC00E)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6

	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=B.example.org, QTYPE=A.
4. Received standard query including QNAME=B.example.org, QTYPE=A.
6. Received standard query including QNAME=B.example.org, QTYPE=A.
8. Not received standard query including QNAME=A.example.org, QTYPE=A.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
5.3.3. Algorithm

5.61. Analyze the response (delegation is invalid)

Purpose

Verify that a NUT checks the query which has invalid delegation.

- If the response shows a delegation, the resolver should check to see that the delegation is "closer" to the answer than the servers in SLIST are.

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 20 Topology No.20".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20

For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
 Client1 (TN)    DNS Server1 (NUT)        DNS Server2 (TN)          DNS Server3 (TN)      DNS Server4
(TN)
  |                     |                        |                         |                     |
  |-------------------->|                        |                         |                     |
  |1.Send standard query|                        |                         |                     |
  | QNAME=A.example.org |                        |                         |                     |
  | QTYPE=A             |                        |                         |                     |
  |                     |------------------------>|                        |                     |
  |                     |2.Send standard query   |                         |                     |
  |                     | QNAME=A.example.org    |                         |                     |
  |                     | QTYPE=A                |                         |                     |
  |                     |<------------------------|                        |                     |
  |                     |3.Send standard response|                         |                     |
  |                     | QNAME=A.example.org    |                         |                     |
  |                     | QTYPE=A                |                         |                     |
  |                     | AUTHORITY Name = org   |                         |                     |
  |                     | AUTHORITY Name Server  |                         |                     |
  |                     |      =NS3.example.org  |                         |                     |
  |                     | ADDITIONAL Name        |                         |                     |
  |                     |      =NS3.example.org  |                         |                     |
  |                     | ADDITIONAL Address     |                         |                     |
  |                     |      =192.168.1.30     |                         |                     |
  |                     |------------------------------------------------->|                     |
  |                     |                        |4.Send standard query    |                     |
  |                     |                        | QNAME=A.example.org     |                     |
  |                     |                        | QTYPE=A                 |                     |
  |                     |<-------------------------------------------------|                     |
  |                     |                        |5.Send standard response|                     |
  |                     |                        | QNAME=A.example.org     |                     |
  |                     |                        | QTYPE=A                 |                     |
  |                     |                        | AUTHORITY Name          |                     |
  |                     |                        |      =invalid.org       |                     |
  |                     |                        | AUTHORITY Name Server   |                     |
  |                     |                        |      =NS4.example.org   |                     |
  |                     |                        | ADDITIONAL Name         |                     |
  |                     |                        |      =NS4.invalid.org   |                     |
  |                     |                        | ADDITIONAL Address      |                     |
  |                     |                        |    =192.168.1.40        |                     |
  |                     |------------------------------------------------------------------------>|
  |                     |                        |                         |6.Send standard query|
  |                     |                        |                         |  QNAME=A.example.org|
  |                     |                        |                         |  QTYPE=A            |
  v                     v                        v                         v                     v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=invalid.org, AUTHORITY Name Server=NS4.invalid.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.invalid.org) (Judgment *6)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	invalid.org (invalid + Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.invalid.org (NS4 + Pointer 0xC01F)
DNS Additional section	NAME	NS4.invalid.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- Termination
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Not received standard query including QNAME=A.example.org, QTYPE=A.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
5.3.3. Algorithm

5.62. Order of transmission of octets and bit

Purpose

Verify that a NUT transmits correct order of transmission of octets and bits

- The order of transmission of the header and data is resolved to the octet level. The order of transmission of octets is the normal order in which they are read in English.
- Whenever an octet represents a numeric quantity, the left most bit in the diagram is the high order or most significant bit.
- Similarly, whenever a multi-octet field represents a numeric quantity the left most bit of the whole field is the most significant bit. When a multi-octet quantity is transmitted the most significant octet is transmitted first.

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 11 Topology No.11".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                    3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.          3600000               A      192.168.1.20

For IPv6
 .                    3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.          3600000        AAAA   3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
```

```
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
Client1 (TN)            DNS Server1 (NUT)                DNS Server2 (TN)
     |                            |                              |
     |----------------------------->|                              |
     | 1. Send standard query     |                              |
     |    QNAME=A.example.org     |                              |
     |    QTYPE=A                 |                              |
     |                            |------------------------------->|
     |                            | 2. Send standard query       |
     |                            |  QNAME=A.example.org         |
     |                            |  QTYPE=A                     |
     v                            v                              v

      1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
      2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any(must be numeric quantity)
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any(must be numeric quantity)
DNS Question section	QNAME	any
	QTYPE	any
	QCLASS	any

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
   *Order of transmission of octets is the normal in which they are read in English.
   *Check order of transmission of octets in DNS header.
   *The left most bit in the octets is most significant bit.
   *Check numeric quantity of OPCODE, Z fields in DNS header.
   *The left most bit in the multi-octets field is most significant bit.
   *Check numeric quantity of QDCOUNT, ANCOUNT, NSCOUNT, ARCOUNT fields in DNS header.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
2.3.2. Data Transmission Order

5.63. Label format

Purpose

Verify that a NUT transmits correct standard query for label format

- Domain names in messages are expressed in terms of a sequence of labels. Each label is represented as a one octet length field followed by that number of octets.
- The high order two bits of every length octet must be zero, and the remaining six bits of the length field limit the label to 63 octets or less.

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 11 Topology No.11".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600      ; serial
         3600            ; refresh every 1 hr
         900             ; retry every 15 min
         604800          ; expire after a week
         3600            ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)            DNS Server1 (NUT)                DNS Server2 (TN)
      |                            |                                |
      |----------------------------->|                              |
      | 1. Send standard query     |                                |
      |  QNAME=A.example.org       |                                |
      |  QTYPE=A                   |                                |
      |                            |--------------------------------->|
      |                            | 2. Recv standard query         |
      |                            |  QNAME=A.example.org           |
      |                            |  QTYPE=A                       |
      v                            v                                v

       1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
       2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any

	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Standard query must be based on above Verification Points.
   *In DNS Question section, QNAME field must include following data.

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
| 0  0  0  0  0  0  0  1|           a           |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
| 0  0  0  0  0  1  1  1|           e           |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|           x           |           a           |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|           m           |           p           |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|           l           |           e           |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
| 0  0  0  0  0  0  1  1|           o           |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|           r           |           g           |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
3.1. Name space definitions

5.64. Label of root

Purpose

Verify that a NUT transmits correct standard query for label of root

- Since every domain name ends with the null label of the root, a domain name is terminated by a length byte of zero.

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 11 Topology No.11".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20

For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)            DNS Server1 (NUT)                DNS Server2 (TN)
      |                           |                                |
      |--------------------------->|                               |
      | 1. Send standard query     |                               |
      |  QNAME=A.example.org       |                               |
      |  QTYPE=A                   |                               |
      |                            |------------------------------->|
      |                            | 2. Recv standard query         |
      |                            |  QNAME=A.example.org           |
      |                            |  QTYPE=A                       |
      v                            v                                v

       1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
       2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY

UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Standard query must be based on above Verification Points.
   *In DNS Question section, QNAME field must include following data.

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
| 0  0  0  0  0  0  0  1|           a           |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
| 0  0  0  0  0  1  1  1|           e           |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|           x           |           a           |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|           m           |           p           |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|           l           |           e           |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
| 0  0  0  0  0  0  1  1|           o           |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|           r           |           g           |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
| 0  0  0  0  0  0  0  0|
+--+--+--+--+--+--+--+--+
```

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
3.1. Name space definitions

5.65. WKS type in standard query

Purpose

Verify that a NUT transmits correct message including WKS type in the QTYPE field.

- Query type WKS.
  Header section field has the following value.

QR	**0**
QDCOUNT	**1**
ANCOUNT	**0**
NSCOUNT	**0**
ARCOUNT	**ANY**

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	**A.example.org**
QTYPE	**WKS (0x000B)**
QCLASS	**IN (0x0001)**

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig.22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
.                       3600000          IN       NS       A.ROOT.NET.
```

```
 A.ROOT.NET.                3600000                    A        192.168.1.20
```

For IPv6

```
 .                          3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.                3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
         IN        NS        NS1.example.com.
NS1      IN        A         192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                   <------------------ TN ------------------->
DNS Client1 (TN)          DNS Server1 (NUT)                DNS Server2  DNS Server3    DNS Server4
    |                           |                                |           |                |
    |---------------------------->|                              |           |                |
    | 1.Send standard query     |                              |           |                |
    |  QNAME=A.example.org      |                              |           |                |
    |  QTYPE=WKS                |                              |           |                |
    |                           |------------------------------>|           |                |
    |                           | 2.Recv standard query        |           |                |
    |                           |  QNAME=A.example.org         |           |                |
    |                           |  QTYPE=WKS                   |           |                |
    |                           |<------------------------------|           |                |
    |                           | 3.Send standard query response |          |                |
    |                           |  QNAME=A.example.org         |           |                |
    |                           |  QTYPE=WKS                   |           |                |
    |                           |  AUTHORITY Name=org          |           |                |
    |                           |  AUTHORITY Name Server=NS3.example.org|          |                |
    |                           |  ADDITIONAL Name=NS3.example.org|        |                |
    |                           |  ADDITIONAL Address=192.168.1.30|        |                |
    |                           |                                v           |                |
    |                           |------------------------------------------>|                |
    |                           |          4.Recv standard query            |                |
    |                           |           QNAME=A.example.org             |                |
    |                           |           QTYPE=WKS                       |                |
    |                           |<------------------------------------------|                |
    |                           |          5.Send standard query response   |                |
    |                           |           QNAME=A.example.org             |                |
    |                           |           QTYPE=WKS                       |                |
    |                           |           AUTHORITY Name=example.org      |                |
    |                           |           AUTHORITY Name Server=NS4.example.org|           |
    |                           |           ADDITIONAL Name = NS4.example.org |              |
    |                           |           ADDITIONAL Address = 192.168.1.40 |              |
    |                           |                                        v                   |
    |                           |------------------------------------------------------------>|
    |                           |                       6.Send standard query                 |
    |                           |                        QNAME=A.example.org                  |
    |                           |                        QTYPE=WKS                            |
    |                           |<------------------------------------------------------------|
    |                           |                       7.Send standard query response        |
    |                           |                        QNAME=A.example.org                  |
    |                           |                        QTYPE=WKS                            |
    |                           |                        ANSWER Name=A.example.org            |
    |                           |                        ANSWER Address=192.168.1.10          |
    |                           |                        ANSWER Protocol=UDP(17)              |
    |                           |                        ANSWER BIT MAP=telnet(6)             |
    |                           |                        AUTHORITY Name=example.org           |
    |                           |                        AUTHORITY Name Server = NS4.example.org|
    |                           |                        ADDITIONAL Name = NS4.example.org    |
    |                           |                        ADDITIONAL Address = 192.168.1.40    |
    |<----------------------------|                                                           |
    | 8.Standard query response |                                                           |
    |  QNAME= A.example.org     |                                                           |
    |  QTYPE=WKS                |                                                           |
    |  ANSWER Name=A.example.org |                                                          |
    |  ANSWER Address=192.168.1.10 |                                                         |
    |  ANSWER Protocol=UDP(17)  |                                                           |
    |  ANSWER BIT MAP=telnet(6) |                                                           |
    |  AUTHORITY Name=example.org |                                                         |
    |  AUTHORITY Name Server    |                                                           |
    |   = NS4.example.org       |                                                           |
    |  ADDITIONAL Name          |                                                           |
    |   = NS4.example.org       |                                                           |
    |  ADDITIONAL Address       |                                                           |
    |   = 192.168.1.40          |                                                           |
    v                           v                                                           v
```

1. TN send standard query QNAME=A.example.org, QTYPE=WKS to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=WKS to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=WKS to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10 Protocol=UDP(17) BIT MAP=telnet(6) to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0

	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6

	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0

	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	WKS (0x000B)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
	PROTOCOL	17
	BIT MAP	25
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03F)

	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	WKS (0x000B)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
	PROTOCOL	17
	BIT MAP	25
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)

DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=WKS.
4. Received standard query including QNAME=A.example.org, QTYPE=WKS.
6. Received standard query including QNAME=A.example.org, QTYPE=WKS.
8. Received standard query response including correct WKS resource record.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
3.2.2. TYPE values

5.66. TXT type in standard query

Purpose

Verify that a NUT transmits correct message including TXT type in the QTYPE field.

- Query type TXT.
  Header section field has the following value.

QR	**0**
QDCOUNT	**1**
ANCOUNT	**0**
NSCOUNT	**0**
ARCOUNT	**ANY**

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	**A.example.org**
QTYPE	**TXT (0x0010)**
QCLASS	**IN (0x0001)**

Category

Server (Recursive mode)

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
.                       3600000          IN       NS       A.ROOT.NET.
```

```
 A.ROOT.NET.              3600000                    A        192.168.1.20
For IPv6
 .                        3600000          IN        NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA      3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
NS1      IN        A         192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                   <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)      DNS Server2 DNS Server3 DNS Server4
    |                           |                         |           |           |
    |---------------------------->|                         |           |           |
    | 1. Send standard query    |                         |           |           |
    |  QNAME=A.example.org      |                         |           |           |
    |  QTYPE=TXT                |                         |           |           |
    |                           |------------------------->|           |           |
    |                           | 2. Recv standard query  |           |           |
    |                           |  QNAME=A.example.org    |           |           |
    |                           |  QTYPE=TXT              |           |           |
    |                           |<-------------------------|           |           |
    |                           | 3. Send standard query response |   |           |
    |                           |  QNAME=A.example.org    |           |           |
    |                           |  QTYPE=TXT              |           |           |
    |                           |  AUTHORITY Name=org     |           |           |
    |                           |  AUTHORITY Name Server  |           |           |
    |                           |            =NS3.example.org |       |           |
    |                           |  ADDITIONAL Name        |           |           |
    |                           |            =NS3.example.org |       |           |
    |                           |  ADDITIONAL Address     |           |           |
    |                           |            =192.168.1.30 |          |           |
    |                           |                         v           |           |
    |                           |------------------------------------------>|           |
    |                           |            4. Recv standard query   |           |
    |                           |             QNAME=A.example.org     |           |
    |                           |             QTYPE=TXT               |           |
```

```
|                              |<-------------------------------------------|           |
|                              |             5. Send standard query response |           |
|                              |              QNAME=A.example.org            |           |
|                              |              QTYPE=TXT                      |           |
|                              |              AUTHORITY Name=example.org     |           |
|                              |              AUTHORITY Name Server          |           |
|                              |                     = NS4.example.org       |           |
|                              |              ADDITIONAL Name                |           |
|                              |                     = NS4.example.org       |           |
|                              |              ADDITIONAL Address = 192.168.1.40|          |
|                              |                                         v           |
|                              |------------------------------------------------------>|
|                              |                         6. Send standard query         |
|                              |                          QNAME=A.example.org           |
|                              |                          QTYPE=TXT                     |
|                              |<------------------------------------------------------|
|                              |                         7. Send standard query response|
|                              |                          QNAME=A.example.org           |
|                              |                          QTYPE=TXT                     |
|                              |                          ANSWER Name=A.example.org     |
|                              |                          ANSWER TXT-DATA=DNS TEST      |
|                              |                          AUTHORITY Name=example.org    |
|                              |                          AUTHORITY Name Server         |
|                              |                              = NS4.example.org         |
|                              |                          ADDITIONAL Name = NS4.example.org |
|                              |                          ADDITIONAL Address= 192.168.1.40  |
|<-----------------------------|                                                        |
| 8. Standard query response   |                                                        |
|  QNAME= A.example.org        |                                                        |
|  QTYPE=TXT                   |                                                        |
|  ANSWER Name=A.example.org   |                                                        |
|  ANSWER TXT-DATA=DNS TEST    |                                                        |
|  AUTHORITY Name=example.org  |                                                        |
|  AUTHORITY Name Server       |                                                        |
|   = NS4.example.org          |                                                        |
|  ADDITIONAL Name             |                                                        |
|   = NS4.example.org          |                                                        |
|  ADDITIONAL Address          |                                                        |
|   = 192.168.1.40             |                                                        |
|                              |                                                        |
v                              v                                                        v
```

1. TN send standard query QNAME=A.example.org, QTYPE=TXT to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=TXT to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=TXT to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER TXT-DATA=DNS TEST.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ

	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	TXT (0x0010)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	TXT (0x0010)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	TXT (0x0010)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any

	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	TXT (0x0010)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	TXT (0x0010)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	TXT (0x0010)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1

	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	TXT (0x0010)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	TXT (0x0010)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	8
	TXT-DATA	DNS TEST
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03F)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0

	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	TXT (0x0010)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	TXT (0x0010)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	8
	TXT-DATA	DNS TEST
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03F)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=TXT.
4. Received standard query including QNAME=A.example.org, QTYPE=TXT.
6. Received standard query including QNAME=A.example.org, QTYPE=TXT.
8. Received standard query response including correct TXT resource record.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
3.2.2. TYPE values

5.67. Resource record TXT type

Purpose

Verify that a NUT transmits correct message including TXT resource record.

- Single host address case.
  Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	1

- Hosts that have multiple Internet addresses will have multiple TXT records.
  Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	2

- TXT RDATA format

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
/                    TXT-DATA                    /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

TXT-DATA	One or more "character-string"s

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
```

```
;
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
A       IN      TXT     "DNS TEST"
A1      IN      TXT     "DNS TEST1"
                TXT     "DNS TEST2"
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                    DNS Server1 (NUT)
    |                                   |
    |------------------------------------>|
    |   1. Send standard query            |
    |       QNAME=A.example.com           |
    |       QTYPE=TXT                     |
    |<------------------------------------|
    |   2. Standard query response        |
    |       TXT=DNS TEST                  |
    |------------------------------------>|
    |   3. Send standard query to NUT     |
    |       QNAME=A1.example.com          |
    |       QTYPE=TXT                     |
    |<------------------------------------|
    |   4. Standard query response        |
    |       TXT=DNS TEST1                 |
    |       TXT=DNS TEST2                 |
    v                                     v

1. TN send standard query QNAME=A.example.com, QTYPE=TXT to NUT.
2. NUT reply query response w/ TXT="DNS TEST" to TN (Judgment *2)
3. TN send standard query QNAME=A1.example.com, QTYPE=A to NUT.
4. NUT reply query response w/ A="DNS TEST1" and A="DNS TEST2" to TN (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0

	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	TXT (0x0010)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	TXT (0x0010)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	TXT (0x0010)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	9
	TXT-DATA	DNS TEST
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03F)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2001
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A1.example.com
	QTYPE	TXT (0x0010)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1

	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A1.example.com
	QTYPE	TXT (0x0010)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A1.example.com (Pointer 0xC00C)
	TYPE	TXT (0x0010)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	9
	TXT-DATA	DNS TEST1
DNS Answer section	NAME	A1.example.com (Pointer 0xC00C)
	TYPE	TXT (0x0010)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	9
	TXT-DATA	DNS TEST2
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC056)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**

  None

Judgment

2. Received standard query response including TXT type record.
4. Received standard query response including multiple TXT type records.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
- 3.2.1 Format
- 3.2.2 TYPE values
- 3.3.14 A RDATA format

5.68. Resource record of WKS type

Purpose

Verify that a NUT transmits correct message including WKS resource record.

- Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	1

- CNAME RDATA format

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    ADDRESS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|       PROTOCOL        |                       |
+--+--+--+--+--+--+--+--+                       |
|                                               |
/                   <BIT MAP>                   /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

ADDRESS	**An 32 bit Internet address**
PROTOCOL	**An 8 bit IP protocol number**
<BIT MAP>	**A variable length bit map. The bit map must be a multiple of 8 bits long.**

The first bit corresponds to port 0, the second to port 1, etc.
If the bit map does not include a bit for a protocol of interest, that bit is assumed zero.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 23 Topology No.23".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
```

```
        3600            ; refresh every 1 hr
        900             ; retry every 15 min
        604800          ; expire after a week
        3600            ; Minimum TTL of a 1 hr
)
;
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
A1      IN      WKS     192.168.1.11        TCP ( telnet )
A2      IN      WKS     192.168.1.12        UDP ( telnet )
A3      IN      WKS     192.168.1.13        TCP ( pop3 smtp )
A4      IN      WKS     192.168.1.14        UDP ( pop3 smtp )
A5      IN      WKS     192.168.1.15        TCP ( telnet )
                WKS     192.168.1.15        UDP ( telnet )
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |--------------------------------------->|
    |   1. Send standard query              |
    |       QNAME=A1.example.com            |
    |       QTYPE=WKS                       |
    |<---------------------------------------|
    |   2. Standard query response          |
    |       ADDRESS=192.168.1.11            |
    |       PROTOCOL=TCP(6)                 |
    |       BITMAP=telnet(6)                |
    |--------------------------------------->|
    |   3. Send standard query              |
    |       QNAME=A2.example.com            |
    |       QTYPE=WKS                       |
    |                                       |
    |<---------------------------------------|
    |   4. Standard query response          |
    |       ADDRESS=192.168.1.12            |
    |       PROTOCOL=UDP(17)                |
    |       BITMAP=telnet(6)                |
    |--------------------------------------->|
    |   5. Send standard query to NUT       |
    |       QNAME=A3.example.com            |
    |       QTYPE=WKS                       |
    |<---------------------------------------|
    |   6. Standard query response          |
    |       ADDRESS=192.168.1.13            |
    |       PROTOCOL=TCP(6)                 |
    |       BITMAP=pop3(110), smtp(25)      |
    |--------------------------------------->|
    |   7. Send standard query to NUT       |
    |       QNAME=A4.example.com            |
    |       QTYPE=WKS                       |
    |<---------------------------------------|
    |   8. Standard query response          |
    |       ADDRESS=192.168.1.14            |
    |       PROTOCOL=UDP(17)                |
    |       BITMAP=pop3(110), smtp(25)      |
    |--------------------------------------->|
    |   9. Send standard query to NUT       |
    |       QNAME=A5.example.com            |
    |       QTYPE=WKS                       |
    |<---------------------------------------|
    |  10. Standard query response          |
    |       ADDRESS=192.168.1.15            |
    |       PROTOCOL=TCP(6)                 |
    |       BITMAP=telnet(25)               |
    |       ADDRESS=192.168.1.15            |
    |       PROTOCOL=UDP(17)                |
    |       BITMAP=telnet(25)               |
    v                                       v
```

1. TN send standard query QNAME=A1.example.com, QTYPE=WKS to NUT.
2. NUT reply query response including ADDRESS=192.168.1.11, PROTOCOL=TCP(6), BITMAP=telnet(25) to TN (Judgment *2)
3. TN send standard query QNAME=A2.example.com, QTYPE=WKS to NUT.
4. NUT reply query response including ADDRESS=192.168.1.12, PROTOCOL=UDP(17), BITMAP=telnet(25) to TN (Judgment *4)
5. TN send standard query QNAME=A3.example.com, QTYPE=WKS to NUT.
6. NUT reply query response including ADDRESS=192.168.1.13, PROTOCOL=TCP(6), BITMAP=pop3(110), smtp(25) to TN (Judgment *6)
7. TN send standard query QNAME=A4.example.com, QTYPE=WKS to NUT.
8. NUT reply query response including ADDRESS=192.168.1.14, PROTOCOL=UDP(17), BITMAP=pop3(110), smtp(25) to TN (Judgment *8)
9. TN send standard query QNAME=A5.example.com, QTYPE=WKS to NUT.
10. NUT reply query response including multiple WKS resource records.
One is including ADDRESS=192.168.1.15, PROTOCOL=TCP(6), BITMAP=telnet(25),others is including ADDRESS=192.168.1.15, PROTOCOL=UDP(17), BITMAP=telnet(25) to TN (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A1.example.com
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53

	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A1.example.com
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A1.example.com (Pointer 0xC00C)
	TYPE	WKS (0x000B)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	8
	ADDRESS	192.168.1.11
	PROTOCOL	6
	<BIT MAP>	000000000000000000000001
DNS Authority section	NAME	example.com (Pointer 0xC00F)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00F)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC040)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ

UDP Header	Src Port	2001
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A2.example.com
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2001
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A2.example.com
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A2.example.com (Pointer 0xC00C)

	TYPE	WKS (0x000B)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	8
	ADDRESS	192.168.1.12
	PROTOCOL	17
	<BIT MAP>	00000000000000000000000001
DNS Authority section	NAME	example.com (Pointer 0xC00F)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00F)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC040)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

5th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2001
	Dst Port	53
DNS Header	ID	0x1002
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A3.example.com
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2001
DNS Header	ID	0x1002
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A3.example.com
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A3.example.com (Pointer 0xC00C)
	TYPE	WKS (0x000B)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	19
	ADDRESS	192.168.1.13
	PROTOCOL	6
	<BIT MAP>	00000000000000000000000010000000000000000000000000000000 00000000000000000000000000000000000000000000000000000010
DNS Authority section	NAME	example.com (Pointer 0xC00F)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00F)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	4
	ADDRESS	192.168.0.10

7th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2001
	Dst Port	53
DNS Header	ID	0x1003
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A4.example.com
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2001
DNS Header	ID	0x1003
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0

	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A4.example.com
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A4.example.com (Pointer 0xC00C)
	TYPE	WKS (0x000B)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	19
	ADDRESS	192.168.1.14
	PROTOCOL	17
	<BIT MAP>	00000000000000000000000001000000000000000000000000000000 00000000000000000000000000000000000000000000000000000010
DNS Authority section	NAME	example.com (Pointer 0xC00F)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00F)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2001
	Dst Port	53
DNS Header	ID	0x1004
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A5.example.com
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2001
DNS Header	ID	0x1004
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A5.example.com
	QTYPE	WKS (0x000B)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A5.example.com (Pointer 0xC00C)
	TYPE	WKS (0x000B)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	8
	ADDRESS	192.168.1.15
	PROTOCOL	6
	<BIT MAP>	00000000000000000000000001
DNS Answer section	NAME	A5.example.com (Pointer 0xC00C)
	TYPE	WKS (0x000B)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	8
	ADDRESS	192.168.1.15
	PROTOCOL	17
	<BIT MAP>	000000000000000000000001
DNS Authority section	NAME	example.com (Pointer 0xC00F)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00F)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC054)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response including WKS resource record.
4. Received standard query response including WKS resource record.
6. Received standard query response including WKS resource record.
8. Received standard query response including WKS resource record.
10. Received standard query response including WKS resource record.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
  3.2.2 TYPE values
  3.4.2 WKS RDATA format

5.69. Header section format (query)

Purpose

Verify that a NUT transmits correct Header section format in query

- Header section format (query)

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                      ID                       |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|QR|   Opcode  |AA|TC|RD|RA|   Z    |   RCODE   |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    QDCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    ANCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    NSCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    ARCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QR	**Query (0)**
Opcode	**A standard query(QUERY) (0)**
TC	**0**
RD	**0**
QDCOUNT	**1**
ANCOUNT	**0**
NSCOUNT	**0**

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 11 Topology No.11".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
.                    3600000        IN    NS    A.ROOT.NET.
A.ROOT.NET.          3600000              A     192.168.1.20
```

For IPv6

```
 .                        3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
NS1      IN        A         192.168.0.10
;
```

Procedure

This test sequence is following.

```
 DNS Client1 (TN)            DNS Server1 (NUT)                DNS Server2 (TN)
        |                           |                                |
        |--------------------------->|                               |
        | 1. Send standard query     |                               |
        |  QNAME=A.example.org       |                               |
        |  QTYPE=A                   |                               |
        |                            |---------------------------->|
        |                            | 2. Recv standard query        |
        |                            |  QNAME=A.example.org          |
        |                            |  QTYPE=A                      |
        v                            v                               v
  1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
  2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	any
	QTYPE	any
	QCLASS	any

- **Termination**
  None

Judgment

2. Standard query must be based on above Verification Points.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
4.1.1. Header section format

5.70. Header section format (response)

Purpose

Verify that a NUT transmits correct Header section format in response

- Header section format (response)

```
                                    1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                      ID                       |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|QR|   Opcode  |AA|TC|RD|RA|   Z    |   RCODE   |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    QDCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    ANCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    NSCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    ARCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

ID	same as query's ID
QR	response (1)
Opcode	a standard query(QUERY) (0)
AA	1
TC	0
RD	1
RCODE	0
QDCOUNT	1
ANCOUNT	1
NSCOUNT	1
ARCOUNT	1

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
NS1      IN        A         192.168.0.10
;
A        IN        A         192.168.1.10
```

Procedure

This test sequence is following.

```
 DNS Client1 (TN)                      DNS Server1 (NUT)
       |                                     |
       |------------------------------------>|
       |   1. Send standard query            |
       |       QNAME=A.example.com           |
       |       QTYPE=A                       |
       |<------------------------------------|
       |   2. Standard query response        |
       |       A=192.168.1.10                |
       v                                     v

 1. TN send standard query QNAME=A.example.com, QTYPE=A to NUT.
 2. NUT reply query response w/ A=192.168.1.10 to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	any
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	any
	QTYPE	any
	QCLASS	any
DNS Answer section	NAME	any
	TYPE	any
	CLASS	any
	TTL	any
	RDLENGTH	any
	ADDRESS	any
DNS Authority section	NAME	any
	TYPE	any
	CLASS	any
	TTL	any

	RDLENGTH	any
	NSDNAME	any
DNS Additional section	NAME	any
	TYPE	any
	CLASS	any
	TTL	any
	RDLENGTH	any
	ADDRESS	any

- **Termination**
  None

Judgment

2. Standard query response must be based on above Verification Points.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
4.1.1. Header section format

5.71. Format error (RCODE=1)

Purpose

Verify that a NUT transmits format error (RCODE=1).

- RCODE Response code - this 4 bit field is set as part of responses. The values have the following interpretation:

  0 No error condition
  1 Format error - The name server was unable to interpret the query.
  2 Server failure - The name server was unable to process this query due to a problem with the name server.
  3 Name Error - Meaningful only for responses from an authoritative name server, this code signifies that the domain name referenced in the query does not exist.
  4 Not Implemented - The name server does not support the requested kind of query.
  5 Refused - The name server refuses to perform the specified operation for policy reasons. For example, a name server may not wish to provide the information to the particular requester, or a name server may not wish to perform a particular operation (e.g., zone transfer) for particular data.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
```

```
NS1      IN       A        192.168.0.10
;
A        IN       A        192.168.1.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
      |                                     |
      |------------------------------------>|
      |   1. Send standard query            |
      |       Not include Question Section  |
      |<------------------------------------|
      |   2. Standard query response        |
      |       Format error (RCODE=1)        |
      v                                     v

1. TN send standard query w/o Question Section to NUT.
2. NUT reply query response to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	any
	Z	0
	RCODE	1
	QDCOUNT	0
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0

- **Termination**
  None

Judgment

2. Received standard query response including RCODE=1.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
4.1.1. Header section format

5.72. Server failure (RCODE=2)

Purpose

Verify that a NUT transmits Server failure (RCODE=2).

. RCODE Response code - this 4 bit field is set as part of responses. The values have the following interpretation:

0 No error condition
1 Format error - The name server was unable to interpret the query.
2 Server failure - The name server was unable to process this query due to a problem with the name server.
3 Name Error - Meaningful only for responses from an authoritative name server, this code signifies that the domain name referenced in the query does not exist.
4 Not Implemented - The name server does not support the requested kind of query.
5 Refused - The name server refuses to perform the specified operation for policy reasons. For example, a name server may not wish to provide the information to the particular requester, or a name server may not wish to perform a particular operation (e.g., zone transfer) for particular data.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:
  empty. No entry

  Example of example.com zone file:
  empty. No entry

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |--------------------------------------->|
    |   1. Send standard query              |
    |       QNAME=A.example.com             |
    |       QTYPE=A                         |
    |<---------------------------------------|
    |   2. Standard query response          |
    |       Server failure                  |
    v                                       v

 1. TN send standard query QNAME=A.example.com, QTYPE=A  to NUT.
 2. NUT reply query response to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ

UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	any
	Z	0
	RCODE	2
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query response including RCODE=2.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
4.1.1. Header section format

5.73. Not Implemented (RCODE=4)

Purpose

Verify that a NUT transmits Not Implemented (RCODE=4).

- RCODE Response code - this 4 bit field is set as part of responses. The values have the following interpretation:

  0 No error condition
  1 Format error - The name server was unable to interpret the query.
  2 Server failure - The name server was unable to process this query due to a problem with the name server.
  3 Name Error - Meaningful only for responses from an authoritative name server, this code signifies that the domain name referenced in the query does not exist.
  4 Not Implemented - The name server does not support the requested kind of query.
  5 Refused - The name server refuses to perform the specified operation for policy reasons. For example, a name server may not wish to provide the information to the particular requester, or a name server may not wish to perform a particular operation (e.g., zone transfer) for particular data.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
```

```
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
```

Procedure

This test sequence is following.

```
    DNS Client1 (TN)                      DNS Server1 (NUT)
        |                                     |
        |------------------------------------>|
        |   1. Send standard query            |
        |       OPCODE=15                     |
        |       QNAME=A.example.com           |
        |       QTYPE=A                       |
        |<------------------------------------|
        |   2. Standard query response        |
        |       Not Implemented (RCODE=4)     |
        |                                     |
        v                                     v

         1. TN send standard query QNAME=A.example.com, QTYPE=A to NUT.
         2. NUT reply query response to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	15
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	15
	AA	ANY
	TC	0
	RD	1
	RA	any
	Z	0
	RCODE	4
	QDCOUNT	ANY
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	ANY
	QTYPE	ANY
	QCLASS	ANY

- **Termination**
  None

Judgment

2. Received standard query response including RCODE=4.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
4.1.1. Header section format

5.74. Refused (RCODE=5) for query

Purpose

Verify that a NUT transmits Refused (RCODE=5) for query.

- RCODE Response code - this 4 bit field is set as part of responses. The values have the following interpretation:

  0 No error condition
  1 Format error - The name server was unable to interpret the query.
  2 Server failure - The name server was unable to process this query due to a problem with the name server.
  3 Name Error - Meaningful only for responses from an authoritative name server, this code signifies that the domain name referenced in the query does not exist.
  4 Not Implemented - The name server does not support the requested kind of query.
  5 Refused - The name server refuses to perform the specified operation for policy reasons. For example, a name server may not wish to provide the information to the particular requester, or a name server may not wish to perform a particular operation (e.g., zone transfer) for particular data.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig.0 Topology No.24".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
```

```
NS1      IN       A        192.168.0.10
;
A        IN       A        192.168.1.10
```

Configure the Server1's (NUT) configuration file to allow the query from TN.

Example of configuration file:

```
acl "Client2" { 192.168.0.21; };
;
zone "example.com" {
        type master;
        file "example.com.zone";
        allow-query {
             "Client2";
        };
};
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
    |                                     |
    |------------------------------------>|
    |   1. Send standard query            |
    |       QNAME=A.example.com           |
    |       QTYPE=A                       |
    |<------------------------------------|
    |   2. Standard query response        |
    |       Refused (RCODE=5)             |
    v                                     v

     1. TN send standard QNAME=A.example.com, QTYPE=A to NUT.
     2. NUT reply query response to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	any
	Z	0
	RCODE	5
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query response including RCODE=5.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
4.1.1. Header section format

5.75. Refused (RCODE=5) for zone transfer

Purpose

Verify that a NUT transmits Refused (RCODE=5) for query.

- RCODE Response code - this 4 bit field is set as part of responses. The values have the following interpretation:

  0 No error condition
  1 Format error - The name server was unable to interpret the query.
  2 Server failure - The name server was unable to process this query due to a problem with the name server.
  3 Name Error - Meaningful only for responses from an authoritative name server, this code signifies that the domain name referenced in the query does not exist.
  4 Not Implemented - The name server does not support the requested kind of query.
  5 Refused - The name server refuses to perform the specified operation for policy reasons. For example, a name server may not wish to provide the information to the particular requester, or a name server may not wish to perform a particular operation (e.g., zone transfer) for particular data.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 30 Topology No.30".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
```

```
;
A        IN      A        192.168.1.10
```

Configure the Server1's (NUT) configuration file to allow the zone transfer from TN.

Example of configuration file:

```
acl "Server2" { 192.168.0.21; };
;
zone "example.com" {
        type master;
        file "example.com.zone";
        allow-transfer {
                "Server2";
        };
};
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
      |                                     |
      |------------------------------------>|
      |   1. Send standard query in TCP     |
      |       QNAME=A.example.com           |
      |       QTYPE=AXFR                    |
      |<------------------------------------|
      |   2. Standard query response in TCP |
      |       Refused (RCODE=5)             |
      v                                     v

1. TN send standard QNAME=A.example.com, QTYPE=A to NUT.
2. NUT reply query response to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT) in TCP		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.com
	QTYPE	AXFR (0x00FC)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN) in TCP		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	any
	Z	0
	RCODE	5
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.com
	QTYPE	AXFR (0x00FC)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query response including RCODE=5.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
4.1.1. Header section format

5.76. Answer section format

Purpose

Verify that a NUT transmits correct Answer section format

- Answer section format

```
                                    1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                                               /
/                      NAME                     /
|                                               |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                      TYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     CLASS                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                      TTL                      |
|                                               |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                   RDLENGTH                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
/                     RDATA                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

NAME	A domain name (A.example.com(Pointer 0xC00C))
TYPE	RR type codes (A type : 1)
CLASS	Class of the data in the RDATA field (IN : 1)
TTL	A 32 bit unsigned integer that specifies the time (1day : 86400)
RDLENGTH	Length in octets of the RDATA field (4)
RDATA	Resource record (192.168.1.10)

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
NS1      IN        A         192.168.0.10
;
A        IN        A         192.168.1.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |-------------------------------------->|
    |   1. Send standard query              |
    |       QNAME=A.example.com             |
    |       QTYPE=A                         |
    |<--------------------------------------|
    |   2. Standard query response          |
    |       A=192.168.1.10                  |
    v                                       v

 1. TN send standard query QNAME=A.example.com, QTYPE=A to NUT.
 2. NUT reply query response w/ A=192.168.1.10 to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0

	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	any
	QR	any
	OPCODE	any
	AA	any
	TC	any
	RD	any
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	any
	ANCOUNT	any
	NSCOUNT	any
	ARCOUNT	any
DNS Question section	QNAME	any
	QTYPE	any
	QCLASS	any
DNS Answer section	NAME	A.example.com(Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	any
	TYPE	any

	CLASS	any
	TTL	any
	RDLENGTH	any
	NSDNAME	any
DNS Additional section	NAME	any
	TYPE	any
	CLASS	any
	TTL	any
	RDLENGTH	any
	ADDRESS	any

- **Termination**
  None

Judgment

2. Standard query must be based on above Verification Points.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
4.1.3. Resource record format

5.77. Authority section format

Purpose

Verify that a NUT transmits correct Authority section format

- Authority section format

```
                                    1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                                               /
/                      NAME                     /
|                                               |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                      TYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     CLASS                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                      TTL                      |
|                                               |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                   RDLENGTH                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
/                     RDATA                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

NAME	A domain name (example.com(Pointer 0xC00E))
TYPE	RR type codes (NS type : 2)
CLASS	Class of the data in the RDATA field (IN : 1)
TTL	A 32 bit unsigned integer that specifies the time (1day : 86400)
RDLENGTH	Length in octets of the RDATA field (6)
RDATA	Resource record (NS1.example.com (NS1 + Pointer 0xC00E))

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
A        IN       A        192.168.1.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
    |                                     |
    |------------------------------------>|
    |   1. Send standard query            |
    |       QNAME=A.example.com           |
    |       QTYPE=A                       |
    |<------------------------------------|
    |   2. Standard query response        |
    |       A=192.168.1.10                |
    v                                     v

 1. TN send standard query QNAME=A.example.com, QTYPE=A to NUT.
 2. NUT reply query response w/ A=192.168.1.10 to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	any
	QR	any
	OPCODE	any
	AA	any
	TC	any
	RD	any
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	any
	ANCOUNT	any
	NSCOUNT	any
	ARCOUNT	any
DNS Question section	QNAME	any
	QTYPE	any
	QCLASS	any
DNS Answer section	NAME	any
	TYPE	any
	CLASS	any
	TTL	any
	RDLENGTH	any
	ADDRESS	any
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	any
	TYPE	any
	CLASS	any
	TTL	any
	RDLENGTH	any
	ADDRESS	any

- **Termination**
  None

Judgment

2. Standard query must be based on above Verification Points.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
4.1.3. Resource record format

5.78. Additional section format

Purpose

Verify that a NUT transmits correct Additional section format

- Additional section format

```
                                    1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                                               /
/                      NAME                     /
|                                               |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                      TYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     CLASS                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                      TTL                      |
|                                               |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                   RDLENGTH                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
/                     RDATA                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

NAME	A domain name (NS1.example.com (Pointer 0xC03B))
TYPE	RR type codes (A type : 1)
CLASS	Class of the data in the RDATA field (IN : 1)
TTL	A 32 bit unsigned integer that specifies the time (1day : 86400)
RDLENGTH	Length in octets of the RDATA field (4)
RDATA	Resource record (NS1.example.com (192.168.0.10))

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1　Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |--------------------------------------->|
    |   1. Send standard query              |
    |       QNAME=A.example.com             |
    |       QTYPE=A                         |
    |<---------------------------------------|
    |   2. Standard query response          |
    |       A=192.168.1.10                  |
    v                                       v

 1. TN send standard query QNAME=A.example.com, QTYPE=A to NUT.
 2. NUT reply query response w/ A=192.168.1.10 to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	any
	QR	any
	OPCODE	any
	AA	any
	TC	any
	RD	any
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	any
	ANCOUNT	any
	NSCOUNT	any
	ARCOUNT	any
DNS Question section	QNAME	any
	QTYPE	any
	QCLASS	any
DNS Answer section	NAME	any
	TYPE	any
	CLASS	any
	TTL	any
	RDLENGTH	any
	ADDRESS	any
DNS Authority section	NAME	any
	TYPE	any
	CLASS	any

	TTL	any
	RDLENGTH	any
	NSDNAME	any
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Standard query must be based on above Verification Points.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
4.1.3. Resource record format

5.79. Message compression

Purpose

Verify that a NUT understands receiving message that contain compression.

- All programs are required to understand arriving messages that contain pointers.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig.25 Topology No.25".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20

For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                        <-------- TN --------->
 DNS Client1 (TN)       DNS Server1 (NUT)               DNS Server2 DNS Server3
     |                       |                                |           |
     |----------------------->|                               |           |
     | 1.Send standard query  |                               |           |
     |  QNAME=A.example.org   |                               |           |
     |  QTYPE=A               |                               |           |
     |                        |------------------------------->|           |
     |                        | 2.Recv standard query          |           |
     |                        |  QNAME=A.example.org           |           |
     |                        |  QTYPE=A                       |           |
     |                        |<-------------------------------|           |
     |                        | 3.Send standard query response |           |
     |                        |  QNAME=A.example.org           |           |
     |                        |  QTYPE=A                       |           |
     |                        |  AUTHORITY Name=org            |           |
     |                        |  AUTHORITY Name Server         |           |
     |                        |            =NS3.example.org    |           |
     |                        |  ADDITIONAL Name               |           |
     |                        |            =NS3.example.org    |           |
     |                        |  ADDITIONAL Address            |           |
     |                        |            =192.168.1.30       |           |
     |                        |  (message contain pointers)    |           |
     |                        |                               v           |
     |                        |------------------------------------------->|
     |                        |             4.Recv standard query          |
     |                        |              QNAME=A.example.org           |
     |                        |              QTYPE=A                       |
     |                        |                                            |
     v                        v                                            v

  1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
  2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
  3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org (message
     contain pointers).
  4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org)
     (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0

	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses

DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any

	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
4.1.4. Message compression

5.80. Message compression format

Purpose

Verify that a NUT transmits correct message that contain compression.

- All programs are required to understand arriving messages that contain pointers.
- Name servers MUST use compression in responses.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |--------------------------------------->|
    |   1. Send standard query              |
    |       QNAME=A.example.com             |
    |       QTYPE=A                         |
    |<---------------------------------------|
    |   2. Standard query response          |
    |       A=192.168.1.10                  |
    |       (message contain pointer)       |
    v                                       v

 1. TN send standard query QNAME=A.example.com, QTYPE=A to NUT.
 2. NUT reply query response w/ A=192.168.1.10 to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	any
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**

  None

Judgment

2. Received standard query response that contain correct pointers.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
4.1.4. Message compression
RFC1123 Requirements for Internet Hosts -- Application and Support
6.1.2.4 Compression: RFC-1035 Section 4.1.4

5.81. Messages carried by UDP are restricted to 512 bytes

Purpose

Verify that a NUT transmits message that carried by UDP are restricted to 512 bytes.

- Messages carried by UDP are restricted to 512 bytes (not counting the IP or UDP headers). Longer messages are truncated and the TC bit is set in the header.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL  86400                ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600           ; serial
      3600                 ; refresh every 1 hr
      900                  ; retry every 15 min
      604800               ; expire after a week
      3600                 ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
B        IN      A        192.168.1.100
         IN      A        192.168.1.101
         IN      A        192.168.1.102
         IN      A        192.168.1.103
         IN      A        192.168.1.104
         IN      A        192.168.1.105
         IN      A        192.168.1.106
         IN      A        192.168.1.107
         IN      A        192.168.1.108
         IN      A        192.168.1.109
```

```
IN      A       192.168.1.110
IN      A       192.168.1.111
IN      A       192.168.1.112
IN      A       192.168.1.113
IN      A       192.168.1.114
IN      A       192.168.1.115
IN      A       192.168.1.116
IN      A       192.168.1.117
IN      A       192.168.1.118
IN      A       192.168.1.119
IN      A       192.168.1.120
IN      A       192.168.1.121
IN      A       192.168.1.122
IN      A       192.168.1.123
IN      A       192.168.1.124
IN      A       192.168.1.125
IN      A       192.168.1.126
IN      A       192.168.1.127
IN      A       192.168.1.128
IN      A       192.168.1.129
IN      A       192.168.1.130
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
     |                                        |
     |---------------------------------------->|
     |   1. Send standard query               |
     |       QNAME=B.example.com              |
     |       QTYPE=A                          |
     |<----------------------------------------|
     |   2. Standard query response           |
     |       TC bit is set                    |
     |       (Answer=192.168.1.100            |
     |          to  192.168.1.129)            |
     |       (*Any Numbers of Answer          |
     v         sections is acceptable)        v

1. TN send standard query QNAME=B.example.com, QTYPE=A to NUT.
2. NUT reply query response that is set 1 as TC bit to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ

	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	1
	RD	1
	RA	any
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	30 (*Any numbers of Answer sections is acceptable.)
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

DNS Answer section	NAME	B.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.100
DNS Answer section x 28 ADDRESS range 192.168.1.101 - 192.168.1.128	NAME	B.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	B.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.129

- **Termination**
  None

Judgment

2. Received standard query response that carried by UDP are restricted to 512 bytes (TC bit is set).

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
4.2.1. UDP usage

5.82. Not depend on response in order

Purpose

Verify that a NUT doesn't depend on response in order.

- Queries or their responses may be reordered by the network, or by processing in name servers, so resolvers should not depend on them being returned in order.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 26 Topology No.26".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL  86400         ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600    ; serial
      3600          ; refresh every 1 hr
      900           ; retry every 15 min
      604800        ; expire after a week
      3600          ; Minimum TTL of a 1 hr
)
;
          IN        NS        NS1.example.com.
NS1       IN        A         192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                <---------------------- TN ---------------------->
DNS Client1 (TN)            DNS Server1 (NUT)          DNS Server2 DNS Server3 DNS Server4 DNS Server5
    |                           |                                |        |           |           |
    |---------------------------->|                              |        |           |           |
    | 1.Send standard query     |                                |        |           |           |
    |  QNAME=A.example.org      |                                |        |           |           |
    |  QTYPE=A                  |                                |        |           |           |
    |                           |---------------------------------->|      |           |           |
    |                           | 2.Recv standard query          |        |           |           |
    |                           |  QNAME=A.example.org           |        |           |           |
    |                           |  QTYPE=A                       |        |           |           |
    |                           |<----------------------------------|      |           |           |
    |                           | 3.Send standard query response |        |           |           |
    |                           |  QNAME=A.example.org           |        |           |           |
    |                           |  QTYPE=A                       |        |           |           |
    |                           |  AUTHORITY Name=org            |        |           |           |
    |                           |  AUTHORITY Name Server         |        |           |           |
    |                           |            =NS3.example.org    |        |           |           |
    |                           |  ADDITIONAL Name=NS3.example.org |      |           |           |
    |                           |  ADDITIONAL Address =192.168.1.30|      |           |           |
    |                           |                                v        |           |           |
    |                           |------------------------------------------>|           |           |
    |                           |         4.Recv standard query            |           |           |
    |                           |          QNAME=A.example.org             |           |           |
    |                           |          QTYPE=A                         |           |           |
    |                           |<------------------------------------------|           |           |
    |                           |         5.Send standard query response   |           |           |
    |                           |          QNAME=A.example.org             |           |           |
    |                           |          QTYPE=A                         |           |           |
    |                           |          AUTHORITY Name=example.org      |           |           |
    |                           |          AUTHORITY Name Server           |           |           |
    |                           |                 = NS4.example.org        |           |           |
    |                           |          ADDITIONAL Name  = NS4.example.org|         |           |
    |                           |          ADDITIONAL Address = 192.168.1.40|         |           |
    |                           |                                       v  |           |           |
    |                           |-------------------------------------------------------->|           |
    |                           |                    6.  Send standard query              |           |
    |                           |                     QNAME=A.example.org                 |           |
    |                           |                     QTYPE=A              |           |           |
    |---------------------------->|                                        |           |           |
    | 7.Send standard query     |                                        |           |           |
    |  QNAME=B.virtual.org      |                                        |           |           |
    |  QTYPE=A                  |                                        |           |           |
    |                           |------------------------------------------>|           |           |
    |                           |         8.  Recv standard query          |           |           |
    |                           |          QNAME=B.virtual.org             |           |           |
    |                           |          QTYPE=A                         |           |           |
    |                           |<------------------------------------------|           |           |
    |                           |         9.Send standard query response   |           |           |
    |                           |          QNAME=B.virtual.org             |           |           |
    |                           |          QTYPE=A                         |           |           |
    |                           |          AUTHORITY Name=virtual.org      |           |           |
    |                           |          AUTHORITY Name Server           |           |           |
    |                           |                 = NS5.virtual.org        |           |           |
    |                           |          ADDITIONAL Name = NS5.virtual.org|         |           |
    |                           |          ADDITIONAL Address = 192.168.1.50|         |           |
    |                           |                                       v  |           v           |
    |                           |-------------------------------------------------------------------->|
    |                           |                    10.Send standard query                           |
    |                           |                     QNAME=B.virtual.org                             |
    |                           |                     QTYPE=A                                         |
```

```
|                            |<-----------------------------------------------------------------|
|                            |                           11. Send standard query response       |
|                            |                               QNAME=B.virtual.org                |
|                            |                               QTYPE=A                            |
|                            |                               ANSWER Name=B.virtual.org          |
|                            |                               ANSWER Address=192.168.1.11        |
|                            |                               AUTHORITY Name=virtual.org         |
|                            |                               AUTHORITY Name Server = NS5.virtual.org|
|                            |                               ADDITIONAL Name = NS5.virtual.org  |
|                            |                               ADDITIONAL Address = 192.168.1.50  |
|                            |                                                                  v
|<---------------------------|                                                 |
| 12.Standard query response |                                                 |
|  QNAME= B.virtual.org      |                                                 |
|  QTYPE=A                   |                                                 |
|  ANSWER Name=B.virtual.org |                                                 |
|  ANSWER Address=192.168.1.11|                                                |
|  AUTHORITY Name=virtual.org |                                                |
|  AUTHORITY Name Server     |                                                 |
|   = NS5.virtual.org        |                                                 |
|  ADDITIONAL Name           |                                                 |
|   = NS5.virtual.org        |                                                 |
|  ADDITIONAL Address = 192.168.1.50|                                          |
|                            |<-----------------------------------------------|
|                            |                  13.Send standard query response |
|                            |                    QNAME=A.example.org          |
|                            |                    QTYPE=A                      |
|                            |                    ANSWER Name=A.example.org    |
|                            |                    ANSWER Address=192.168.1.10  |
|                            |                    AUTHORITY Name=example.org   |
|                            |                    AUTHORITY Name Server = NS4.example.org |
|                            |                    ADDITIONAL Name = NS4.example.org |
|                            |                    ADDITIONAL Address = 192.168.1.40 |
|<---------------------------|                                                 |
| 14.Standard query response |                                                 |
|  QNAME= A.example.org      |                                                 |
|  QTYPE=A                   |                                                 |
|  ANSWER Name=A.example.org |                                                 |
|  ANSWER Address=192.168.1.10|                                                |
|  AUTHORITY Name=example.org |                                                |
|  AUTHORITY Name Server     |                                                 |
|   = NS4.example.org        |                                                 |
|  ADDITIONAL Name           |                                                 |
|   = NS4.example.org        |                                                 |
|  ADDITIONAL Address        |                                                 |
|   = 192.168.1.40           |                                                 |
v                            v                                                 v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send standard query QNAME=B.virtual.org, QTYPE=A to NUT.
8. NUT transmits standard query QNAME=B.virtual.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *8)
9. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS5.virtual.org.
10. NUT transmits standard query QNAME=B.virtual.org, QTYPE=A to DNS Server4 (TN: NS4.virtual.org) (Judgment *10)
11. TN send query response to ANSWER Name=B.virtual.org, ANSWER Address=192.168.1.11.
12. NUT transmits query response to DNS Client1 (TN) (Judgment *12)
13. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
14. NUT transmits query response to DNS Client1 (TN) (Judgment *14)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ

	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.virtual.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

8th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	B.virtual.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.virtual.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	virtual.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS5.virtual.org (NS5 + Pointer 0xC00E)
DNS Additional section	NAME	NS5.virtual.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.50

10th packet.

Standard query from DNS Server1 (NUT) to Server5 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV5_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any

	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	B.virtual.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

11th packet.

Standard query response from DNS Server5 (TN) to Server1 (NUT)		
IP Header	Source Address	SV5_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.virtual.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.virtual.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	virtual.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS5.virtual.org (NS5 + Pointer 0xC00E)
DNS Additional section	NAME	NS5.virtual.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.50

12th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.virtual.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.virtual.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4

	ADDRESS	192.168.1.11
DNS Authority section	NAME	virtual.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS5.virtual.org (NS5 + Pointer 0xC00E)
DNS Additional section	NAME	NS5.virtual.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.50

13th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10

DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

14th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)

	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query including QNAME=B.virtual.org, QTYPE=A.
10. Received standard query including QNAME=B.virtual.org, QTYPE=A.
12. Received standard query response including correct A resource record for QNAME=B.virtual.org, QTYPE=A.
14. Received standard query response including correct A resource record for QNAME=A.example.org, QTYPE=A.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
4.2.1. UDP usage

5.83. TCP connection management check

Purpose

Verify that a NUT supports multiple TCP connections.

- The server should not block other activities waiting for TCP data.
- The server should support multiple connections.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 27 Topology No.27".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20

For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.0.11
```

Procedure

This test sequence is following.

```
                                                   <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)       DNS Server2 DNS Server3 DNS Server4
    |                       |                       |           |           |
    |----------------------->|                       |           |           |
    | 1.Send standard query |                       |           |           |
    |  QNAME=A.example.org  |                       |           |           |
    |  QTYPE=A              |                       |           |           |
    |                       |----------------------->|           |           |
    |                       | 2.Recv standard query |           |           |
    |                       |  QNAME=A.example.org  |           |           |
    |                       |  QTYPE=A              |           |           |
    |                       |<-----------------------|           |           |
    |                       | 3.Send standard query response|   |           |
    |                       |  QNAME=A.example.org  |           |           |
    |                       |  QTYPE=A              |           |           |
    |                       |  AUTHORITY Name=org   |           |           |
    |                       |  AUTHORITY Name Server|           |           |
    |                       |            =NS3.example.org|      |           |
    |                       |  ADDITIONAL Name      |           |           |
    |                       |            =NS3.example.org|      |           |
    |                       |  ADDITIONAL Address   |           |           |
    |                       |            =192.168.1.30|         |           |
    |                       |                       v           |           |
    |                       |------------------------------------------->|
    |                       |             4.Recv standard query |           |
    |                       |              QNAME=A.example.org  |           |
    |                       |              QTYPE=A              |           |
    |                       |<------------------------------------------|
    |                       |            5.Send standard query response|   |
    |                       |             QNAME=A.example.org   |           |
    |                       |             QTYPE=A               |           |
    |                       |             AUTHORITY Name=example.org|       |
    |                       |             AUTHORITY Name Server |           |
    |                       |                    = NS4.example.org|       |
    |                       |             ADDITIONAL Name       |           |
    |                       |                    = NS4.example.org|       |
    |                       |             ADDITIONAL Address    |           |
    |                       |                    = 192.168.1.40 |          |
    |                       |                                  v           |
    |                       |------------------------------------------------------>|
    |                       |                       6.Send standard query |
    |                       |                        QNAME=A.example.org  |
    |                       |                        QTYPE=A              |
    |                       |<------------------------------------------------------|
    |                       |                       7.Send standard query response|
    |                       |                         TC bit is set                |
    |                       |                         QNAME=A.example.org          |
    |                       |                         QTYPE=A                      |
    |                       |                         ANSWER Name=A.example.org    |
    |                       |                         ANSWER Address=192.168.1.100|
    |                       |                                       to             |
    |                       |                                        192.168.1.129|
    |                       |------------------------------------------------------>|
    |                       |                       8.Send standard query in TCP  |
    |                       |                         QNAME=A.example.org          |
    |                       |                         QTYPE=A                      |
```

```
|---------------------------->|                                          |
| 9.Send standard query in TCP |                                         |
|  QNAME=A.example.com         |                                         |
|  QTYPE=A                     |                                         |
|<----------------------------|                                          |
| 10.Standard query response   |                                         |
|     in TCP                   |                                         |
|  QNAME= A.example.com        |                                         |
|  QTYPE=A                     |                                         |
|  ANSWER Name=A.example.com   |                                         |
|  ANSWER Address=192.168.0.11 |                                         |
|---------------------------->|                                          |
|11.Send standard query in TCP |                                         |
|  QNAME=B.example.org         |                                         |
|  QTYPE=A                     |                                         |
|                              |---------------------------------------->|
|                              |                    12.Send standard query |
|                              |                        QNAME=B.example.org |
|                              |                        QTYPE=A            |
|                              |<----------------------------------------|
|                              |                    13.Send standard query response |
|                              |                        TC bit is set      |
|                              |                        QNAME=B.example.org |
|                              |                        QTYPE=A            |
|                              |                        ANSWER Name=A.example.org |
|                              |                        ANSWER Address=192.168.0.200|
|                              |                                  to       |
|                              |                                    192.168.1.229|
|                              |---------------------------------------->|
|                              |                    14.Send standard query in TCP |
|                              |                       QNAME=B.example.org |
|                              |                       QTYPE=A            |
|                              |<----------------------------------------|
|                              |                    15.Send standard query response |
|                              |                                     in TCP |
|                              |                       QNAME=B.example.org |
|                              |                       QTYPE=A            |
|                              |                       ANSWER Name=A.example.org |
|                              |                       ANSWER Address=192.168.0.200 |
|                              |                                  to       |
|                              |                                   192.168.1.230 |
|<----------------------------|                                          |
| 16.Standard query response   |                                         |
|     in TCP                   |                                         |
|  QNAME= A.example.org        |                                         |
|  QTYPE=A                     |                                         |
|  ANSWER Name=A.example.org   |                                         |
|  ANSWER Address=192.168.0.200|                                         |
|               to             |                                         |
|                 192.168.1.230|                                         |
|                              |<----------------------------------------|
|                              |                    17.Send standard query response |
|                              |                                     in TCP |
|                              |                       QNAME=A.example.org |
|                              |                       QTYPE=A            |
|                              |                       ANSWER Name=A.example.org |
|                              |                       ANSWER Address=192.168.1.100 |
|                              |                                  to       |
|                              |                                   192.168.1.130 |
```

```
|<----------------------------|                                                |
| 18.Standard query response  |                                                |
|  TC bit is set              |                                                |
|  QNAME= A.example.org       |                                                |
|  QTYPE=A                    |                                                |
|  ANSWER Name=A.example.org  |                                                |
|  ANSWER Address=192.168.1.100|                                               |
|               to            |                                                |
|                 192.168.1.129|                                               |
|                             |                                                |
v                             v                                                v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.100 - 192.168.1.129 to NUT.
8. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) in TCP (Judgment *8)
9. TN send standard query QNAME=A.example.com, QTYPE=A to NUT in TCP.
10. NUT transmits query response to DNS Client1 (TN) in TCP (Judgment *10)
11. TN send standard query QNAME=B.example.org, QTYPE=A to NUT in TCP.
12. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *12)
13. TN send query response to ANSWER Name=B.example.org, ANSWER Address=192.168.0.200 - 192.168.1.229 to NUT.
14. TN send standard query QNAME=B.example.com, QTYPE=A to NUT in TCP. (Judgment *14)
15. TN send query response to ANSWER Name=B.example.org, ANSWER Address=192.168.0.200 - 192.168.1.230 to NUT in TCP.
16. NUT transmits query response to DNS Client1 (TN) (Judgment *16)
17. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.100 - 192.168.1.130 to NUT in TCP.
18. NUT transmits query response to DNS Client1 (TN) (Judgment *18)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1

	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any

	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	1
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	30
	NSCOUNT	0
	ARCOUNT	0

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.100
DNS Answer section x 28 ADDRESS range 192.168.1.101 - 192.168.1.128	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.129

8th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN) in TCP		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
TCP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org

	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT) in TCP		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10 packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN) in TCP		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.11
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

11th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT) in TCP		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1002
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

12th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

13th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	1
	RD	0
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	30
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.200
DNS Answer section x 28 ADDRESS range 192.168.0.201 - 192.168.1.228	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.229

14th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN) in TCP		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
TCP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any

	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

15th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT) in TCP		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
TCP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	31
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.200
DNS Answer section x 28 ADDRESS range 192.168.0.201 - 192.168.1.229	NAME	B.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4

	ADDRESS	****
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.230
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC221)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

16th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN) in TCP		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1002
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	31
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.200
DNS Answer section x 28 ADDRESS range 192.168.0.201 - 192.168.1.229	NAME	B.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.230
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC221)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

17th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT) in TCP		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
TCP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0

	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	31
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.100
DNS Answer section x 28 ADDRESS range 192.168.1.101 - 192.168.1.129	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.130
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC221)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

18th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	1
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	30
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.100
DNS Answer section x 25 ADDRESS range 192.168.1.101 - 192.168.1.128	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.129

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query including QNAME=A.example.org in TCP.
10. Received standard query response for QNAME=A.example.com QTYPE=A in TCP.
12. Received standard query including QNAME=B.example.org, QTYPE=A.
14. Received standard query including QNAME=B.example.org, QTYPE=A in TCP.
16. Received standard query response for QNAME=B.example.org QTYPE=A in TCP.
18. Received standard query response for QNAME=A.example.org QTYPE=A (TC bit is set).

References

RFC1035 DOMAIN NAMES - CONCEPTS AND FACILITIES
4.2.2. TCP usage

5.84. Accept UDP while server waits TCP connecting

Purpose

Verify that a NUT accepts UDP query while NUT wait TCP response.

- A name server must employ multiple concurrent activities, whether they are implemented as separate tasks in the host's OS or multiplexing inside a single name server program. It is simply not acceptable for a name server to block the service of UDP requests while it waits for TCP data for refreshing or query activities. Similarly, a name server should not attempt to provide recursive service without processing such requests in parallel, though it may choose to serialize requests from a single client, or to regard identical requests from the same client as duplicates.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 31 Topology No.31".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
```

```
NS1       IN        A         192.168.0.10
;
A         IN        A         192.168.0.11
```

Procedure

This test sequence is following.

```
                                                <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)           DNS Server2 DNS Server3 DNS Server4
     |                           |                              |           |           |
     |---------------------------->|                              |           |           |
     | 1.Send standard query     |                              |           |           |
     |  QNAME=A.example.org      |                              |           |           |
     |  QTYPE=A                  |                              |           |           |
     |                           |------------------------------>|           |           |
     |                           | 2.Recv standard query        |           |           |
     |                           |  QNAME=A.example.org         |           |           |
     |                           |  QTYPE=A                     |           |           |
     |                           |<------------------------------|           |           |
     |                           | 3.Send standard query response|           |           |
     |                           |  QNAME=A.example.org         |           |           |
     |                           |  QTYPE=A                     |           |           |
     |                           |  AUTHORITY Name=org          |           |           |
     |                           |  AUTHORITY Name Server       |           |           |
     |                           |            =NS3.example.org  |           |           |
     |                           |  ADDITIONAL Name             |           |           |
     |                           |            =NS3.example.org  |           |           |
     |                           |  ADDITIONAL Address =192.168.1.30|           |           |
     |                           |                              v           |           |
     |                           |------------------------------------------>|           |
     |                           |             4.Recv standard query         |           |
     |                           |              QNAME=A.example.org          |           |
     |                           |              QTYPE=A                      |           |
     |                           |<------------------------------------------|           |
     |                           |             5.Send standard query response|           |
     |                           |              QNAME=A.example.org          |           |
     |                           |              QTYPE=A                      |           |
     |                           |              AUTHORITY Name=example.org   |           |
     |                           |              AUTHORITY Name Server        |           |
     |                           |                     = NS4.example.org     |           |
     |                           |              ADDITIONAL Name              |           |
     |                           |                     = NS4.example.org     |           |
     |                           |              ADDITIONAL Address           |           |
     |                           |                     = 192.168.1.40        |           |
     |                           |                                        v           |
     |                           |-------------------------------------------------------->|
     |                           |                        6.Send standard query            |
     |                           |                         QNAME=A.example.org             |
     |                           |                         QTYPE=A                         |
     |                           |<--------------------------------------------------------|
     |                           |                        7.Send standard query response|
     |                           |                         TC bit is set                   |
     |                           |                         QNAME=A.example.org             |
     |                           |                         QTYPE=A                         |
     |                           |                         ANSWER Name=A.example.org       |
     |                           |                         ANSWER Address=192.168.1.100 |
     |                           |                                        to               |
     |                           |                                        192.168.1.129 |
```

```
|                              |-------------------------------------------------------->|
|                              |                        8.Send standard query in TCP  |
|                              |                          QNAME=A.example.org         |
|                              |                          QTYPE=A                     |
|----------------------------->|                                                      |
| 9.Send standard query in TCP |                                                      |
|  QNAME=A.example.com         |                                                      |
|  QTYPE=A                     |                                                      |
|<-----------------------------|                                                      |
| 10.Standard query response   |                                                      |
|     in TCP                   |                                                      |
|  QNAME= A.example.com        |                                                      |
|  QTYPE=A                     |                                                      |
|  ANSWER Name=A.example.com   |                                                      |
|  ANSWER Address=192.168.0.11 |                                                      |
|----------------------------->|                                                      |
|11.Send standard query in TCP |                                                      |
|  QNAME=B.example.org         |                                                      |
|  QTYPE=A                     |                                                      |
|                              |-------------------------------------------------------->|
|                              |                       12.Send standard query         |
|                              |                          QNAME=B.example.org         |
|                              |                          QTYPE=A                     |
|                              |<--------------------------------------------------------|
|                              |                       13.Send standard query response|
|                              |                          TC bit is set               |
|                              |                          QNAME=B.example.org         |
|                              |                          QTYPE=A                     |
|                              |                          ANSWER Name=A.example.org   |
|                              |                          ANSWER Address=192.168.1.200|
|                              |                                       to             |
|                              |                                         192.168.1.229|
|                              |-------------------------------------------------------->|
|                              |                       14.Send standard query in TCP  |
|                              |                          QNAME=B.example.org         |
|                              |                          QTYPE=A                     |
|                              |<--------------------------------------------------------|
|                              |                       15.Send standard query response in TCP  |
|                              |                          QNAME=B.example.org         |
|                              |                          QTYPE=A                     |
|                              |                          ANSWER Name=A.example.org   |
|                              |                          ANSWER Address=192.168.1.200|
|                              |                                       to             |
|                              |                                         192.168.1.230|
|<-----------------------------|                                                      |
| 16.Standard query response   |                                                      |
|     in TCP                   |                                                      |
|  QNAME= A.example.org        |                                                      |
|  QTYPE=A                     |                                                      |
|  ANSWER Name=A.example.org   |                                                      |
|  ANSWER Address=192.168.1.200|                                                      |
|                to            |                                                      |
|                  192.168.1.230|                                                      |
```

```
|                              |<-----------------------------------------------------|
|                              |                        17.Send standard query response|
|                              |                           in TCP                     |
|                              |                        QNAME=A.example.org           |
|                              |                        QTYPE=A                       |
|                              |                        ANSWER Name=A.example.org     |
|                              |                        ANSWER Address=192.168.1.100|
|                              |                                   to                 |
|                              |                                     192.168.1.130|
|<-----------------------------|                                                      |
| 18.Standard query response   |                                                      |
|  TC bit is set               |                                                      |
|  QNAME= A.example.org        |                                                      |
|  QTYPE=A                     |                                                      |
|  ANSWER Name=A.example.org   |                                                      |
|  ANSWER Address=192.168.1.100|                                                      |
|                to            |                                                      |
|                  192.168.1.129|                                                      |
|                              |                                                      |
v                              v                                                      v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.100 - 192.168.1.129 to NUT.
8. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) in TCP (Judgment *8)
9. TN send standard query QNAME=A.example.com, QTYPE=A to NUT in TCP.
10. NUT transmits query response to DNS Client1 (TN) in TCP (Judgment *10)
11. TN send standard query QNAME=B.example.org, QTYPE=A to NUT in TCP.
12. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *12)
13. TN send query response to ANSWER Name=B.example.org, ANSWER Address=192.168.1.200 - 192.168.1.229 to NUT.
14. TN send standard query QNAME=B.example.com, QTYPE=A to NUT in TCP. (Judgment *14)
15. TN send query response to ANSWER Name=B.example.org, ANSWER Address=192.168.1.200 - 192.168.1.230 to NUT in TCP.
16. NUT transmits query response to DNS Client1 (TN) (Judgment *16)
17. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.100 - 192.168.1.130 to NUT in TCP.
18. NUT transmits query response to DNS Client1 (TN) (Judgment *18)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53

DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any

	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1

	TC	1
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	30
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.100
DNS Answer section x 28 ADDRESS range 192.168.1.101 - 192.168.1.128	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.129

8th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN) in TCP		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
TCP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0

	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT) in TCP		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN) in TCP		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001

	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.11
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

11th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT) in TCP		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1002
	QR	0

	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

12th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

13th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ

UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	1
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	30
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.200
DNS Answer section x 28 ADDRESS range 192.168.1.201 - 192.168.1.228	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.229

14th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN) in TCP		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
TCP Header	Src Port	any

	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

15th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT) in TCP		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
TCP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	31
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.200
DNS Answer section x 28 ADDRESS range 192.168.1.201 - 192.168.1.229	NAME	B.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.230
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC221)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

16th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN) in TCP		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1002
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	31
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.200
DNS Answer section x 28 ADDRESS range 192.168.1.201 - 192.168.1.229	NAME	B.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.230
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC221)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

17th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT) in TCP		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
TCP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	31
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.100
DNS Answer section x 28 ADDRESS range 192.168.1.101 - 192.168.1.129	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.130
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC221)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

18th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	1
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	30
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.100
DNS Answer section X 25 ADDRESS 192.168.1.101 -	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)

192.168.1.128	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.129

- Termination
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query including QNAME=A.example.org in TCP.
10. Received standard query response for QNAME=A.example.com QTYPE=A in TCP.
12. Received standard query including QNAME=B.example.org, QTYPE=A.
14. Received standard query including QNAME=B.example.org, QTYPE=A in TCP.
16. Received standard query response for QNAME=B.example.org QTYPE=A in TCP.
18. Received standard query response for QNAME=A.example.org QTYPE=A (TC bit is set).

References

RFC1035 DOMAIN NAMES - CONCEPTS AND FACILITIES
4.2.2. TCP usage

5.85. Processing queries with QCLASS=*

Purpose

Verify that a NUT process query with QCLASS=* correctly.

- When processing queries with QCLASS=*, or some other QCLASS which matches multiple classes, the response should never be authoritative unless the server can guarantee that the response covers all classes.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
```

Procedure

This test sequence is following.

```
    DNS Client1 (TN)                      DNS Server1 (NUT)
        |                                     |
        |------------------------------------->|
        |   1. Send standard query            |
        |       QNAME=A.example.com           |
        |       QTYPE=A                       |
        |       QCLASS=*                      |
        |<-------------------------------------|
        |   2. Standard query response        |
        |       A=192.168.1.10                |
        v                                     v
    1. TN send standard query QNAME=A.example.com, QTYPE=A, QCLASS=* to NUT.
    2. NUT reply query response w/ A=192.168.1.10 to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	* (0x00FF)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1

	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	* (0x00FF)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response w/ A=192.168.1.10.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
6.2. Standard query processing

5.86. Duplicate answer is omitted from the additional section

Purpose

Verify that a NUT omits duplicate answer from the additional section

- When composing a response, RRs which are to be inserted in the additional section, but duplicate RRs in the answer or authority sections, may be omitted from the additional section.
- A Resource Record Set should only be included once in any DNS reply. It may occur in any of the Answer, Authority, or Additional Information sections, as required. However it should not be repeated in the same, or any other, section, except where explicitly required by a specification.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig.1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL      86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
          2005081600      ; serial
          3600            ; refresh every 1 hr
          900             ; retry every 15 min
          604800          ; expire after a week
          3600            ; Minimum TTL of a 1 hr
)
;
          IN        NS        NS1.example.com.
NS1       IN        A         192.168.0.10
;
A         IN        A         192.168.1.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |-------------------------------------->|
    |   1. Send standard query              |
    |     QNAME=NS1.example.com             |
    |     QTYPE=A                           |
    |<--------------------------------------|
    |   2. Standard query response          |
    |     ANSWER Name=NS1.example.com       |
    |     ANSWER Address=192.168.0.10       |
    |     AUTHORITY Name=example.com        |
    |     AUTHORITY Nsdname=NS1.example.com|
    v                                       v
1. TN send standard query QNAME=NS1.example.com, QTYPE=A, QCLASS=* to NUT.
2. NUT reply query response w/ A=192.168.0.10 to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	NS1.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	NS1.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	NS1.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Authority section	NAME	example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	2
	NSDNAME	NS1.example.com (Pointer 0xC00C)

- **Termination**
  None

Judgment

2. Received standard query response that must not include Additional section.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  6.2. Standard query processing
RFC2181 Clarifications to the DNS Specification
  5.5. Sending RRSets (reprise)

5.87. Authority section guarantee uniqueness of the answer

Purpose

Verify that a NUT treats truncated response including Authority section as unique answer.

- When a response is so long that truncation is required, the truncation should start at the end of the response and work forward in the datagram. Thus if there is any data for the authority section, the answer section is guaranteed to be unique.
- The TC bit should not be set merely because some extra information could have been included, but there was insufficient room. This includes the results of additional section processing.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 28 Topology No.28".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600      ; serial
         3600            ; refresh every 1 hr
         900             ; retry every 15 min
         604800          ; expire after a week
         3600            ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                  <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)     DNS Server2 DNS Server3 DNS Server4
    |                       |                     |           |           |
    |----------------------->|                    |           |           |
    | 1.Send standard query |                     |           |           |
    |  QNAME=A.example.org  |                     |           |           |
    |  QTYPE=A              |                     |           |           |
    |                       |----------------------->|        |           |
    |                       | 2.Recv standard query |         |           |
    |                       |  QNAME=A.example.org |          |           |
    |                       |  QTYPE=A             |          |           |
    |                       |<----------------------|         |           |
    |                       | 3.Send standard query response|  |           |
    |                       |  QNAME=A.example.org |          |           |
    |                       |  QTYPE=A             |          |           |
    |                       |  AUTHORITY Name=org  |          |           |
    |                       |  AUTHORITY Name Server |        |           |
    |                       |            =NS3.example.org |   |           |
    |                       |  ADDITIONAL Name     |          |           |
    |                       |            =NS3.example.org |   |           |
    |                       |  ADDITIONAL Address  |          |           |
    |                       |            =192.168.1.30 |      |           |
    |                       |                      v          |           |
    |                       |------------------------------------------->|
    |                       |            4.Recv standard query |           |
    |                       |             QNAME=A.example.org |           |
    |                       |             QTYPE=A             |           |
    |                       |<-------------------------------------------|
    |                       |            5.Send standard query response|  |
    |                       |              QNAME=A.example.org |          |
    |                       |              QTYPE=A             |          |
    |                       |              AUTHORITY Name=example.org |   |
    |                       |              AUTHORITY Name Server |        |
    |                       |                     = NS4.example.org |    |
    |                       |              ADDITIONAL Name     |          |
    |                       |                     = NS4.example.org |    |
    |                       |              ADDITIONAL Address  |          |
    |                       |                     = 192.168.1.40 |       |
    |                       |                                v           |
    |                       |------------------------------------------------------->|
    |                       |                       6.Send standard query |
    |                       |                         QNAME=A.example.org |
    |                       |                         QTYPE=A             |
    |                       |<-------------------------------------------------------|
    |                       |                       7.Send standard query response |
    |                       |                         TC bit is set                |
    |                       |                         QNAME=A.example.org          |
    |                       |                         QTYPE=A                      |
    |                       |                         ANSWER Name=A.example.org    |
    |                       |                         ANSWER Address=192.168.1.100 |
    |                       |                                      to              |
    |                       |                                        192.168.1.127 |
    |                       |                         AUTHORITY Name=example.org   |
    |                       |                         AUTHORITY Name Server        |
    |                       |                                     =NS4.example.org |
```

```
|                            (|-------------------------------------------------------->|)
|                             |                        8. Send standard query in TCP |
|                             |                         QNAME=A.example.org          |
|                             |                         QTYPE=A                      |
|<----------------------------|                                                      |
| 9.Standard query response   |                                                      |
|  TC bit is not set          |                                                      |
|  QNAME= A.example.org       |                                                      |
|  QTYPE=A                    |                                                      |
|  ANSWER Name=A.example.org  |                                                      |
|  ANSWER Address=192.168.1.100|                                                      |
|               to            |                                                      |
|                 192.168.1.127|                                                      |
|  AUTHORITY Name=example.org |                                                      |
|  AUTHORITY Name Server      |                                                      |
|              =NS4.example.org|                                                      |
|                             |                                                      |
v                             v                                                      v

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org)
   (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
   (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.100 - 192.168.1.127
   to NUT.
8. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) in
   TCP (Judgment *8)
9. NUT transmits query response to DNS Client1 (TN) (Judgment *9)
*step 8.is optional.
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0

	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0

	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	1
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	28
	NSCOUNT	1
	ARCOUNT	0

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.100
DNS Answer section X 28 ADDRESS 192.168.1.101 - 192.168.1.126	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.127
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)

8th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN) in TCP		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
TCP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any

	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	28
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.100
DNS Answer section X 25 ADDRESS 192.168.1.101 - 192.168.1.126	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4

	ADDRESS	****
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.127
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. When the tcp packet is received, this test cannot be continued.
9. Received standard query response (TC bit is not set).
   *step 8 is optional.

References

RFC1035 DOMAIN NAMES - CONCEPTS AND FACILITIES
  6.2. Standard query processing
RFC2181 Clarifications to the DNS Specification
  9. The TC (truncated) header bit

5.88. Invalid response (query is returned)

Purpose

Verify that a NUT checks the header of response.

- Check the header for reasonableness. Discard datagrams which are queries when responses are expected.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20

For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
```

Procedure

This test sequence is following.

```
                                                  <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)             DNS Server2 DNS Server3 DNS Server4
    |                           |                               |           |          |
    |---------------------------->|                               |           |          |
    | 1.Send standard query       |                               |           |          |
    |  QNAME=A.example.org        |                               |           |          |
    |  QTYPE=A                    |                               |           |          |
    |                             |------------------------------>|           |          |
    |                             | 2.Recv standard query         |           |          |
    |                             |  QNAME=A.example.org          |           |          |
    |                             |  QTYPE=A                      |           |          |
    |                             |<------------------------------|           |          |
    |                             | 3.Send standard query response|           |          |
    |                             |  QNAME=A.example.org          |           |          |
    |                             |  QTYPE=A                      |           |          |
    |                             |  AUTHORITY Name=org           |           |          |
    |                             |  AUTHORITY Name Server        |           |          |
    |                             |            =NS3.example.org   |           |          |
    |                             |  ADDITIONAL Name              |           |          |
    |                             |            =NS3.example.org   |           |          |
    |                             |  ADDITIONAL Address           |           |          |
    |                             |            =192.168.1.30      |           |          |
    |                             |                               v           |          |
    |                             |------------------------------------------>|          |
    |                             |             4.Recv standard query         |          |
    |                             |              QNAME=A.example.org          |          |
    |                             |              QTYPE=A                      |          |
    |                             |<------------------------------------------|          |
    |                             |             5.Send standard query response|          |
    |                             |              QNAME=A.example.org          |          |
    |                             |              QTYPE=A                      |          |
    |                             |              AUTHORITY Name=example.org   |          |
    |                             |              AUTHORITY Name Server        |          |
    |                             |                     = NS4.example.org     |          |
    |                             |              ADDITIONAL Name              |          |
    |                             |                     = NS4.example.org     |          |
    |                             |              ADDITIONAL Address           |          |
    |                             |                     = 192.168.1.40        |          |
    |                             |                                           v          |
    |                             |-------------------------------------------------->|
    |                             |                       6.Send standard query         |
    |                             |                        QNAME=A.example.org          |
    |                             |                        QTYPE=A                      |
```

```
|                            |<-------------------------------------------------|
|                            |                       7.Send standard query response|
|                            |                         QR=0(invalid)               |
|                            |                         QNAME=A.example.org         |
|                            |                         QTYPE=A                     |
|                            |                         ANSWER Name=A.example.org   |
|                            |                         ANSWER Address=192.168.1.10 |
|                            |                         AUTHORITY Name=example.org  |
|                            |                         AUTHORITY Name Server       |
|                            |                              = NS4.example.org      |
|                            |                         ADDITIONAL Name             |
|                            |                              = NS4.example.org      |
|                            |                         ADDITIONAL Address          |
|                            |                              = 192.168.1.40         |
| X <-------------------------|                                                    |
| 8.Standard query response  |                                                    |
|  QNAME= A.example.org      |                                                    |
|  QTYPE=A                   |                                                    |
|  ANSWER Name=A.example.org |                                                    |
|  ANSWER Address=192.168.1.10|                                                   |
|  AUTHORITY Name=example.org |                                                   |
|  AUTHORITY Name Server     |                                                    |
|   = NS4.example.org        |                                                    |
|  ADDITIONAL Name           |                                                    |
|   = NS4.example.org        |                                                    |
|  ADDITIONAL Address        |                                                    |
|   = 192.168.1.40           |                                                    |
|                            |                                                    |
v                            v                                                    v

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org)
   (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
   (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0

	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses

DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any

	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	0 (invalid)
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Not received standard query response.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
7.3. Processing responses

5.89. Invalid response (RRs are incorrectly formatted)

Purpose

Verify that a NUT checks the RRs of response

- Parse the sections of the message, and insure that all RRs are correctly formatted.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20

For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
NS1      IN        A         192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                <-------------- TN --------------->
DNS Client1 (TN)          DNS Server1 (NUT)        DNS Server2 DNS Server3 DNS Server4
  |                          |                            |         |         |
  |--------------------------->|                            |         |         |
  | 1.Send standard query      |                            |         |         |
  |  QNAME=A.example.org       |                            |         |         |
  |  QTYPE=A                   |                            |         |         |
  |                            |----------------------------->|         |         |
  |                            | 2.Recv standard query      |         |         |
  |                            |  QNAME=A.example.org       |         |         |
  |                            |  QTYPE=A                   |         |         |
  |                            |<-----------------------------|         |         |
  |                            | 3.Send standard query response|         |         |
  |                            |  QNAME=A.example.org       |         |         |
  |                            |  QTYPE=A                   |         |         |
  |                            |  AUTHORITY Name=org        |         |         |
  |                            |  AUTHORITY Name Server     |         |         |
  |                            |            =NS3.example.org |         |         |
  |                            |  ADDITIONAL Name           |         |         |
  |                            |            =NS3.example.org |         |         |
  |                            |  ADDITIONAL Address        |         |         |
  |                            |            =192.168.1.30   |         |         |
  |                            |                            v         |         |
  |                            |------------------------------------->|         |
  |                            |           4.Recv standard query      |         |
  |                            |            QNAME=A.example.org       |         |
  |                            |            QTYPE=A                   |         |
  |                            |<-------------------------------------|         |
  |                            |           5.Send standard query response|         |
  |                            |            QNAME=A.example.org       |         |
  |                            |            QTYPE=A                   |         |
  |                            |            AUTHORITY Name=example.org |         |
  |                            |            AUTHORITY Name Server     |         |
  |                            |                   = NS4.example.org  |         |
  |                            |            ADDITIONAL Name           |         |
  |                            |                   = NS4.example.org  |         |
  |                            |            ADDITIONAL Address        |         |
  |                            |                   = 192.168.1.40     |         |
  |                            |                                      v         |
  |                            |------------------------------------------------>|
  |                            |                     6.Send standard query         |
  |                            |                      QNAME=A.example.org          |
  |                            |                      QTYPE=A                      |
  |                            |<------------------------------------------------|
  |                            |                     7.Send standard query response|
  |                            |                      QNAME=A.example.org          |
  |                            |                      QTYPE=A                      |
  |                            |                      ANSWER Name=A.example.org    |
  |                            |                      ANSWER Address=empty         |
  |                            |                      AUTHORITY Name=example.org   |
  |                            |                      AUTHORITY Name Server        |
  |                            |                          = NS4.example.org        |
  |                            |                      ADDITIONAL Name              |
  |                            |                          = NS4.example.org        |
  |                            |                      ADDITIONAL Address           |
  |                            |                          = 192.168.1.40           |
```

```
   | X <------------------------|                                                |
   | 8.Standard query response  |                                                |
   |  QNAME= A.example.org      |                                                |
   |  QTYPE=A                   |                                                |
   |  ANSWER Name=A.example.org |                                                |
   |  ANSWER Address=empty      |                                                |
   |  AUTHORITY Name=example.org|                                                |
   |  AUTHORITY Name Server     |                                                |
   |   = NS4.example.org        |                                                |
   |  ADDITIONAL Name           |                                                |
   |   = NS4.example.org        |                                                |
   |  ADDITIONAL Address        |                                                |
   |   = 192.168.1.40           |                                                |
   |                            |                                                |
   v                            v                                                v

  1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
  2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
  3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
  4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org)
     (Judgment *4)
  5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
  6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
     (Judgment *6)
  7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=empty.
  8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)

	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any

	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	0
	ADDRESS	*empty* (invalid)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC037)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Not received standard query response.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
7.3. Processing responses

5.90. invalid response(Long TTL)(optional)

Purpose

Verify that a NUT checks the TTL of response

- As an optional step, check the TTLs of arriving data looking for RRs with excessively long TTLs. If a RR has an excessively long TTL, say greater than 1 week, either discard the whole response, or limit all TTLs in the response to 1 week.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN        NS   NS1.example.com.
NS1      IN        A    192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                  <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)     DNS Server2 DNS Server3 DNS Server4
  |                           |                         |           |           |
  |---------------------------->|                         |           |           |
  | 1. Send standard query    |                         |           |           |
  |  QNAME=A.example.org      |                         |           |           |
  |  QTYPE=A                  |                         |           |           |
  |                           |---------------------------->|           |           |
  |                           | 2.Recv standard query   |           |           |
  |                           |  QNAME=A.example.org    |           |           |
  |                           |  QTYPE=A                |           |           |
  |                           |<----------------------------|           |           |
  |                           | 3.Send standard query response|           |           |
  |                           |  QNAME=A.example.org    |           |           |
  |                           |  QTYPE=A                |           |           |
  |                           |  AUTHORITY Name=org     |           |           |
  |                           |  AUTHORITY Name Server  |           |           |
  |                           |            =NS3.example.org|           |           |
  |                           |  ADDITIONAL Name        |           |           |
  |                           |            =NS3.example.org|           |           |
  |                           |  ADDITIONAL Address     |           |           |
  |                           |            =192.168.1.30|           |           |
  |                           |                         v           |           |
  |                           |------------------------------------------>|           |
  |                           |             4.Recv standard query         |           |
  |                           |              QNAME=A.example.org          |           |
  |                           |              QTYPE=A                      |           |
  |                           |<------------------------------------------|           |
  |                           |             5.Send standard query response|           |
  |                           |              QNAME=A.example.org          |           |
  |                           |              QTYPE=A                      |           |
  |                           |              AUTHORITY Name=example.org   |           |
  |                           |              AUTHORITY Name Server        |           |
  |                           |                     = NS4.example.org     |           |
  |                           |              ADDITIONAL Name              |           |
  |                           |                     = NS4.example.org     |           |
  |                           |              ADDITIONAL Address           |           |
  |                           |                     = 192.168.1.40        |           |
  |                           |                                           v           |
  |                           |-------------------------------------------------------->|
  |                           |                     6.Send standard query             |
  |                           |                      QNAME=A.example.org              |
  |                           |                      QTYPE=A                          |
  |                           |<--------------------------------------------------------|
  |                           |                     7.Send standard query response    |
  |                           |                      QNAME=A.example.org              |
  |                           |                      QTYPE=A                          |
  |                           |                      ANSWER Name=A.example.org        |
  |                           |                      ANSWER Address=192.168.1.10      |
  |                           |                      ANSWER TTL=2 weeks (invalid)     |
  |                           |                      AUTHORITY Name=example.org       |
  |                           |                      AUTHORITY Name Server            |
  |                           |                              = NS4.example.org        |
  |                           |                      ADDITIONAL Name = NS4.example.org|
  |                           |                      ADDITIONAL Address = 192.168.1.40|
```

```
| X <-------------------------|                                                |
| 8A.Standard query response  |                                                |
|  QNAME= A.example.org       |                                                |
|  QTYPE=A                    |                                                |
|  ANSWER Name=A.example.org  |                                                |
|  ANSWER Address=192.168.1.10|                                                |
|  AUTHORITY Name=example.org |                                                |
|  AUTHORITY Name Server      |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Name            |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Address         |                                                |
|   = 192.168.1.40            |                                                |
|<----------------------------|                                                |
| 8B.Standard query response  |                                                |
|  QNAME= A.example.org       |                                                |
|  QTYPE=A                    |                                                |
|  ANSWER Name=A.example.org  |                                                |
|  ANSWER Address=192.168.1.10|                                                |
|  ANSWER TTL=1 week          |                                                |
|  AUTHORITY Name=example.org |                                                |
|  AUTHORITY Name Server      |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Name            |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Address         |                                                |
|   = 192.168.1.40            |                                                |
|                             |                                                |
v                             v                                                v

  1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
  2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
  3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
  4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org)
     (Judgment *4)
  5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
  6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
     (Judgment *6)
  7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
  8A. NUT transmits query response to DNS Client1 (TN) (Judgment *8A)
  8B. NUT transmits query response to DNS Client1 (TN) (Judgment *8B)
   *8A or 8B is observed.
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0

	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ

UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0

	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	2 weeks (1209600) (invalid)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet(8B).

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0

	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 week (604800)(modified from the original response(7th Packet))
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8A. Not received standard query response.
8B. Received standard query response with TTL=1 week.
*8A or 8B is judged.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
7.3. Processing responses

5.91. Invalid response (ID does not match)

Purpose

Verify that a NUT checks the ID of response.

- The recommended strategy is to do a preliminary matching using the ID field in the domain header, and then to verify that the question section corresponds to the information currently desired.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                   <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)      DNS Server2 DNS Server3 DNS Server4
  |                          |                            |           |           |
  |--------------------------->|                            |           |           |
  | 1.Send standard query      |                            |           |           |
  |  QNAME=A.example.org       |                            |           |           |
  |  QTYPE=A                   |                            |           |           |
  |                            |----------------------------->|           |           |
  |                            | 2.Recv standard query      |           |           |
  |                            |  QNAME=A.example.org       |           |           |
  |                            |  QTYPE=A                   |           |           |
  |                            |<-----------------------------|           |           |
  |                            | 3.Send standard query response|           |           |
  |                            |  QNAME=A.example.org       |           |           |
  |                            |  QTYPE=A                   |           |           |
  |                            |  AUTHORITY Name=org        |           |           |
  |                            |  AUTHORITY Name Server     |           |           |
  |                            |            =NS3.example.org |           |           |
  |                            |  ADDITIONAL Name           |           |           |
  |                            |            =NS3.example.org |           |           |
  |                            |  ADDITIONAL Address        |           |           |
  |                            |            =192.168.1.30   |           |           |
  |                            |                            v           |           |
  |                            |------------------------------------------>|           |
  |                            |          4.Recv standard query           |           |
  |                            |           QNAME=A.example.org            |           |
  |                            |           QTYPE=A                        |           |
  |                            |<------------------------------------------|           |
  |                            |          5.Send standard query response  |           |
  |                            |           QNAME=A.example.org            |           |
  |                            |           QTYPE=A                        |           |
  |                            |           AUTHORITY Name=example.org     |           |
  |                            |           AUTHORITY Name Server          |           |
  |                            |                  = NS4.example.org       |           |
  |                            |           ADDITIONAL Name= NS4.example.org|           |
  |                            |           ADDITIONAL Address= 192.168.1.40|           |
  |                            |                                       v  |           |
  |                            |-------------------------------------------------------->|
  |                            |                   6.Send standard query                 |
  |                            |                    QNAME=A.example.org                  |
  |                            |                    QTYPE=A                              |
  |                            |<--------------------------------------------------------|
  |                            |                   7.Send standard query response        |
  |                            |                    ID=Not same as 6th's query(invalid)|
  |                            |                     QNAME=A.example.org                 |
  |                            |                     QTYPE=A                             |
  |                            |                     ANSWER Name=A.example.org           |
  |                            |                     ANSWER Address=192.168.1.10         |
  |                            |                     AUTHORITY Name=example.org          |
  |                            |                     AUTHORITY Name Server               |
  |                            |                          = NS4.example.org              |
  |                            |                     ADDITIONAL Name= NS4.example.org    |
  |                            |                     ADDITIONAL Address= 192.168.1.40    |
```

```
| X <-------------------------|                                                |
| 8.Standard query response   |                                                |
|  QNAME= A.example.org       |                                                |
|  QTYPE=A                    |                                                |
|  ANSWER Name=A.example.org  |                                                |
|  ANSWER Address=192.168.1.10|                                                |
|  AUTHORITY Name=example.org |                                                |
|  AUTHORITY Name Server      |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Name            |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Address         |                                                |
|   = 192.168.1.40            |                                                |
|                             |                                                |
v                             v                                                v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)

	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any

	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	0xffff (Not same as 6th Packet's ID)
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Not received standard query response.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
7.3. Processing responses

5.92. Invalid response (invalid question section)

Purpose

Verify that a NUT checks the Question section of response.

- The recommended strategy is to do a preliminary matching using the ID field in the domain header, and then to verify that the question section corresponds to the information currently desired.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)           DNS Server2 DNS Server3 DNS Server4
  |                          |                              |           |           |
  |--------------------------->|                              |           |           |
  | 1.Send standard query      |                              |           |           |
  |  QNAME=A.example.org       |                              |           |           |
  |  QTYPE=A                   |                              |           |           |
  |                            |------------------------------>|           |           |
  |                            | 2.Recv standard query        |           |           |
  |                            |  QNAME=A.example.org         |           |           |
  |                            |  QTYPE=A                     |           |           |
  |                            |<------------------------------|           |           |
  |                            | 3.Send standard query response|           |           |
  |                            |  QNAME=A.example.org         |           |           |
  |                            |  QTYPE=A                     |           |           |
  |                            |  AUTHORITY Name=org          |           |           |
  |                            |  AUTHORITY Name Server       |           |           |
  |                            |            =NS3.example.org  |           |           |
  |                            |  ADDITIONAL Name             |           |           |
  |                            |            =NS3.example.org  |           |           |
  |                            |  ADDITIONAL Address          |           |           |
  |                            |            =192.168.1.30     |           |           |
  |                            |                              v           |           |
  |                            |------------------------------------------>|           |
  |                            |             4.Recv standard query         |           |
  |                            |              QNAME=A.example.org          |           |
  |                            |              QTYPE=A                      |           |
  |                            |<------------------------------------------|           |
  |                            |             5 Send standard query response|           |
  |                            |              QNAME=A.example.org          |           |
  |                            |              QTYPE=A                      |           |
  |                            |              AUTHORITY Name=example.org   |           |
  |                            |              AUTHORITY Name Server        |           |
  |                            |                     = NS4.example.org     |           |
  |                            |              ADDITIONAL Name              |           |
  |                            |                     = NS4.example.org     |           |
  |                            |              ADDITIONAL Address           |           |
  |                            |                     = 192.168.1.40        |           |
  |                            |                                           v           |
  |                            |-------------------------------------------------------->|
  |                            |                        6.Send standard query            |
  |                            |                         QNAME=A.example.org             |
  |                            |                         QTYPE=A                         |
  |                            |<--------------------------------------------------------|
  |                            |                        7.Send standard query response|
  |                            |                         QNAME=B.example.org (invalid)|
  |                            |                         QTYPE=A                         |
  |                            |                         ANSWER Name=A.example.org       |
  |                            |                         ANSWER Address=192.168.1.10     |
  |                            |                         AUTHORITY Name=example.org      |
  |                            |                         AUTHORITY Name Server           |
  |                            |                             = NS4.example.org           |
  |                            |                         ADDITIONAL Name                 |
  |                            |                             = NS4.example.org           |
  |                            |                         ADDITIONAL Address              |
  |                            |                             = 192.168.1.40              |
```

```
| X <-------------------------|                                                |
| 8.Standard query response   |                                                |
|  QNAME= B.example.org       |                                                |
|            or               |                                                |
|  QNAME= A.example.org       |                                                |
|  QTYPE=A                    |                                                |
|  ANSWER Name=A.example.org  |                                                |
|  ANSWER Address=192.168.1.10|                                                |
|  AUTHORITY Name=example.org |                                                |
|  AUTHORITY Name Server      |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Name            |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Address         |                                                |
|   = 192.168.1.40            |                                                |
|                             |                                                |
v                             v                                                v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0

	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any

	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (A + Pointer 0xC00E)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Not received standard query response.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
7.3. Processing responses

5.93. Caching several RRs of same type

Purpose

Verify that a NUT uses the cached data.

- When several RRs of the same type are available for a particular owner name, the resolver should either cache them all or none at all.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 29 Topology No.29".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.            3600000               A      192.168.1.20

For IPv6
 .                      3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.            3600000        AAAA   3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
         IN   NS   NS1.example.com.
NS1      IN        A          192.168.0.10
```

Procedure

This test sequence is following.

```
                                                  <-------------- TN --------------->
DNS Client1 (TN)          DNS Server1 (NUT)       DNS Server2 DNS Server3 DNS Server4
  |                          |                          |           |           |
  |--------------------------->|                          |           |           |
  | 1.Send standard query    |                          |           |           |
  |  QNAME=A.example.org     |                          |           |           |
  |  QTYPE=A                 |                          |           |           |
  |                          |----------------------------->|           |           |
  |                          | 2.Recv standard query    |           |           |
  |                          |  QNAME=A.example.org     |           |           |
  |                          |  QTYPE=A                 |           |           |
  |                          |<-----------------------------|           |           |
  |                          | 3.Send standard query response|           |           |
  |                          |  QNAME=A.example.org     |           |           |
  |                          |  QTYPE=A                 |           |           |
  |                          |  AUTHORITY Name=org      |           |           |
  |                          |  AUTHORITY Name Server   |           |           |
  |                          |            =NS3.example.org |           |           |
  |                          |  ADDITIONAL Name         |           |           |
  |                          |            =NS3.example.org |           |           |
  |                          |  ADDITIONAL Address      |           |           |
  |                          |            =192.168.1.30 |           |           |
  |                          |                          v           |           |
  |                          |------------------------------------------>|           |
  |                          |           4.Recv standard query      |           |
  |                          |            QNAME=A.example.org       |           |
  |                          |            QTYPE=A                   |           |
  |                          |<------------------------------------------|           |
  |                          |           5.Send standard query response |           |
  |                          |            QNAME=A.example.org       |           |
  |                          |            QTYPE=A                   |           |
  |                          |            AUTHORITY Name=example.org |           |
  |                          |            AUTHORITY Name Server     |           |
  |                          |                   = NS4.example.org |           |
  |                          |            ADDITIONAL Name=NS4.example.org|           |
  |                          |            ADDITIONAL Address=192.168.1.40|           |
  |                          |                                   v           |
  |                          |------------------------------------------------------>|
  |                          |                     6.Send standard query             |
  |                          |                      QNAME=A.example.org              |
  |                          |                      QTYPE=A                          |
  |                          |<------------------------------------------------------|
  |                          |                     7.Send standard query response    |
  |                          |                      QNAME=A.example.org              |
  |                          |                      QTYPE=A                          |
  |                          |                      ANSWER Name=A.example.org        |
  |                          |                      ANSWER Address=192.168.1.10      |
  |                          |                      ANSWER Name=A.example.org        |
  |                          |                      ANSWER Address=192.168.1.11      |
  |                          |                      AUTHORITY Name=example.org       |
  |                          |                      AUTHORITY Name Server            |
  |                          |                          = NS4.example.org            |
  |                          |                      ADDITIONAL Name = NS4.example.org|
  |                          |                      ADDITIONAL Address = 192.168.1.40|
```

```
|<----------------------------|                                                |
| 8.Standard query response   |                                                |
|  QNAME= A.example.org       |                                                |
|  QTYPE=A                    |                                                |
|  ANSWER Name=A.example.org  |                                                |
|  ANSWER Address=192.168.1.10|                                                |
|  ANSWER Name=A.example.org  |                                                |
|  ANSWER Address=192.168.1.11|                                                |
|  AUTHORITY Name=example.org |                                                |
|  AUTHORITY Name Server      |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Name            |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Address         |                                                |
|   = 192.168.1.40            |                                                |
|---------------------------->|                                                |
| 9.Send standard query       |                                                |
|  QNAME=A.example.org        |                                                |
|  QTYPE=A                    |                                                |
|<----------------------------|                                                |
| 10A.Standard query response |                                                |
|  QNAME= A.example.org       |                                                |
|  QTYPE=A                    |                                                |
|  ANSWER Name=A.example.org  |                                                |
|  ANSWER Address=192.168.1.10|                                                |
|  ANSWER Name=A.example.org  |                                                |
|  ANSWER Address=192.168.1.11|                                                |
|  AUTHORITY Name=example.org |                                                |
|  AUTHORITY Name Server      |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Name            |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Address         |                                                |
|   = 192.168.1.40            |                                                |
|                             |------------------------------------------------>|
|                             |                     10B.  Send standard query  |
|                             |                       QNAME=A.example.org      |
|                             |                       QTYPE=A                  |
v                             v                                                v

 1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
 2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
 3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
 4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org)
    (Judgment *4)
 5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
 6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
    (Judgment *6)
 7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10, 192.168.1.11.
 8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)
 9. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
 10A. NUT transmits query response to DNS Client1 (TN) (Judgment *10A)
                        or
 10B. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
     (Judgment *10B)
 *10A or 10B is observed.
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4

	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)

DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet(10A).

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1

	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	any
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	any
	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	any
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	any
	RDLENGTH	4
	ADDRESS	192.168.1.40

10th packet(10B).

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any

	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response.
10A. Received standard query response from Cache.
or
10B. Received standard query including QNAME=A.example.org, QTYPE=A.
*10A or 10B is judged.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
7.4. Using the cache

5.94. Unused fields in a query

Purpose

Verify that a NUT transmits correct standard query format for unused fields

- Header section format (query)

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                      ID                       |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|QR|   Opcode  |AA|TC|RD|RA|   Z    |   RCODE   |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    QDCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    ANCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    NSCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                    ARCOUNT                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

AA	**Must be zero (0)**
RA	**Must be zero (0)**
Z	**Must be zero (0)**
RCODE	**Must be zero (0)**

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 11 Topology No.11".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
.                    3600000        IN    NS    A.ROOT.NET.
A.ROOT.NET.          3600000              A     192.168.1.20
```

For IPv6

```
.                    3600000        IN    NS    A.ROOT.NET.
```

```
A.ROOT.NET.              3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
  DNS Client1 (TN)          DNS Server1 (NUT)                DNS Server2 (TN)
        |                            |                                |
        |---------------------------->|                                |
        | 1. Send standard query      |                                |
        |  QNAME=A.example.org        |                                |
        |  QTYPE=A                    |                                |
        |                             |------------------------------->|
        |                             | 2. Recv standard query         |
        |                             |  QNAME=A.example.org           |
        |                             |  QTYPE=A                       |
        v                             v                                v

  1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
  2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	ANY
	OPCODE	ANY
	AA	0
	TC	ANY
	RD	ANY
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	ANY
	ANCOUNT	ANY
	NSCOUNT	ANY
	ARCOUNT	ANY
DNS Question section	QNAME	ANY
	QTYPE	ANY
	QCLASS	ANY

- **Termination**
  None

Judgment

2. Standard query must be based on above Verification Points.

References

RFC1123 Requirements for Internet Hosts -- Application and Support
6.1.2.3 Unused Fields: RFC-1035 Section 4.1.1

5.95. Multiplex concurrent requests

Purpose

Verify that a NUT supports multiplex concurrent requests.

- A name resolver SHOULD be able to multiplex concurrent requests if the host supports concurrent processes.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 32 Topology No.32".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20

For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                <------------- TN --------------->
DNS Client1 (TN)     DNS Server1 (NUT)             DNS Server2 DNS Server3 DNS Server4
  |                      |                              |         |         |
  |----------------------->|                              |         |         |
  | 1.Send standard query |                              |         |         |
  |  QNAME=A.example.org  |                              |         |         |
  |  QTYPE=A              |                              |         |         |
  |                      |------------------------------>|         |         |
  |                      | 2.Recv standard query         |         |         |
  |                      |  QNAME=A.example.org          |         |         |
  |                      |  QTYPE=A                      |         |         |
  |                      |<------------------------------|         |         |
  |                      | 3.Send standard query response|         |         |
  |                      |  QNAME=A.example.org          |         |         |
  |                      |  QTYPE=A                      |         |         |
  |                      |  AUTHORITY Name=org           |         |         |
  |                      |  AUTHORITY Name Server        |         |         |
  |                      |            =NS3.example.org   |         |         |
  |                      |  ADDITIONAL Name              |         |         |
  |                      |            =NS3.example.org   |         |         |
  |                      |  ADDITIONAL Address           |         |         |
  |                      |            =192.168.1.30      |         |         |
  |                      |                               v         |         |
  |                      |---------------------------------------->|         |
  |                      |             4. Recv standard query      |         |
  |                      |              QNAME=A.example.org        |         |
  |                      |              QTYPE=A                    |         |
  |----------------------->|                              |         |         |
  | 5.Send standard query |                              |         |         |
  |  QNAME=A.example.edu  |                              |         |         |
  |  QTYPE=A              |                              |         |         |
  |                      |------------------------------>|         |         |
  |                      | 6.Recv standard query         |         |         |
  |                      |  QNAME=A.example.edu          |         |         |
  |                      |  QTYPE=A                      |         |         |
  |                      |<------------------------------|         |         |
  |                      | 7.Send standard query response|         |         |
  |                      |  QNAME=A.example.edu          |         |         |
  |                      |  QTYPE=A                      |         |         |
  |                      |  AUTHORITY Name=edu           |         |         |
  |                      |  AUTHORITY Name Server        |         |         |
  |                      |            =NS4.example.org   |         |         |
  |                      |  ADDITIONAL Name              |         |         |
  |                      |            =NS4.example.org   |         |         |
  |                      |  ADDITIONAL Address           |         |         |
  |                      |            =192.168.1.40      |         |         |
  |                      |                               v         v         |
  |                      |------------------------------------------------>|
  |                      |                    8. Recv standard query         |
  |                      |                     QNAME=A.example.edu           |
  |                      |                     QTYPE=A                       |
  |                      |                                                   |
  v                      v                                                   v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org (message contain pointers).
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send standard query QNAME=A.example.edu, QTYPE=A to NUT.
6. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *6)
7. TN send query response to NUT w/ AUTHORITY Name=edu, AUTHORITY Name Server=NS4.example.org.
8. NUT transmits standard query QNAME=A.example.edu, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0

	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6

	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0

	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.edu
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

6th packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.edu
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses

	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.edu
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	edu (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any

	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.edu
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.edu, QTYPE=A.
8. Received standard query including QNAME=A.example.edu, QTYPE=A.

References

RFC1123 Requirements for Internet Hosts -- Application and Support
6.1.3.1 Resolver Implementation

5.96. Time out of cache

Purpose

Verify that a NUT has time out information in the cache.

- The resolver MUST implement a local caching function to avoid repeated remote access for identical requests, and MUST time out information in the cache.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20

For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                   <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)      DNS Server2 DNS Server3 DNS Server4
  |                          |                          |          |          |
  |--------------------------->|                          |          |          |
  | 1.Send standard query    |                          |          |          |
  |  QNAME=A.example.org     |                          |          |          |
  |  QTYPE=A                 |                          |          |          |
  |                          |------------------------->|          |          |
  |                          | 2.Recv standard query    |          |          |
  |                          |  QNAME=A.example.org     |          |          |
  |                          |  QTYPE=A                 |          |          |
  |                          |<-------------------------|          |          |
  |                          | 3.Send standard query response |    |          |
  |                          |  QNAME=A.example.org     |          |          |
  |                          |  QTYPE=A                 |          |          |
  |                          |  AUTHORITY Name=org      |          |          |
  |                          |  AUTHORITY Name Server   |          |          |
  |                          |            =NS3.example.org |       |          |
  |                          |  ADDITIONAL Name         |          |          |
  |                          |            =NS3.example.org |       |          |
  |                          |  ADDITIONAL Address      |          |          |
  |                          |            =192.168.1.30 |          |          |
  |                          |                          v          |          |
  |                          |------------------------------------>|          |
  |                          |          4.Recv standard query      |          |
  |                          |           QNAME=A.example.org       |          |
  |                          |           QTYPE=A                   |          |
  |                          |<------------------------------------|          |
  |                          |          5.Send standard query response |      |
  |                          |           QNAME=A.example.org       |          |
  |                          |           QTYPE=A                   |          |
  |                          |           AUTHORITY Name=example.org |         |
  |                          |           AUTHORITY Name Server     |          |
  |                          |                  = NS4.example.org  |          |
  |                          |           ADDITIONAL Name=NS4.example.org|     |
  |                          |           ADDITIONAL Address=192.168.1.40|     |
  |                          |                                 v           |
  |                          |------------------------------------------------>|
  |                          |                   6.Send standard query             |
  |                          |                    QNAME=A.example.org              |
  |                          |                    QTYPE=A                          |
  |                          |<------------------------------------------------|
  |                          |                   7.Send standard query response    |
  |                          |                    QNAME=A.example.org              |
  |                          |                    QTYPE=A                          |
  |                          |                    ANSWER Name=A.example.org        |
  |                          |                    ANSWER Address=192.168.1.10      |
  |                          |                    ANSWER TTL=10 seconds            |
  |                          |                    AUTHORITY Name=example.org       |
  |                          |                    AUTHORITY Name Server            |
  |                          |                        = NS4.example.org            |
  |                          |                    ADDITIONAL Name = NS4.example.org|
  |                          |                    ADDITIONAL Address = 192.168.1.40|
```

```
|<----------------------------|                                                |
| 8.Standard query response   |                                                |
|  QNAME= A.example.org       |                                                |
|  QTYPE=A                    |                                                |
|  ANSWER Name=A.example.org  |                                                |
|  ANSWER Address=192.168.1.10|                                                |
|  AUTHORITY Name=example.org |                                                |
|  AUTHORITY Name Server      |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Name            |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Address         |                                                |
|   = 192.168.1.40            |                                                |
|---------------------------->|                                                |
| 9.Send standard query       |                                                |
|  QNAME=A.example.org        |                                                |
|  QTYPE=A                    |                                                |
|  *Send query within 10 sec. |                                                |
|<----------------------------|                                                |
| 10.Standard query response  |                                                |
|  QNAME= A.example.org       |                                                |
|  QTYPE=A                    |                                                |
|  ANSWER Name=A.example.org  |                                                |
|  ANSWER Address=192.168.1.10|                                                |
|  AUTHORITY Name=example.org |                                                |
|  AUTHORITY Name Server      |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Name            |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Address         |                                                |
|   = 192.168.1.40            |                                                |
|---------------------------->|                                                |
| 11.Send standard query      |                                                |
|  QNAME=A.example.org        |                                                |
|  QTYPE=A                    |                                                |
|  *Send query after 10 sec.  |                                                |
|                             |------------------------------------------------>|
|                             |                        12.Send standard query  |
|                             |                          QNAME=A.example.org   |
|                             |                          QTYPE=A               |
|                             |                                                |
v                             v                                                v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER ADDRESS=192.168.1.10.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)
9. TN send standard query QNAME=A.example.org, QTYPE=A to NUT within 10 seconds from 8.
10. NUT transmits query response to DNS Client1 (TN) from Cache (Judgment *10)
11. TN send standard query QNAME=A.example.org, QTYPE=A to NUT after 10 seconds from 8.
12. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *12)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	10 seconds (10)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ

UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	10 seconds (10)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000

	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	any
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	any
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	any
	RDLENGTH	4
	ADDRESS	192.168.1.40

11th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1002
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

12th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response.
10. Received standard query response from Cache.
12. Received standard query including QNAME=A.example.org, QTYPE=A.

References

RFC1123 Requirements for Internet Hosts - Application and Support
6.2.3.1 Resolver Implementation

5.97. Not refuse TCP query (query)

Purpose

Verify that a NUT transmits correct TCP query

- A name server MAY limit the resources it devotes to TCP queries, but it SHOULD NOT refuse to service a TCP query just because it would have succeeded with UDP.
- DNS resolvers and recursive servers MUST support UDP, and SHOULD support TCP, for sending (non-zone-transfer) queries. Specifically, a DNS resolver or server that is sending a non-zone-transfer query MUST send a UDP query first. If the Answer section of the response is truncated and if the requester supports TCP, it SHOULD try the query again using TCP.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600      ; serial
         3600            ; refresh every 1 hr
         900             ; retry every 15 min
         604800          ; expire after a week
         3600            ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
```

```
NS1      IN      A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                   <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)        DNS Server2 DNS Server3 DNS Server4
  |                         |                              |           |           |
  |------------------------>|                              |           |           |
  | 1.Send standard query in TCP |                         |           |           |
  |  QNAME=A.example.org    |                              |           |           |
  |  QTYPE=A                |                              |           |           |
  |                         |------------------------------>|           |           |
  |                         | 2.Recv standard query        |           |           |
  |                         |  QNAME=A.example.org         |           |           |
  |                         |  QTYPE=A                     |           |           |
  |                         |<------------------------------|           |           |
  |                         | 3.Send standard query response|           |           |
  |                         |  QNAME=A.example.org         |           |           |
  |                         |  QTYPE=A                     |           |           |
  |                         |  AUTHORITY Name=org          |           |           |
  |                         |  AUTHORITY Name Server       |           |           |
  |                         |            =NS3.example.org  |           |           |
  |                         |  ADDITIONAL Name             |           |           |
  |                         |            =NS3.example.org  |           |           |
  |                         |  ADDITIONAL Address =192.168.1.30|           |           |
  |                         |                              v           |           |
  |                         |------------------------------------------>|           |
  |                         |           4.Recv standard query           |           |
  |                         |            QNAME=A.example.org            |           |
  |                         |            QTYPE=A                        |           |
  |                         |<------------------------------------------|           |
  |                         |           5.Send standard query response  |           |
  |                         |            QNAME=A.example.org            |           |
  |                         |            QTYPE=A                        |           |
  |                         |            AUTHORITY Name=example.org     |           |
  |                         |            AUTHORITY Name Server          |           |
  |                         |                   = NS4.example.org       |           |
  |                         |            ADDITIONAL Name=NS4.example.org|           |
  |                         |            ADDITIONAL Address=192.168.1.40|           |
  |                         |                                        v           |
  |                         |------------------------------------------------------>|
  |                         |                     6.Send standard query             |
  |                         |                      QNAME=A.example.org              |
  |                         |                      QTYPE=A                          |
  |                         |<------------------------------------------------------|
  |                         |                     7.Send standard query response    |
  |                         |                       QNAME=A.example.org             |
  |                         |                       QTYPE=A                         |
  |                         |                       ANSWER Name=A.example.org       |
  |                         |                       ANSWER Address=192.168.1.10     |
  |                         |                       AUTHORITY Name=example.org      |
  |                         |                       AUTHORITY Name Server           |
  |                         |                           = NS4.example.org           |
  |                         |                       ADDITIONAL Name= NS4.example.org|
  |                         |                       ADDITIONAL Address= 192.168.1.40|
```

```
|<----------------------------|                                                |
|8.Standard query response(TCP)|                                             |
|  QNAME= A.example.org       |                                               |
|  QTYPE=A                    |                                               |
|  ANSWER Name=A.example.org  |                                               |
|  ANSWER Address=192.168.1.10 |                                              |
|  AUTHORITY Name=example.org |                                               |
|  AUTHORITY Name Server      |                                               |
|   = NS4.example.org         |                                               |
|  ADDITIONAL Name            |                                               |
|   = NS4.example.org         |                                               |
|  ADDITIONAL Address         |                                               |
|   = 192.168.1.40            |                                               |
|                             |                                               |
v                             v                                               v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER ADDRESS=192.168.1.10.
8. NUT transmits query response to DNS Client1 (TN) in TCP. (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT) in TCP		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
TCP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org

	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any

	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN) in TCP		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
TCP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4

	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A in TCP.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response in TCP.

References

RFC1123 Requirements for Internet Hosts - Application and Support
6.1.3.2 Transport Protocols

5.98. Not refuse TCP query (response)

Purpose

Verify that a NUT transmits correct TCP response.

- A name server MAY limit the resources it devotes to TCP queries, but it SHOULD NOT refuse to service a TCP query just because it would have succeeded with UDP.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig.1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL  86400                ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600           ; serial
      3600                 ; refresh every 1 hr
      900                  ; retry every 15 min
      604800               ; expire after a week
      3600                 ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |--------------------------------------->|
    |   1. Send standard query in TCP       |
    |       QNAME=A.example.com             |
    |       QTYPE=A                         |
    |<---------------------------------------|
    |   2. Standard query response in TCP   |
    |       A=192.168.1.10                  |
    v                                       v
1. TN send standard query QNAME=A.example.com, QTYPE=A to NUT.
2. NUT reply query response w/ A=192.168.1.10 to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT) in TCP		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
TCP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN) in TCP		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
TCP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	any
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1

	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- Termination
  None

Judgment

2. Received standard query response in TCP.

References

RFC1123 6.1.3.2 Transport Protocols
6.1.3.2 Transport Protocols

5.99. Caching truncated responses

Purpose

Verify that a NUT must not cache truncated response.

- Truncated responses MUST NOT be saved (cached) and later used in such a way that the fact that they are truncated is lost.
- When a response is truncated, and a resolver doesn't know whether it has a complete set, it should not cache a possibly partial set of RRs.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 28 Topology No.28".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600      ; serial
         3600            ; refresh every 1 hr
         900             ; retry every 15 min
         604800          ; expire after a week
         3600            ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                  <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)     DNS Server2 DNS Server3 DNS Server4
 |                           |                    |          |          |
 |---------------------------->|                  |          |          |
 | 1.Send standard query       |                  |          |          |
 |  QNAME=A.example.org        |                  |          |          |
 |  QTYPE=A                    |                  |          |          |
 |                             |------------------>|          |          |
 |                             | 2.Recv standard query        |          |
 |                             |  QNAME=A.example.org         |          |
 |                             |  QTYPE=A                     |          |
 |                             |<------------------|          |          |
 |                             | 3.Send standard query response|         |
 |                             |  QNAME=A.example.org         |          |
 |                             |  QTYPE=A                     |          |
 |                             |  AUTHORITY Name=org          |          |
 |                             |  AUTHORITY Name Server       |          |
 |                             |            =NS3.example.org  |          |
 |                             |  ADDITIONAL Name             |          |
 |                             |            =NS3.example.org  |          |
 |                             |  ADDITIONAL Address          |          |
 |                             |            =192.168.1.30     |          |
 |                             |                              v          |
 |                             |------------------------------------------>|
 |                             |           4.Recv standard query          |
 |                             |            QNAME=A.example.org           |
 |                             |            QTYPE=A                       |
 |                             |<------------------------------------------|
 |                             |           5.Send standard query response|
 |                             |            QNAME=A.example.org           |
 |                             |            QTYPE=A                       |
 |                             |            AUTHORITY Name=example.org    |
 |                             |            AUTHORITY Name Server         |
 |                             |                   = NS4.example.org      |
 |                             |            ADDITIONAL Name               |
 |                             |                   = NS4.example.org      |
 |                             |            ADDITIONAL Address            |
 |                             |                   = 192.168.1.40         |
 |                             |                                          v
 |                             |------------------------------------------------------>|
 |                             |                     6.  Send standard query           |
 |                             |                      QNAME=A.example.org              |
 |                             |                      QTYPE=A                          |
 |                             |<------------------------------------------------------|
 |                             |                     7.Send standard query response|
 |                             |                      TC bit is set                    |
 |                             |                      QNAME=A.example.org              |
 |                             |                      QTYPE=A                          |
 |                             |                      ANSWER Name=A.example.org        |
 |                             |                      ANSWER Address=192.168.1.100 |
 |                             |                                   to                  |
 |                             |                                     192.168.1.129 |
```

```
|                              |(------------------------------------------------>)|
|                              |                     8.Send standard query in TCP  |
|                              |                      QNAME=A.example.org          |
|                              |                      QTYPE=A                      |
|<-----------------------------|                                                   |
| 9.Standard query response    |                                                   |
|  TC bit is set               |                                                   |
|  QNAME= A.example.org        |                                                   |
|  QTYPE=A                     |                                                   |
|  ANSWER Name=A.example.org   |                                                   |
|  ANSWER Address=192.168.1.100|                                                   |
|               to             |                                                   |
|                 192.168.1.129|                                                   |
|----------------------------->|                                                   |
| 10.  Send standard query     |                                                   |
|  QNAME=A.example.org         |                                                   |
|  QTYPE=A                     |                                                   |
|                              |------------------------------------------------->|
|                              |                          11.  Send standard query  |
|                              |                           QNAME=A.example.org      |
|                              |                           QTYPE=A                  |
|                              |                                                   |
v                              v                                                   v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.100 - 192.168.1.129 to NUT.
8. If the packet of tcp is transmitted, this test cannot be continued.
9. NUT transmits query response to DNS Client1 (TN) (Judgment *9)
10. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
11. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *11)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0

	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses

DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any

	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	1
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	30
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.100
DNS Answer section x 28 ADDRESS range 192.168.1.101 - 192.168.1.128	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.129

8th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN) in TCP		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
TCP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	1
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	30
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.100
DNS Answer section x 25 ADDRESS range 192.168.1.101 - 192.168.1.128	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.129

10th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

11th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any

	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query including QNAME=A.example.org in TCP.
9. Received standard query response (TC bit is set).
11. Received standard query including QNAME=A.example.org, QTYPE=A.

References

RFC1035 DOMAIN NAMES - CONCEPTS AND FACILITIES
  7.4 Using the cache
RFC1123 Requirements for Internet Hosts - Application and Support
  6.1.3.2 Transport Protocols

5.100. Processing UDP query while zone transferring

Purpose

Verify that a NUT continues to process UDP query while zone transferring.

- A DNS server MUST have sufficient internal concurrency that it can continue to process UDP queries while awaiting a response or performing a zone transfer on an open TCP connection

Category

Server (Secondary)

Initialization

- **Network Topology**
  Refer the topology "Fig. 16 Topology No.16".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as secondary server about sec.example.com zone.
  - ✧ disable notify function.

  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20
For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600      ; serial
         3600            ; refresh every 1 hr
         900             ; retry every 15 min
         604800          ; expire after a week
         3600            ; Minimum TTL of a 1 hr
)
      INNS       NS1.example.com.
NS1      IN      A        192.168.0.10
A        IN      A        192.168.1.10
```

  Example of DNS server configuration for secondary:

```
zone "sec.example.com" {
      type slave;
      masters {192.168.0.31;};
```

```
        file "s/sec.example.com";
};
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                  DNS Server1 (NUT)                      DNS Server7 (TN)
      |                                   |                                          |
      |                                   |----------------------------------------->|
      |                                   | 1. Standard query                        |
      |                                   |  QNAME = sec.example.com                 |
      |                                   |  QTYPE = SOA (0x0006)                    |
      |                                   |<-----------------------------------------|
      |                                   | 2. Standard query response               |
      |                                   |  QNAME = sec.example.com                 |
      |                                   |  QTYPE = SOA (0x0006)                    |
      |                                   |  ANSWER Name =sec.example.com            |
      |                                   |  ANSWER Type = SOA (0x0006)              |
      |                                   |  ANSWER TTL = 300                        |
      |                                   |  ANSWER Mname = NS7.sec.example.com      |
      |                                   |  ANSWER Rname = root.sec.example.com     |
      |                                   |  ANSWER Serial = 1                       |
      |                                   |  ANSWER Refresh = 300sec                 |
      |                                   |  ANSWER Retry = 30sec                    |
      |                                   |  ANSWER Expire = 600sec                  |
      |                                   |  ANSWER Minimum = 300sec                 |
      |                                   |  AUTHORITY Name = sec.example.com        |
      |                                   |  AUTHORITY Type = NS (0x0002)            |
      |                                   |  AUTHORITY Name Server = NS7.sec.example.com|
      |                                   |  ADDITIONAL Name = NS7.sec.example.com|
      |                                   |  ADDITIONAL Type = A (0x0001)            |
      |                                   |  ADDITIONAL Address = 192.168.0.31       |
      |                                   |----------------------------------------->|
      |                                   | 3. Standard query (using TCP)            |
      |                                   |  QNAME = sec.example.com                 |
      |                                   |  QTYPE = AXFR (0x00FC)                   |
      |------------------------------------->|                                       |
      | 4. Send standard query            |                                          |
      |  QNAME = A.example.com            |                                          |
      |  QTYPE = A                        |                                          |
      |<-------------------------------------|                                       |
      | 5. Standard query response        |                                          |
      |  QNAME = A.example.com            |                                          |
      |  QTYPE = A                        |                                          |
      |  ANSWER Name = A.example.com      |                                          |
      |  ANSWER Type = A (0x0001)         |                                          |
      |  ANSWER Address =192.168.1.10     |                                          |
      |  AUTHORITY Name = example.com     |                                          |
      |  AUTHORITY Type = NS (0x0002)     |                                          |
      |  AUTHORITY Name Server = NS1.example.com|                                     |
      |  ADDITIONAL Name = NS1.example.com |                                         |
      |  ADDITIONAL Type = A (0x0001)     |                                          |
      |  ADDITIONAL Address = 192.168.0.10 |                                         |
      |                                   |                                          |
      v                                   v                                          v
```

This test sequence is following.

1. DNS Server1 (NUT) transmits standard query QNAME = sec.example.com, QTYPE = SOA to DNS Server7 (TN). (Judgment *1)
2. DNS Server7 (TN) sends standard query response with SOA RRs to DNS Server1 (NUT).
3. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, QTYPE = AXFR using TCP to DNS Server7 (TN). (Judgment *3)
4. DNS Client1 (TN) sends standard query QNAME = A.example.com QTYPE=A to DNS Server1 (NUT).
5. DNS Server1 (NUT) transmits standard query response ANSWER Address = 192.168.1.10 to DNS Client1 (TN). (Judgment *5)

Packet Description

1st packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1

	ARCOUNT	2
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	1
	REFRESH	300sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	300sec
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	300sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

3rd packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
TCP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY

	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	AXFR (0x00FC)
	QCLASS	IN (0x0001)

4th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**

  None

Judgment

1. Received standard query with Type=SOA.
3. Received standard query with Type=AXFR using TCP
5. Received standard query response including Answer address 192.168.1.10.

References

RFC1123 Requirements for Internet Hosts -- Application and Support
6.1.3.2 Transport Protocols

5.101. Broadcast/Multicast query

Purpose

Verify that a NUT supports UDP query with broadcast or multicast address

- A server MAY support a UDP query that is delivered using an IP broadcast or multicast address. However, the Recursion Desired bit MUST NOT be set in a query that is multicast, and MUST be ignored by name servers receiving queries via a broadcast or multicast address. A host that sends broadcast or multicast DNS queries SHOULD send them only as occasional probes, caching the IP address(es) it obtains from the response(s) so it can normally send unicast queries.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig.1　Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |--------------------------------------->|
    |   1. Send standard query              |
    |       *broadcast or multicast         |
    |       QNAME=A.example.com             |
    |       QTYPE=A                         |
    |<---------------------------------------|
    |   2. Standard query response          |
    |       A=192.168.1.10                  |
    v                                       v

1. TN send standard query QNAME=A.example.com, QTYPE=A to NUT with broadcast or multicast.
2. NUT reply query response w/ A=192.168.1.10 to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	BRO_MULTI
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	any
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**

  None

Judgment

2. Received standard query response w/ A=192.168.1.10.

References

RFC1123 Requirements for internet Hosts -- Application and Support
6.1.3.2 Transport Protocols

5.102. Server ignores queries via broadcast or multicast address

Purpose

Verify that a NUT ignores queries with RD=1.

- A server MAY support a UDP query that is delivered using an IP broadcast or multicast address. However, the Recursion Desired bit MUST NOT be set in a query that is multicast, and MUST be ignored by name servers receiving queries via a broadcast or multicast address. A host that sends broadcast or multicast DNS queries SHOULD send them only as occasional probes, caching the IP address(es) it obtains from the response(s) so it can normally send unicast queries.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 11 Topology No.11".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600      ; serial
         3600            ; refresh every 1 hr
         900             ; retry every 15 min
         604800          ; expire after a week
         3600            ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)            DNS Server1 (NUT)              DNS Server2 (TN)
      |                           |                                |
      |----------------------------->|                             |
      | 1. Send standard query    |                                |
      |  *broadcast or multicast  |                                |
      |  RD=1                     |                                |
      |  QNAME=A.example.org      |                                |
      |  QTYPE=A                  |                                |
      |                           |------------------------------> X |
      |                           | 2. Recv standard query         |
      |                           |  QNAME=A.example.org           |
      |                           |  QTYPE=A                       |
      v                           v                                v

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	BRO_MULTI
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**

  None

Judgment

2. Not received standard query to DNS Server2 (TN).

References

RFC1123 Requirements for internet Hosts -- Application and Support
6.1.3.2 Transport Protocols

5.103. Retransmission control

Purpose

Verify that a NUT implements retransmission controls.

- The resolver MUST implement retransmission controls to insure that it does not waste communication bandwidth, and MUST impose finite bounds on the resources consumed to respond to a single request.
- While local limits on the number of times a resolver will retransmit a particular query to a particular name server address are essential, the resolver should have a global per-request counter to limit work on a single request.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                A       192.168.1.20
For IPv6
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000        AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN     NS      NS1.example.com.
NS1      IN     A       192.168.0.10
;
```

Procedure

```
                                                <-------------- TN --------------->
DNS Client1 (TN)    DNS Server1 (NUT)                DNS Server2 DNS Server3 DNS Server4
 |                   |                                   |           |           |
 |------------------>|                                   |           |           |
 | 1.Send standard query|                                |           |           |
 |  QNAME=A.example.org |                                |           |           |
 |  QTYPE=A            |                                 |           |           |
 |                     |--------------------------------->|           |           |
 |                     | 2.Recv standard query           |           |           |
 |                     |  QNAME=A.example.org            |           |           |
 |                     |  QTYPE=A                        |           |           |
 |                     |<---------------------------------|           |           |
 |                     | 3.Send standard query response  |           |           |
 |                     |  QNAME=A.example.org            |           |           |
 |                     |  QTYPE=A                        |           |           |
 |                     |  AUTHORITY Name=org             |           |           |
 |                     |  AUTHORITY Name Server = NS3.example.org|           |           |
 |                     |  ADDITIONAL Name =NS3.example.org|          |           |
 |                     |  ADDITIONAL Address =192.168.1.30|          |           |
 |                     |                                 v           |           |
 |                     |---------------------------------------------->|           |
 |                     |             4.Recv standard query           |           |
 |                     |              QNAME=A.example.org            |           |
 |                     |              QTYPE=A                        |           |
 |                     |<----------------------------------------------|           |
 |                     |             5.Send standard query response  |           |
 |                     |              QNAME=A.example.org            |           |
 |                     |              QTYPE=A                        |           |
 |                     |              AUTHORITY Name=example.org     |           |
 |                     |              AUTHORITY Name Server = NS4.example.org |           |
 |                     |              ADDITIONAL Name = NS4.example.org |           |
 |                     |              ADDITIONAL Address = 192.168.1.40 |           |
 |                     |                                            v           |
 |                     |------------------------------------------------------------>|
 |                     |                         6.Send standard query               |
 |                     |                          QNAME=A.example.org                |
 |                     |                          QTYPE=A                            |
 //                    //                                                            //
 |                     |                                                             |
 |                     |------------------------------------------------------------>|
 |                     |                         N.Send standard query               |
 |                     |                          QNAME=A.example.org                |
 |                     |                          QTYPE=A                            |
 |                     |------------------------------------------------------------> X |
 |                     |                         N+1.Send standard query             |
 |                     |                          QNAME=A.example.org                |
 |                     |                          QTYPE=A                            |
 |                     |                                                             |
 v                     v                                                             v
```

```
This test sequence is following.
1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org)
   (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
   (Judgment *6)
N. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
   (Judgment *N)
N+1. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
   (Judgment *N+1)
*N means that number of retransmission.
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0

	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6

	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

N th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
N. Received standard query including QNAME=A.example.org, QTYPE=A.
N+1. Not received standard query.

References

RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  7.1. Transforming a user request into a query
RFC1123 Requirements for internet Hosts -- Application and Support
  6.1.3.3 Efficient Resource Usage

5.104. Caching of temporary failure

Purpose

Verify that a NUT caches of temporary failure.

- All DNS name servers and resolvers SHOULD cache temporary failures, with a timeout period of the order of minutes.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20

For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com. root.example.com. (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                  <-------------- TN --------------->
DNS Client1 (TN)        DNS Server1 (NUT)         DNS Server2 DNS Server3 DNS Server4
  |                       |                              |           |           |
  |----------------------->|                              |           |           |
  | 1.Send standard query  |                              |           |           |
  |  QNAME=A.example.org   |                              |           |           |
  |  QTYPE=A               |                              |           |           |
  |                        |------------------------------>|           |           |
  |                        | 2.Recv standard query        |           |           |
  |                        |  QNAME=A.example.org         |           |           |
  |                        |  QTYPE=A                     |           |           |
  |                        |<------------------------------|           |           |
  |                        | 3.Send standard query response |           |           |
  |                        |  QNAME=A.example.org         |           |           |
  |                        |  QTYPE=A                     |           |           |
  |                        |  AUTHORITY Name=org          |           |           |
  |                        |  AUTHORITY Name Server = NS3.example.org|           |           |
  |                        |  ADDITIONAL Name =NS3.example.org|           |           |
  |                        |  ADDITIONAL Address =192.168.1.30|           |           |
  |                        |                              v           |           |
  |                        |------------------------------------------>|           |
  |                        |            4.Recv standard query           |           |
  |                        |             QNAME=A.example.org            |           |
  |                        |             QTYPE=A                        |           |
  |                        |<------------------------------------------|           |
  |                        |            5.Send standard query response  |           |
  |                        |             QNAME=A.example.org            |           |
  |                        |             QTYPE=A                        |           |
  |                        |             AUTHORITY Name=example.org     |           |
  |                        |             AUTHORITY Name Server = NS4.example.org|           |
  |                        |             ADDITIONAL Name = NS4.example.org|           |
  |                        |             ADDITIONAL Address             |           |
  |                        |                     = 192.168.1.40         |           |
  |                        |                                            v           |
  |                        |-------------------------------------------------------->|
  |                        |                         6.Send standard query           |
  |                        |                          QNAME=A.example.org            |
  |                        |                          QTYPE=A                        |
  //                       //                                                        //
  |                        |-------------------------------------------------------->|
  |                        |                         N.  Send standard query         |
  |                        |                          QNAME=A.example.org            |
  |                        |                          QTYPE=A                        |
  |                        |-------------------------------------------------------> X |
  |                        |                         N+1.  Send standard query       |
  |                        |                          QNAME=A.example.org            |
  |                        |                          QTYPE=A                        |
  |----------------------->|                                                         |
  | N+2.  Send standard query|                                                        |
  |  QNAME=A.example.org   |                                                         |
  |  QTYPE=A               |                                                         |
  |                        |-------------------------------------------------------> X |
  |                        |                         N+3.  Send standard query       |
  |                        |                          QNAME=A.example.org            |
  |                        |                          QTYPE=A                        |
  v                        v                                                         v
```

```
1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org)
   (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
   (Judgment *6)
N. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
   (Judgment *N)
N+1. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
   (Judgment *N+1)
N+2. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
N+3. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
   (Judgment *N+1)
*N means that number of retransmission.
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53

DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0

	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1

	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

N th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

N+2 th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
N. Received standard query including QNAME=A.example.org, QTYPE=A.
N+1. Not received standard query.
N+3. Not received standard query.

References

RFC1123 Requirements for internet Hosts -- Application and Support
6.1.3.3 Efficient Resource Usage

5.105. Continue to provide service

Purpose

Verify that a NUT continues to provide service for the reachable part of the name space.

- DNS software may need to operate in environments where the root servers or other servers are unavailable due to network connectivity or other problems. In this situation, DNS name servers and resolvers MUST continue to provide service for the reachable part of the name space, while giving temporary failures for the rest.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 26 Topology No.26".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600      ; serial
         3600            ; refresh every 1 hr
         900             ; retry every 15 min
         604800          ; expire after a week
         3600            ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
```

Procedure

This test sequence is following.

```
                                                        <------------- TN -------------------->
                                                         DNS Server2        DNS Server4
DNS Client1 (TN)     DNS Server1 (NUT)                              DNS Server3      DNS Server5
  |                              |                              |          |          |          |
  |----------------------------->|                              |          |          |          |
  | 1.Send standard query        |                              |          |          |          |
  |  QNAME=A.example.org         |                              |          |          |          |
  |  QTYPE=A                     |                              |          |          |          |
  |                              |------------------------------>|          |          |          |
  |                              | 2.Recv standard query        |          |          |          |
  |                              |  QNAME=A.example.org         |          |          |          |
  |                              |  QTYPE=A                     |          |          |          |
  |                              |<------------------------------|          |          |          |
  |                              | 3.Send standard query response|          |          |          |
  |                              |  QNAME=A.example.org         |          |          |          |
  |                              |  QTYPE=A                     |          |          |          |
  |                              |  AUTHORITY Name=org          |          |          |          |
  |                              |  AUTHORITY Name Server       |          |          |          |
  |                              |            =NS3.example.org  |          |          |          |
  |                              |  ADDITIONAL Name             |          |          |          |
  |                              |            =NS3.example.org  |          |          |          |
  |                              |  ADDITIONAL Address          |          |          |          |
  |                              |            =192.168.1.30     |          |          |          |
  |                              |                              v          |          |          |
  |                              |----------------------------------------->|          |          |
  |                              |           4.Recv standard query          |          |          |
  |                              |            QNAME=A.example.org           |          |          |
  |                              |            QTYPE=A                       |          |          |
  |                              |<-----------------------------------------|          |          |
  |                              |           5.Send standard query response|          |          |
  |                              |            QNAME=A.example.org           |          |          |
  |                              |            QTYPE=A                       |          |          |
  |                              |            AUTHORITY Name=example.org    |          |          |
  |                              |            AUTHORITY Name Server         |          |          |
  |                              |                   = NS4.example.org      |          |          |
  |                              |            ADDITIONAL Name               |          |          |
  |                              |                   = NS4.example.org      |          |          |
  |                              |            ADDITIONAL Address            |          |          |
  |                              |                   = 192.168.1.40         |          |          |
  |                              |                                        v          |          |
  |                              |------------------------------------------------------>|          |
  |                              |                         6. Send standard query   |          |
  |                              |                          QNAME=A.example.org     |          |
  |                              |                          QTYPE=A                 |          |
  //                             //                                                  //         //
  |                              |                                                  |          |
  |                              |------------------------------------------------------>|          |
  |                              |                         N. Send standard query   |          |
  |                              |                          QNAME=A.example.org     |          |
  |                              |                          QTYPE=A                 |          |
  |                              |-----------------------------------------------------> X |          |
  |                              |                         N+1. Send standard query |          |
  |                              |                          QNAME=A.example.org     |          |
  |                              |                          QTYPE=A                 |          |
```

```
|---------------------------->|                                      |         |         |
| N+2.Send standard query     |                                      |         |         |
|  QNAME=B.virtual.org        |                                      |         |         |
|  QTYPE=A                    |                                      |         |         |
|                             |---------------------------------------->|         |         |
|                             |        N+3.  Recv standard query     |         |         |
|                             |            QNAME=B.virtual.org       |         |         |
|                             |            QTYPE=A                   |         |         |
|                             |<----------------------------------------|         |         |
|                             |        N+4.  Send standard query response|         |         |
|                             |            QNAME=B.virtual.org       |         |         |
|                             |            QTYPE=A                   |         |         |
|                             |            AUTHORITY Name=virtual.org |         |         |
|                             |            AUTHORITY Name Server     |         |         |
|                             |                   = NS5.virtual.org  |         |         |
|                             |            ADDITIONAL Name           |         |         |
|                             |                   = NS5.virtual.org  |         |         |
|                             |            ADDITIONAL Address        |         |         |
|                             |                   = 192.168.1.50     |         |         |
|                             |                                      v         v         |
|                             |------------------------------------------------------------>|
|                             |                           N+5.  Send standard query         |
|                             |                               QNAME=B.virtual.org           |
|                             |                               QTYPE=A                       |
|                             |<------------------------------------------------------------|
|                             |                           N+6.  Send standard query response|
|                             |                               QNAME=B.virtual.org           |
|                             |                               QTYPE=A                       |
|                             |                               ANSWER Name=B.virtual.org     |
|                             |                               ANSWER Address=192.168.1.11   |
|                             |                               AUTHORITY Name=virtual.org    |
|                             |                               AUTHORITY Name Server         |
|                             |                                   = NS5.virtual.org         |
|                             |                               ADDITIONAL Name               |
|                             |                                   = NS5.virtual.org         |
|                             |                               ADDITIONAL Address            |
|                             |                                   = 192.168.1.50            |
|<----------------------------|                                                             |
| N+7.  Standard query response|                                                            |
|  QNAME= B.virtual.org       |                                                             |
|  QTYPE=A                    |                                                             |
|  ANSWER Name=B.virtual.org  |                                                             |
|  ANSWER Address=192.168.1.11|                                                             |
|  AUTHORITY Name=virtual.org |                                                             |
|  AUTHORITY Name Server      |                                                             |
|   = NS5.virtual.org         |                                                             |
|  ADDITIONAL Name            |                                                             |
|   = NS5.virtual.org         |                                                             |
|  ADDITIONAL Address         |                                                             |
|   = 192.168.1.50            |                                                             |
v                             v                                                             v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
N. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *N)
N+1. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *N+1)
N+2. TN send standard query QNAME=B.virtual.org, QTYPE=A to NUT.
N+3. NUT transmits standard query QNAME=B.virtual.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *N+3)
N+4. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS5.virtual.org.
N+5. NUT transmits standard query QNAME=B.virtual.org, QTYPE=A to DNS Server4 (TN: NS4.virtual.org) (Judgment *N+5)
N+6. TN send query response to ANSWER NAME=B.virtual.org, ANSWER ADDRESS=192.168.1.11.
N+7. NUT transmits query response to DNS Client1 (TN) (Judgment *N+7)
*N means that number of retransmission.

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY

	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

N th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

N+2 th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53

DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.virtual.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

N+3 th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.virtual.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

N+4 th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.virtual.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	virtual.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS5.virtual.org (NS5 + Pointer 0xC00E)
DNS Additional section	NAME	NS5.virtual.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.50

N+5 th packet.

Standard query from DNS Server1 (NUT) to Server5 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV5_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY

	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.virtual.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

N+6 th packet.

Standard query response from DNS Server5 (TN) to Server1 (NUT)		
IP Header	Source Address	SV5_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.virtual.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.virtual.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	virtual.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS5.virtual.org (NS5 + Pointer 0xC00E)
DNS Additional section	NAME	NS5.virtual.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.50

N+7 th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.virtual.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.virtual.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4

	ADDRESS	192.168.1.11
DNS Authority section	NAME	virtual.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS5.virtual.org (NS5 + Pointer 0xC00E)
DNS Additional section	NAME	NS5.virtual.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.50

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
N. Received standard query including QNAME=A.example.org, QTYPE=A.
N+1. Not received standard query.
N+3. Received standard query including QNAME=B.virtual.org, QTYPE=A.
N+5. Received standard query including QNAME=B.virtual.org, QTYPE=A.
N+7. Received standard query response including correct A resource record for QNAME=B.virtual.org, QTYPE=A.

References

RFC1123 Requirements for internet Hosts -- Application and Support
6.1.3.7 Robustness

5.106. an IXFR client sends an IXFR message

Purpose

Verify that a NUT sends an IXFR message to get new information about zone.

- If an IXFR client, which likely has an older version of a zone, thinks it needs new information about the zone through SOA refresh timeout, it sends an IXFR message containing the SOA serial number of its, presumably outdated, copy of the zone.
- The query type value of IXFR assigned by IANA is 251.
- The IXFR query packet format is the same as that of a normal DNS query, but with the query type being IXFR and the authority section containing the SOA record of client's version of the zone.
- Transport of a query may be by either UDP or TCP.
- A client should first make an IXFR query using UDP.

Category

Server (an IXFR client)

Initialization

- **Network Topology**
  Refer the topology "Fig. 33 Topology No.33".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable incremental zone transfer function.

  Example of DNS server configuration on DNS Server1 (NUT):

  - ✧ For IPv4 transport

```
zone "sec.example.com" {
      type slave;
      masters {192.168.0.31;};
      file "s/sec.example.com";
};
```

  - ✧ For IPv6 transport

```
 zone "sec.example.com" {
      type slave;
      masters {3ffe:501:ffff:100::31;};
      file "s/sec.example.com";
};
```

Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS7.sec.example.com.  root.sec.example.com.  (
         1       ; serial
         180     ; refresh every 3 min
         30      ; retry every 30 sec
         360     ; expire after 6 min
         30      ; Minimum TTL of 30 sec
)
;
         IN      NS      NS7.sec.example.com.
         IN      NS      NS1.sec.example.com.
         IN      MX      10       NS7
NS7      IN      A       192.168.0.31
         IN      AAAA    3ffe:501:ffff:100::31
NS1      IN      A       192.168.0.10
         IN      AAAA    3ffe:501:ffff:100::10
;
CL1      IN      A       192.168.0.20
CL2      IN      A       192.168.0.21
```

Pre-test Sequence:

After all zone information are transferred between primary DNS server7 (TN) and slave DNS server1 (NUT), following pre-test sequence is performed.

```
DNS Client1 (TN)            DNS Server1 (NUT)              DNS Server7 (TN)
     |                           |                                |
     |---------------------------->|                                |
     | 1. Send standard query    |                                |
     |  RD bit = 0               |                                |
     |  QNAME = CL2.sec.example.com |                             |
     |  QTYPE = A                |                                |
     |<----------------------------|                                |
     | 2. Standard query response |                               |
     |  AA bit = 0               |                                |
     |  RD bit = 0               |                                |
     |  RA bit = 1               |                                |
     |  QNAME = CL2.sec.example.com |                             |
     |  QTYPE = A                |                                |
     |  ANSWER Name              |                                |
     |        = CL2.sec.example.com |                             |
     |  ANSWER Type  = A (0x0001)  |                              |
     |  ANSWER Address           |                                |
     |        = 192.168.0.21     |                                |
     |                           |                                |
     v                           v                                v
```

Procedure

This test sequence is following.
NOTE: SOA's parameter and TTL are same as above sec.example.com zone information.
TN includes NS7 and NS1.sub.example.com into Authority as type = NS.
Also TN includes NS7 and NS1.sub.example.com address into Additional section.
Thus NUT may reply to answer client with Authority and Additional section including those values.

```
DNS Client1 (TN)            DNS Server1 (NUT)             DNS Server7 (TN)
      |                            |                             |
      |                            |  Before SOA refresh (180sec)  |
      |                            |  timeout expired            |
      |                            |----------------------------->|
      |                            | 1. Standard query           |
      |                            |  QNAME = sec.example.com    |
      |                            |  QTYPE = SOA (0x0006)       |
      |                            |<-----------------------------|
      |                            | 2. Standard query response  |
      |                            |  QNAME = sec.example.com    |
      |                            |  QTYPE = SOA (0x0006)       |
      |                            |  ANSWER Name = sec.example.com|
      |                            |  ANSWER Type = SOA (0x0006)  |
      |                            |  ANSWER Serial = 2          |
      |                            |----------------------------->|
      |                            | 3. Standard query           |
      |                            |    using UDP or TCP         |
      |                            |  QNAME = sec.example.com    |
      |                            |  QTYPE = IXFR (0x00FB)      |
      |                            |  AUTHORITY Name             |
      |                            |       = sec.example.com     |
      |                            |  AUTHORITY Type = SOA (0x0006)|
      |                            |  AUTHORITY Serial = 1       |
      |                            |                             |
      v                            v                             v

This test sequence is following.
1. After SOA refresh time expired, DNS Server1 (NUT) transmits standard query QNAME = sec.example.com, Type=SOA
      to DNS Server7 (TN). (Judgment *1)
2. DNS Server7 (TN) sends standard query response with SOA Serial = 2 to DNS Server1 (NUT).
3. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = IXFR, including
      AUTHORITY Name = sec.example.com, Type = SOA Serial = 1 using UDP or TCP to DNS Server7 (TN).
      (Judgment *3)
```

Packet Description

1st packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY

	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	2
	ARCOUNT	4
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec

	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec

	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

3rd packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
TCP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	>=1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	*IXFR (0x00FB)*
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*1*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

- Termination

  None

Judgment

1. Received standard query with Type=SOA after SOA refresh time expired.
3. Received standard query with Type=IXFR serial=1 using TCP.

References

RFC1995 Incremental Zone Transfer in DNS
   2. Brief Description of the Protocol
   3. Query Format

5.107. an IXFR client receive an IXFR response with the full zone transfer message

Purpose

Verify that a NUT receives an IXFR response with the full zone transfer message

- If an IXFR client, which likely has an older version of a zone, thinks it needs new information about the zone through SOA refresh timeout, it sends an IXFR message containing the SOA serial number of its, presumably outdated, copy of the zone.
- When an IXFR client sent an IXFR request with an older version number, the server may transfer the entire zone just as in a normal full zone transfer.
- If incremental zone transfer is not available, the entire zone is returned. The first and the last RR of the response is the SOA record of the zone.

Category

Server (an IXFR client)

Initialization

- **Network Topology**
  Refer the topology "Fig. 33 Topology No.33".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable incremental zone transfer function.

  Example of DNS server configuration on DNS Server1 (NUT):

  - ✧ For IPv4 transport

```
zone "sec.example.com" {
        type slave;
        masters {192.168.0.31;};
        file "s/sec.example.com";
};
```

  - ✧ For IPv6 transport

```
zone "sec.example.com" {
      type slave;
      masters {3ffe:501:ffff:100::31;};
      file "s/sec.example.com";
};
```

Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS7.sec.example.com.  root.sec.example.com.  (
         1       ; serial
         180     ; refresh every 3 min
         30      ; retry every 30 sec
         360     ; expire after 6 min
         30      ; Minimum TTL of 30 sec
)
;
         IN      NS      NS7.sec.example.com.
         IN      NS      NS1.sec.example.com.
NS7      IN      A       192.168.0.31
         IN      AAAA    3ffe:501:ffff:100::31
NS1      IN      A       192.168.0.10
         IN      AAAA    3ffe:501:ffff:100::10
;
CL1      IN      A       192.168.0.20
CL2      IN      A       192.168.0.21
```

Pre-test Sequence:

After all zone information are transferred between primary DNS server7 (TN) and slave DNS server1 (NUT), following pre-test sequence is performed.

```
DNS Client1 (TN)                DNS Server1 (NUT)         DNS Server7 (TN)
     |                                  |                         |
     |---------------------------------->|                         |
     | 1. Send standard query            |                         |
     |  RD bit = 0                       |                         |
     |  QNAME = CL2.sec.example.com      |                         |
     |  QTYPE = A                        |                         |
     |<----------------------------------|                         |
     | 2. Standard query response        |                         |
     |  AA bit = 0                       |                         |
     |  RD bit = 0                       |                         |
     |  RA bit = 1                       |                         |
     |  QNAME = CL2.sec.example.com      |                         |
     |  QTYPE = A                        |                         |
     |  ANSWER Name = CL2.sec.example.com|                         |
     |  ANSWER Type = A (0x0001)         |                         |
     |  ANSWER Address = 192.168.0.21    |                         |
     |                                   |                         |
     v                                   v                         v
```

Procedure

This test sequence is following.

NOTE: SOA's parameter and $TTL are same as above sec.example.com zone information. TN includes NS7 and NS1.sub.example.com into Authority as type = NS.
Also TN includes NS7 and NS1.sub.example.com address into Additional section. Thus NUT may reply to answer client with Authority and Additional section including those values.

```
DNS Client1 (TN)            DNS Server1 (NUT)                    DNS Server7 (TN)
      |                            |                                  |
      |                            |  Before SOA  refresh (180sec)    |
      |                            |  timeout expired                 |
      |                            |---------------------------------->|
      |                            | 1. Standard query                |
      |                            |  QNAME = sec.example.com         |
      |                            |  QTYPE = SOA (0x0006)            |
      |                            |<----------------------------------|
      |                            | 2. Standard query response       |
      |                            |  QNAME = sec.example.com         |
      |                            |  QTYPE = SOA (0x0006)            |
      |                            |                                  |
      |                            |  ANSWER Name =sec.example.com    |
      |                            |  ANSWER Type =SOA (0x0006)       |
      |                            |  ANSWER Serial = 2               |
      |                            |---------------------------------->|
      |                            | 3. Standard query                |
      |                            |  QNAME = sec.example.com         |
      |                            |  QTYPE = IXFR (0x00FB)           |
      |                            |                                  |
      |                            |  AUTHORITY Name = sec.example.com |
      |                            |  AUTHORITY Type =SOA (0x0006)    |
      |                            |  AUTHORITY Serial = 1            |
```

```
|                              |<---------------------------------|
|                              | 4. Standard query response       |
|                              |  modify exist record             |
|                              |  QNAME = sec.example.com         |
|                              |  QTYPE = IXFR (0x00FB)           |
|                              |                                  |
|                              |  ANSWER Name =sec.example.com    |
|                              |  ANSWER Type = SOA (0x0006)      |
|                              |  ANSWER Serial = 2               |
|                              |                                  |
|                              |  ANSWER Name =sec.example.com    |
|                              |  ANSWER Type = NS (0x0002)       |
|                              |  ANSWER Nsdname = NS7.sec.example.com |
|                              |                                  |
|                              |  ANSWER Name =sec.example.com    |
|                              |  ANSWER Type = NS (0x0002)       |
|                              |  ANSWER Nsdname = NS1.sec.example.com |
|                              |                                  |
|                              |  ANSWER Name = NS7.sec.example.com |
|                              |  ANSWER Type = A (0x0001)        |
|                              |  ANSWER Address =192.168.0.31    |
|                              |                                  |
|                              |  ANSWER Name = NS7.sec.example.com |
|                              |  ANSWER Type = AAAA (0x001C)     |
|                              |  ANSWER Address = 3ffe:501:ffff:100::31 |
|                              |                                  |
|                              |  ANSWER Name = NS1.sec.example.com |
|                              |  ANSWER Type = A (0x0001)        |
|                              |  ANSWER Address =192.168.0.10    |
|                              |                                  |
|                              |  ANSWER Name = NS1.sec.example.com |
|                              |  ANSWER Type = AAAA (0x001C)     |
|                              |  ANSWER Address = 3ffe:501:ffff:100::10 |
|                              |                                  |
|                              |  ANSWER Name = CL1.sec.example.com |
|                              |  ANSWER Type = A (0x0001)        |
|                              |  ANSWER Address =192.168.0.20    |
|                              |                                  |
|                              |  ANSWER Name = CL2.sec.example.com |
|                              |  ANSWER Type = A (0x0001)        |
|                              |  ANSWER Address =192.168.0.22    |
|----------------------------->|                                  |
| 5. Send standard query       |                                  |
|  RD bit = 0                  |                                  |
|  QNAME = CL2.sec.example.com |                                  |
|  QTYPE = A                   |                                  |
|                              |                                  |
```

```
        |<----------------------------|                                |
        | 6. Standard query response  |                                |
        |  AA bit = 0                 |                                |
        |  RD bit = 0                 |                                |
        |  RA bit = 1                 |                                |
        |  QNAME = CL2.sec.example.com |                               |
        |  QTYPE = A                  |                                |
        |  ANSWER Name                |                                |
        |        = CL2.sec.example.com |                              |
        |  ANSWER Type = A (0x0001)   |                                |
        |  ANSWER Address =192.168.0.22|                               |
        |                             |                                |
        v                             v                                v
```

This test sequence is following.

1. After SOA refresh time expired, DNS Server1 (NUT) transmits standard query QNAME = sec.example.com, Type = SOA to DNS Server7 (TN). (Judgment *1)
2. DNS Server7 (TN) sends standard query response with SOA Serial = 2 to DNS Server1 (NUT).
3. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY Name = sec.example.com, Type = SOA Serial = 1 to DNS Server7 (TN). (Judgment *3)
4. DNS Server7 (TN) sends standard query response including all of RRs in sec.example.com zone to DNS Server1 (NUT). The difference from previous zone is that CL2.sec.example.com's address is changed from 192.168.0.21 to 192.168.0.22.
5. DNS Client1 (TN) sends standard query QNAME = CL2.sec.example.com to DNS Server1 (NUT).
6. DNS Server1 (NUT) transmits standard query response ANSWER Address = 192.168.0.22 to DNS Client1 (TN). (Judgment *6)

Packet Description

1st packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com

	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	2
	ARCOUNT	4
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2

	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

3rd packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0

	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	>=1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	*IXFR (0x00FB)*
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*1*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

4th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	9

	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (NS7 + Pointer 0xC02D)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
DNS Answer section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Answer section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	3ffe:501:ffff:100::31
DNS Answer section	NAME	NS1.sec.example.com (Pointer 0xC05A)

	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Answer section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	AAAA (0x0001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	3ffe:501:ffff:100::10
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.22

5th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x2000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x2000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	*ANY*
	ARCOUNT	*ANY*
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	CL2.sec.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.22
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC010)
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS7.sec.example.com (NS7 + Pointer 0xC010)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC041)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC041)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC053)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC053)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

- Termination
  None

Judgment

1. Received standard query with Type=SOA after SOA refresh time expired.
3. Received standard query with Type=IXFR serial=1.
6. Received standard query response QNAME=CL2.sec.example.com and Answer address 192.168.0.22.

References

RFC1995 Incremental Zone Transfer in DNS
2. Brief Description of the Protocol
3. Query Format

5.108. an IXFR client sends an IXFR message (add)

Purpose

Verify that a NUT sends an IXFR message to get new information about zone.

- If an IXFR client, which likely has an older version of a zone, thinks it needs new information about the zone through SOA refresh timeout, it sends an IXFR message containing the SOA serial number of its, presumably outdated, copy of the zone.
- The query type value of IXFR assigned by IANA is 251.
- The IXFR query packet format is the same as that of a normal DNS query, but with the query type being IXFR and the authority section containing the SOA record of client's version of the zone.

Category

Server (an IXFR client)

Initialization

- **Network Topology**
  Refer the topology "Fig. 33 Topology No.33".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable incremental zone transfer function.

  Example of DNS server configuration on DNS Server1 (NUT):

  - ✧ For IPv4 transport

```
zone "sec.example.com" {
        type slave;
        masters {192.168.0.31;};
        file "s/sec.example.com";
};
```

  - ✧ For IPv6 transport

```
zone "sec.example.com" {
        type slave;
        masters {3ffe:501:ffff:100::31;};
        file "s/sec.example.com";
};
```

  Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS7.sec.example.com.  root.sec.example.com.  (
```

```
        1       ; serial
        180     ; refresh every 3 min
        30      ; retry every 30 sec
        360     ; expire after 6 min
        30      ; Minimum TTL of 30 sec
)
;
        IN      NS      NS7.sec.example.com.
        IN      NS      NS1.sec.example.com.
NS7     IN      A       192.168.0.31
        IN      AAAA    3ffe:501:ffff:100::31
NS1     IN      A       192.168.0.10
        IN      AAAA    3ffe:501:ffff:100::10
;
CL1     IN      A       192.168.0.20
```

Pre-test Sequence:

After all zone information are transferred between primary DNS server7 (TN) and slave DNS server1 (NUT), following pre-test sequence is performed.

```
DNS Client1 (TN)              DNS Server1 (NUT)         DNS Server7 (TN)
     |                                |                         |
     |-------------------------------->|                         |
     | 1. Send standard query         |                         |
     |  QNAME = CL2.sec.example.com   |                         |
     |  QTYPE = A                     |                         |
     |<--------------------------------|                         |
     | 2. Standard query response     |                         |
     |  AA bit = 1                    |                         |
     |  RCODE  = 3                    |                         |
     |  QNAME = CL2.sec.example.com   |                         |
     |  QTYPE = A                     |                         |
     |  AUTHORITY Name = sec.example.com|                        |
     |  AUTHORITY Type = SOA (0x0006) |                         |
     |  AUTHORITY Serial = 2          |                         |
     |                                |                         |
     v                                v                         v
```

Procedure

This test sequence is following.

NOTE: SOA's parameter and $TTL are same as above sec.example.com zone information.
TN includes NS7 and NS1.sub.example.com into Authority as type = NS.
Also TN includes NS7 and NS1.sub.example.com address into Additional section.
Thus NUT may reply to answer client with Authority and Additional section including those values.

```
DNS Client1 (TN)            DNS Server1 (NUT)            DNS Server7 (TN)
      |                            |                            |
      |                            |  Before SOA  refresh (180sec)|
      |                            |  timeout expired            |
      |                            |----------------------------->|
      |                            | 1. Standard query           |
      |                            |  QNAME = sec.example.com    |
      |                            |  QTYPE = SOA (0x0006)       |
      |                            |<-----------------------------|
      |                            | 2. Standard query response  |
      |                            |  QNAME = sec.example.com    |
      |                            |  QTYPE = SOA (0x0006)       |
      |                            |  ANSWER Name =sec.example.com|
      |                            |  ANSWER Type = SOA (0x0006)  |
      |                            |  ANSWER Serial = 2          |
      |                            |----------------------------->|
      |                            | 3. Standard query           |
      |                            |  QNAME = sec.example.com    |
      |                            |  QTYPE = IXFR (0x00FB)      |
      |                            |  AUTHORITY Name = sec.example.com|
      |                            |  AUTHORITY Type =SOA (0x0006)|
      |                            |  AUTHORITY Serial = 1       |
      |                            |<-----------------------------|
      |                            | 4. Standard query response  |
      |                            |  add new record             |
      |                            |  QNAME = sec.example.com    |
      |                            |  QTYPE = IXFR (0x00FB)      |
      |                            |                             |
      |                            |  ANSWER Name =sec.example.com|
      |                            |  ANSWER Type = SOA (0x0006)  |
      |                            |  ANSWER Serial = 2          |
      |                            |                             |
      |                            |  ANSWER Name =sec.example.com|
      |                            |  ANSWER Type = SOA (0x0006)  |
      |                            |  ANSWER Serial = 1          |
      |                            |                             |
      |                            |  ANSWER Name =sec.example.com|
      |                            |  ANSWER Type = SOA (0x0006)  |
      |                            |  ANSWER Serial = 2          |
      |                            |                             |
      |                            |  ANSWER Name = CL2.sec.example.com|
      |                            |  ANSWER Type = A (0x0001)   |
      |                            |  ANSWER Address =192.168.0.21|
      |                            |                             |
      |                            |  ANSWER Name =sec.example.com|
      |                            |  ANSWER Type = SOA (0x0006)  |
      |                            |  ANSWER Serial = 2          |
      |----------------------------->|                           |
      | 5. Send standard query     |                             |
      |  QNAME = CL2.sec.example.com |                           |
      |  QTYPE = A                 |                             |
      |<-----------------------------|                           |
      | 6. Standard query response |                             |
      |  QNAME = CL2.sec.example.com |                           |
      |  QTYPE = A                 |                             |
      |  ANSWER Name = CL2.sec.example.com|                      |
      |  ANSWER Type = A (0x0001)  |                             |
      |  ANSWER Address =192.168.0.21|                           |
      |                            |                             |
      v                            v                             v
```

This test sequence is following.

1. After SOA refresh time expired, DNS Server1 (NUT) transmits standard query QNAME=sec.example.com, Type = SOA to DNS Server7 (TN). (Judgment *1)
2. DNS Server7 (TN) sends standard query response with SOA Serial = 2 to DNS Server1 (NUT).
3. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY Name = sec.example.com, Type = SOA Serial = 1 to DNS Server7 (TN). (Judgment *3)
4. DNS Server7 (TN) sends standard query response including only difference RRs previous one to DNS Server1 (NUT). Its difference is that CL2.sec.example.com's address is added as 192.168.0.21.
5. DNS Client1 (TN) sends standard query QNAME = CL2.sec.example.com to DNS Server1 (NUT).
6. DNS Server1 (NUT) transmits standard query response ANSWER Address = 192.168.0.21 to DNS Client1 (TN). (Judgment *6)

Packet Description

1st packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0

	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	2
	ARCOUNT	4
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4

	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

3rd packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	>=1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	***IXFR (0x00FB)***
	QCLASS	IN (0x0001)

DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	***1***
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

4th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	5
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)

	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*1*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)

	SERIAL	2
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

5th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x2000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x2000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1

	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	*ANY*
	ARCOUNT	*ANY*
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	CL2.sec.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC010)
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS7.sec.example.com (NS7 + Pointer 0xC010)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC041)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC041)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC053)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)

	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC053)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

- **Termination**
  None

Judgment

1. Received standard query with Type=SOA after SOA refresh time expired.
3. Received standard query with Type=IXFR serial=1.
6. Received standard query response QNAME=CL2.sec.example.com and Answer address 192.168.0.21.

References

RFC1995 Incremental Zone Transfer in DNS
2. Brief Description of the Protocol
3. Query Format

5.109. an IXFR client sends an IXFR message (remove)

Purpose

Verify that a NUT sends an IXFR message to get new information about zone.

- If an IXFR client, which likely has an older version of a zone, thinks it needs new information about the zone through SOA refresh timeout, it sends an IXFR message containing the SOA serial number of its, presumably outdated, copy of the zone.
- The query type value of IXFR assigned by IANA is 251.
- The IXFR query packet format is the same as that of a normal DNS query, but with the query type being IXFR and the authority section containing the SOA record of client's version of the zone.

Category

Server (an IXFR client)

Initialization

- **Network Topology**
  Refer the topology "Fig. 33 Topology No.33".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable incremental zone transfer function.

  Example of DNS server configuration on DNS Server1 (NUT):

  - ✧ For IPv4 transport

```
zone "sec.example.com" {
        type slave;
        masters {192.168.0.31;};
        file "s/sec.example.com";
};
```

  - ✧ For IPv6 transport

```
zone "sec.example.com" {
        type slave;
        masters {3ffe:501:ffff:100::31;};
        file "s/sec.example.com";
};
```

  Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
```

```
@ IN SOA NS7.sec.example.com.  root.sec.example.com.  (
         1       ; serial
         180     ; refresh every 3 min
         30      ; retry every 30 sec
         360     ; expire after 6 min
         30      ; Minimum TTL of 30 sec
)
;
         IN      NS       NS7.sec.example.com.
         IN      NS       NS1.sec.example.com.
NS7      IN      A        192.168.0.31
         IN      AAAA     3ffe:501:ffff:100::31
NS1      IN      A        192.168.0.10
         IN      AAAA     3ffe:501:ffff:100::10
;
CL1      IN      A        192.168.0.20
CL2      IN      A        192.168.0.21
```

Pre-test Sequence:

After all zone information are transferred between primary DNS server7 (TN) and slave DNS server1 (NUT), following pre-test sequence is performed.

```
DNS Client1 (TN)              DNS Server1 (NUT)           DNS Server7 (TN)
     |                                |                          |
     |--------------------------------->|                          |
     | 1. Send standard query          |                          |
     |  QNAME = CL2.sec.example.com    |                          |
     |  QTYPE = A                      |                          |
     |<---------------------------------|                          |
     | 2. Standard query response      |                          |
     |  QNAME = CL2.sec.example.com    |                          |
     |  QTYPE = A                      |                          |
     |  ANSWER Name= CL2.sec.example.com|                          |
     |  ANSWER Type = A (0x0001)       |                          |
     |  ANSWER Address = 192.168.0.21  |                          |
     |                                 |                          |
     v                                 v                          v
```

Procedure

This test sequence is following.

NOTE: SOA's parameter and $TTL are same as above sec.example.com zone information.
TN includes NS7 and NS1.sub.example.com into Authority as type = NS. Also TN includes NS7 and NS1.sub.example.com address into Additional section. Thus NUT may reply to answer client with Authority and Additional section including those values.

```
DNS Client1 (TN)            DNS Server1 (NUT)             DNS Server7 (TN)
      |                            |                            |
      |                            |  Before SOA refresh (180sec)|
      |                            |  timeout expired            |
      |                            |----------------------------->|
      |                            | 1. Standard query           |
      |                            |  QNAME = sec.example.com    |
      |                            |  QTYPE = SOA (0x0006)       |
      |                            |<-----------------------------|
      |                            | 2. Standard query response  |
      |                            |  QNAME = sec.example.com    |
      |                            |  QTYPE = SOA (0x0006)       |
      |                            |  ANSWER Name =sec.example.com|
      |                            |  ANSWER Type = SOA (0x0006) |
      |                            |  ANSWER Serial = 2          |
      |                            |----------------------------->|
      |                            | 3. Standard query           |
      |                            |  QNAME = sec.example.com    |
      |                            |  QTYPE = IXFR (0x00FB)      |
      |                            |  AUTHORITY Name = sec.example.com|
      |                            |  AUTHORITY Type =SOA (0x0006)|
      |                            |  AUTHORITY Serial = 1       |
      |                            |<-----------------------------|
      |                            | 4. Standard query response  |
      |                            |  add new record             |
      |                            |  QNAME = sec.example.com    |
      |                            |  QTYPE = IXFR (0x00FB)      |
      |                            |                             |
      |                            |  ANSWER Name =sec.example.com|
      |                            |  ANSWER Type = SOA (0x0006) |
      |                            |  ANSWER Serial = 2          |
      |                            |                             |
      |                            |  ANSWER Name =sec.example.com|
      |                            |  ANSWER Type = SOA (0x0006) |
      |                            |  ANSWER Serial = 1          |
      |                            |                             |
      |                            |  ANSWER Name = CL2.sec.example.com|
      |                            |  ANSWER Type = A (0x0001)   |
      |                            |  ANSWER Address =192.168.0.21|
      |                            |                             |
      |                            |  ANSWER Name =sec.example.com|
      |                            |  ANSWER Type = SOA (0x0006) |
      |                            |  ANSWER Serial = 2L         |
      |----------------------------->|                           |
      | 5. Send standard query     |                            |
      |  QNAME = CL2.sec.example.com |                          |
      |  QTYPE = A                 |                            |
      |<-----------------------------|                          |
      | 6. Standard query response |                            |
      |  AA bit = 1                |                            |
      |  RCODE  = 3                |                            |
      |  QNAME = CL2.sec.example.com |                          |
      |  QTYPE = A                 |                            |
      |  AUTHORITY Name = sec.example.com|                      |
      |  AUTHORITY Type =SOA (0x0006)|                          |
      |  AUTHORITY Serial = 2      |                            |
      |                            |                            |
      v                            v                            v
```

This test sequence is following.

1. After SOA refresh time expired, DNS Server1 (NUT) transmits standard query QNAME = sec.example.com, Type = SOA to DNS Server7 (TN). (Judgment *1)
2. DNS Server7 (TN) sends standard query response with SOA Serial = 2 to DNS Server1 (NUT).
3. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY Name = sec.example.com, Type = SOA Serial = 1 to DNS Server7 (TN). (Judgment *3)
4. DNS Server7 (TN) sends standard query response including only difference RRs previous one to DNS Server1 (NUT). Its difference is that CL2.sec.example.com's record is removed.
5. DNS Client1 (TN) sends standard query QNAME = CL2.sec.example.com to DNS Server1 (NUT).
6. DNS Server1 (NUT) transmits standard query response with RCODE=3 to DNS Client1 (TN). (Judgment *6)

Packet Description

1st packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1

	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	2
	ARCOUNT	4
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10

DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

3rd packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	>=1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	***IXFR (0x00FB)***
	QCLASS	IN (0x0001)
DNS Authority	NAME	sec.example.com (Pointer 0xC00C)

section	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*1*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec

4th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	5
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*

	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*1*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec

5th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x2000

	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x2000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	*ANY*
	ARCOUNT	*ANY*
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec

	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec

- **Termination**
  None

Judgment

1. Received standard query with Type=SOA after SOA refresh time expired.
3. Received standard query with Type=IXFR serial=1.
6. Received standard query response with RCODE=3 to DNS Client1 (TN).

References

RFC1995 Incremental Zone Transfer in DNS
2. Brief Description of the Protocol
3. Query Format

5.110. an IXFR client sends an IXFR message (change)

Purpose

Verify that a NUT sends an IXFR message to get new information about zone.

- If an IXFR client, which likely has an older version of a zone, thinks it needs new information about the zone through SOA refresh timeout, it sends an IXFR message containing the SOA serial number of its, presumably outdated, copy of the zone.
- The query type value of IXFR assigned by IANA is 251.
- The IXFR query packet format is the same as that of a normal DNS query, but with the query type being IXFR and the authority section containing the SOA record of client's version of the zone.

Category

Server (an IXFR client)

Initialization

- **Network Topology**
  Refer the topology "Fig. 33 Topology No.33".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable incremental zone transfer function.

  Example of DNS server configuration on DNS Server1 (NUT):

  - ✧ For IPv4 transport

```
zone "sec.example.com" {
        type slave;
        masters {192.168.0.31;};
        file "s/sec.example.com";
};
```

  - ✧ For IPv6 transport

```
zone "sec.example.com" {
        type slave;
        masters {3ffe:501:ffff:100::31;};
        file "s/sec.example.com";
};
```

  Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS7.sec.example.com.  root.sec.example.com.  (
         1       ; serial
         180     ; refresh every 3 min
         30      ; retry every 30 sec
         360     ; expire after 6 min
         30      ; Minimum TTL of 30 sec
)
;
         IN      NS       NS7.sec.example.com.
         IN      NS       NS1.sec.example.com.
NS7      IN      A        192.168.0.31
         IN      AAAA     3ffe:501:ffff:100::31
NS1      IN      A        192.168.0.10
         IN      AAAA     3ffe:501:ffff:100::10
;
CL1      IN      A        192.168.0.20
CL2      IN      A        192.168.0.21
```

Pre-test Sequence:

After all zone information are transferred between primary DNS server7 (TN) and slave DNS server1 (NUT), following pre-test sequence is performed.

```
DNS Client1 (TN)            DNS Server1 (NUT)             DNS Server7 (TN)
     |                            |                             |
     |---------------------------->|                             |
     | 1. Send standard query     |                             |
     |  QNAME = CL2.sec.example.com |                           |
     |  QTYPE = A                 |                             |
     |<----------------------------|                             |
     | 2. Standard query response |                             |
     |  QNAME = CL2.sec.example.com |                           |
     |  QTYPE = A                 |                             |
     |  ANSWER Name               |                             |
     |        = CL2.sec.example.com |                           |
     |  ANSWER Type = A (0x0001)  |                             |
     |  ANSWER Address =192.168.0.21|                           |
     |                            |                             |
     v                            v                             v
```

Procedure

This test sequence is following.

NOTE: SOA's parameter and $TTL are same as above sec.example.com zone information. TN includes NS7 and NS1.sub.example.com into Authority as type = NS. Also TN includes NS7 and NS1.sub.example.com address into Additional section. Thus NUT may reply to answer client with Authority and Additional section including those values.

```
DNS Client1 (TN)            DNS Server1 (NUT)             DNS Server7 (TN)
     |                            |                             |
     |                            |  Before SOA refresh (180sec)|
     |                            |  timeout expired            |
     |                            |---------------------------->|
     |                            | 1. Standard query           |
     |                            |  QNAME = sec.example.com    |
     |                            |  QTYPE = SOA (0x0006)       |
     |                            |<----------------------------|
     |                            | 2. Standard query response  |
     |                            |  QNAME = sec.example.com    |
     |                            |  QTYPE = SOA (0x0006)       |
     |                            |  ANSWER Name =sec.example.com|
     |                            |  ANSWER Type = SOA (0x0006) |
     |                            |  ANSWER Serial = 2          |
     |                            |---------------------------->|
     |                            | 3. Standard query           |
     |                            |  QNAME = sec.example.com    |
     |                            |  QTYPE = IXFR (0x00FB)      |
     |                            |  AUTHORITY Name = sec.example.com |
     |                            |  AUTHORITY Type =SOA (0x0006)|
     |                            |  AUTHORITY Serial = 1       |
     |                            |<----------------------------|
     |                            | 4. Standard query response  |
     |                            |  add new record             |
     |                            |  QNAME = sec.example.com    |
     |                            |  QTYPE = IXFR (0x00FB)      |
     |                            |                             |
     |                            |  ANSWER Name =sec.example.com|
     |                            |  ANSWER Type = SOA (0x0006) |
     |                            |  ANSWER Serial = 2          |
     |                            |                             |
     |                            |  ANSWER Name =sec.example.com|
     |                            |  ANSWER Type = SOA (0x0006) |
     |                            |  ANSWER Serial = 1          |
     |                            |                             |
     |                            |  ANSWER Name = CL2.sec.example.com |
     |                            |  ANSWER Type = A (0x0001)   |
     |                            |  ANSWER Address =192.168.0.21|
     |                            |                             |
     |                            |  ANSWER Name =sec.example.com|
     |                            |  ANSWER Type = SOA (0x0006) |
     |                            |  ANSWER Serial = 2          |
     |                            |                             |
     |                            |  ANSWER Name = CL2.sec.example.com |
     |                            |  ANSWER Type = A (0x0001)   |
     |                            |  ANSWER Address =192.168.0.22|
     |                            |                             |
     |                            |  ANSWER Name =sec.example.com|
     |                            |  ANSWER Type = SOA (0x0006) |
     |                            |  ANSWER Serial = 2          |
     |---------------------------->|                            |
     | 5. Send standard query     |                             |
     |  QNAME = CL2.sec.example.com |                           |
     |  QTYPE = A                 |                             |
```

```
        |<----------------------------|                              |
        | 6. Standard query response  |                              |
        |  QNAME = CL2.sec.example.com |                             |
        |  QTYPE = A                  |                              |
        |  ANSWER Name = CL2.sec.example.com |                       |
        |  ANSWER Type = A (0x0001)   |                              |
        |  ANSWER Address =192.168.0.22|                             |
        |                             |                              |
        v                             v                              v
```

This test sequence is following.

1. After SOA refresh time expired, DNS Server1 (NUT) transmits standard query QNAME = sec.example.com, Type = SOA to DNS Server7 (TN). (Judgment *1)
2. DNS Server7 (TN) sends standard query response with SOA Serial = 2 to DNS Server1 (NUT).
3. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY Name = sec.example.com, Type = SOA Serial = 1 to DNS Server7 (TN). (Judgment *3)
4. DNS Server7 (TN) sends standard query response including only difference RRs previous one to DNS Server1 (NUT). Its difference is that CL2.sec.example.com's record is changed.
5. DNS Client1 (TN) sends standard query QNAME = CL2.sec.example.com to DNS Server1 (NUT).
6. DNS Server1 (NUT) transmits standard query response ANSWER Address = 192.168.0.22 to DNS Client1 (TN). (Judgment *6)

Packet Description

1st packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	2
	ARCOUNT	4
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)

	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

3rd packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	>=1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	***IXFR (0x00FB)***
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	***1***
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec

4th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	5
	NSCOUNT	0
	ARCOUNT	0
DNS Question	QNAME	sec.example.com

section	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*1*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec

	EXPIRE	360sec
	MINIMUM	30sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.22
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec

5th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x2000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)

	QCLASS	IN (0x0001)

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x2000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	*ANY*
	ARCOUNT	*ANY*
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	CL2.sec.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC010)
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS7.sec.example.com (NS7 + Pointer 0xC010)

DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC041)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC041)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC053)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC053)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

- Termination
  None

Judgment

1. Received standard query with Type=SOA after SOA refresh time expired.
3. Received standard query with Type=IXFR serial=1.
6. Received standard query response QNAME=CL2.sec.example.com and Answer address 192.168.0.22.

References

RFC1995 Incremental Zone Transfer in DNS
2. Brief Description of the Protocol
3. Query Format

5.111. an IXFR client sends an IXFR message (remove/add/change)

Purpose

Verify that a NUT sends an IXFR message to get new information about zone.

- If an IXFR client, which likely has an older version of a zone, thinks it needs new information about the zone through SOA refresh timeout, it sends an IXFR message containing the SOA serial number of its, presumably outdated, copy of the zone.
- The query type value of IXFR assigned by IANA is 251.
- The IXFR query packet format is the same as that of a normal DNS query, but with the query type being IXFR and the authority section containing the SOA record of client's version of the zone.

Category

Server (an IXFR client)

Initialization

- **Network Topology**
  Refer the topology "Fig. 33 Topology No.33".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable incremental zone transfer function.

  Example of DNS server configuration on DNS Server1 (NUT):

  - ✧ For IPv4 transport

```
zone "sec.example.com" {
        type slave;
        masters {192.168.0.31;};
        file "s/sec.example.com";
};
```

  - ✧ For IPv6 transport

```
zone "sec.example.com" {
        type slave;
        masters {3ffe:501:ffff:100::31;};
        file "s/sec.example.com";
};
```

  Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
```

```
@ IN SOA NS7.sec.example.com. root.sec.example.com. (
         1       ; serial
         180     ; refresh every 3 min
         30      ; retry every 30 sec
         360     ; expire after 6 min
         30      ; Minimum TTL of 30 sec
)
;
         IN      NS     NS7.sec.example.com.
         IN      NS     NS1.sec.example.com.
NS7      IN      A      192.168.0.31
         IN      AAAA   3ffe:501:ffff:100::31
NS1      IN      A      192.168.0.10
         IN      AAAA   3ffe:501:ffff:100::10
;
CL1      IN      A      192.168.0.20
CL2      IN      A      192.168.0.21
```

Pre-test Sequence:

After all zone information are transferred between primary DNS server7 (TN) and slave DNS server1 (NUT), following pre-test sequence is performed.

```
    DNS Client1 (TN)                DNS Server1 (NUT)        DNS Server7 (TN)
         |                                 |                          |
         |--------------------------------->|                          |
         | 1. Send standard query           |                          |
         |  QNAME = CL2.sec.example.com     |                          |
         |  QTYPE = A                       |                          |
         |<---------------------------------|                          |
         | 2. Standard query response       |                          |
         |  QNAME = CL2.sec.example.com     |                          |
         |  QTYPE = A                       |                          |
         |  ANSWER Name = CL2.sec.example.com|                         |
         |  ANSWER Type = A (0x0001)        |                          |
         |  ANSWER Address = 192.168.0.21   |                          |
         |                                  |                          |
         v                                  v                          v
```

Procedure

This test sequence is following.

NOTE: SOA's parameter and $TTL are same as above sec.example.com zone information. TN includes NS7 and NS1.sub.example.com into Authority as type = NS. Also TN includes NS7 and NS1.sub.example.com address into Additional section. Thus NUT may reply to answer client with Authority and Additional section including those values.

```
DNS Client1 (TN)            DNS Server1 (NUT)             DNS Server7 (TN)
     |                             |                            |
     |                             |  Before SOA refresh (180sec)|
     |                             |  timeout expired            |
     |                             |---------------------------->|
     |                             | 1. Standard query           |
     |                             |  QNAME = sec.example.com    |
     |                             |  QTYPE = SOA (0x0006)       |
     |                             |<----------------------------|
     |                             | 2. Standard query response  |
     |                             |  QNAME = sec.example.com    |
     |                             |  QTYPE = SOA (0x0006)       |
     |                             |  ANSWER Name = sec.example.com|
     |                             |  ANSWER Type = SOA (0x0006)  |
     |                             |  ANSWER Serial = 3          |
     |                             |---------------------------->|
     |                             | 3. Standard query           |
     |                             |  QNAME = sec.example.com    |
     |                             |  QTYPE = IXFR (0x00FB)      |
     |                             |  AUTHORITY Name = sec.example.com |
     |                             |  AUTHORITY Type =SOA (0x0006)|
     |                             |  AUTHORITY Serial = 1       |
     |                             |                            |
```

```
|                              |<----------------------------|
|                              | 4. Standard query response  |
|                              |  add new record             |
|                              |  QNAME = sec.example.com    |
|                              |  QTYPE = IXFR (0x00FB)      |
|                              |                             |
|                              |  ANSWER Name =sec.example.com|
|                              |  ANSWER Type = SOA (0x0006) |
|                              |  ANSWER Serial = 3          |
|                              |                             |
|                              |  [remove]                   |
|                              |  ANSWER Name =sec.example.com|
|                              |  ANSWER Type = SOA (0x0006) |
|                              |  ANSWER Serial = 1          |
|                              |                             |
|                              |  ANSWER Name = CL2.sec.example.com|
|                              |  ANSWER Type = A (0x0001)   |
|                              |  ANSWER Address =192.168.0.21|
|                              |                             |
|                              |  [add]                      |
|                              |  ANSWER Name =sec.example.com|
|                              |  ANSWER Type = SOA (0x0006) |
|                              |  ANSWER Serial = 2          |
|                              |                             |
|                              |  ANSWER Name = CL2.sec.example.com |
|                              |  ANSWER Type = A (0x0001)   |
|                              |  ANSWER Address =192.168.0.22|
|                              |                             |
|                              |  [remove]                   |
|                              |  ANSWER Name =sec.example.com|
|                              |  ANSWER Type = SOA (0x0006) |
|                              |  ANSWER Serial = 2          |
|                              |                             |
|                              |  ANSWER Name = CL2.sec.example.com |
|                              |  ANSWER Type = A (0x0001)   |
|                              |  ANSWER Address =192.168.0.22|
|                              |                             |
|                              |                             |
|                              |  [add]                      |
|                              |  ANSWER Name =sec.example.com|
|                              |  ANSWER Type = SOA (0x0006) |
|                              |  ANSWER Serial = 3          |
|                              |                             |
|                              |  ANSWER Name = CL2.sec.example.com |
|                              |  ANSWER Type = A (0x0001)   |
|                              |  ANSWER Address =192.168.0.23|
|                              |                             |
|                              |  ANSWER Name =sec.example.com|
|                              |  ANSWER Type = SOA (0x0006) |
|                              |  ANSWER Serial = 3          |
|                              |                             |
|----------------------------->|                             |
| 5. Send standard query       |                             |
|  QNAME = CL2.sec.example.com |                             |
|  QTYPE = A                   |                             |
|                              |                             |
```

```
        |<----------------------------|                              |
        | 6. Standard query response  |                              |
        |  QNAME = CL2.sec.example.com |                              |
        |  QTYPE = A                  |                              |
        |  ANSWER Name = CL2.sec.example.com |                        |
        |  ANSWER Type = A (0x0001)   |                              |
        |  ANSWER Address =192.168.0.23|                             |
        |                             |                              |
        v                             v                              v
```

This test sequence is following.

1. After SOA refresh time expired, DNS Server1 (NUT) transmits standard query QNAME = sec.example.com, Type = SOA to DNS Server7 (TN). (Judgment *1)
2. DNS Server7 (TN) sends standard query response with SOA Serial = 3 to DNS Server1 (NUT).
3. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY Name = sec.example.com, Type = SOA Serial = 1 to DNS Server7 (TN). (Judgment *3)
4. DNS Server7 (TN) sends standard query response including only difference RRs previous one to DNS Server1 (NUT).
   Its difference is that CL2.sec.example.com's record is removed, and CL2.sec.example.com's record is added again.
   After that, CL2.sec.example.com's record is changed.
5. DNS Client1 (TN) sends standard query QNAME = CL2.sec.example.com to DNS Server1 (NUT).
6. DNS Server1 (NUT) transmits standard query response ANSWER Address = 192.168.0.23 to DNS Client1 (TN). (Judgment *6)

Packet Description

1st packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)

	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	2
	ARCOUNT	4
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*3*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)

DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

3rd packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0

	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	>=1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	***IXFR (0x00FB)***
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	***1***
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec

4th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	10
	NSCOUNT	0

	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*3*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*1*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*2*

	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.22
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.22
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*3*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.23
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*3*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	360sec
	MINIMUM	30sec

5th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x2000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x2000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	*ANY*
	ARCOUNT	*ANY*
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	CL2.sec.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.23
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC010)
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS7.sec.example.com (NS7 + Pointer 0xC010)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC041)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC041)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC053)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC053)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

- **Termination**
  None

Judgment

1. Received standard query with Type=SOA after SOA refresh time expired.
3. Received standard query with Type=IXFR serial=1.
6. Received standard query response QNAME=CL2.sec.example.com and Answer address 192.168.0.23.

References

RFC1995 Incremental Zone Transfer in DNS
2. Brief Description of the Protocol
3. Query Format

5.112. an IXFR client tries an AXFR, if the query type is not recognized by the server

Purpose

Verify that a NUT sends an AXFR message, if the query type is not recognized by the server.

- A client should first make an IXFR query using UDP.
- If the query type is not recognized by the server, an AXFR (preceded by a UDP SOA query) should be tried, ensuring backward compatibility.
- If the query response is a single packet with the entire new zone, or if the server does not have a newer version than the client, everything is done.
- Otherwise, a TCP IXFR query should be tried.

Category

Server (an IXFR client)

Initialization

- **Network Topology**
  Refer the topology "Fig.33　Topology No.33".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable incremental zone transfer function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type slave;
        masters {192.168.0.31;};
        file "s/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type slave;
        masters {3ffe:501:ffff:100::31;};
        file "s/sec.example.com";
};
```

  Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS7.sec.example.com. root.sec.example.com. (
         1       ; serial
         180     ; refresh every 3 min
         30      ; retry every 30 sec
         360     ; expire after 6 min
         30      ; Minimum TTL of 30 sec
)
;
         IN      NS      NS7.sec.example.com.
         IN      NS      NS1.sec.example.com.
NS7      IN      A       192.168.0.31
         IN      AAAA    3ffe:501:ffff:100::31
NS1      IN      A       192.168.0.10
         IN      AAAA    3ffe:501:ffff:100::10
;
CL1      IN      A       192.168.0.20
```

Pre-test Sequence:

After all zone information are transferred between primary DNS server7 (TN) and slave DNS server1 (NUT), following pre-test sequence is performed.

```
DNS Client1 (TN)              DNS Server1 (NUT)          DNS Server7 (TN)
     |                              |                          |
     |------------------------------>|                          |
     | 1. Send standard query        |                          |
     |  QNAME = CL2.sec.example.com  |                          |
     |  QTYPE = A                    |                          |
     |<------------------------------|                          |
     | 2. Standard query response    |                          |
     |  AA bit = 1                   |                          |
     |  RCODE  = 3                   |                          |
     |  QNAME = CL2.sec.example.com  |                          |
     |  QTYPE = A                    |                          |
     |  AUTHORITY Name=sec.example.com|                          |
     |  AUTHORITY Type = SOA (0x0006) |                          |
     |  AUTHORITY Serial = 1         |                          |
     v                              v                          v
```

Procedure

This test sequence is following.

NOTE: SOA's parameter and $TTL are same as above sec.example.com zone information. TN includes NS7 and NS1.sub.example.com into Authority as type = NS.
Also TN includes NS7 and NS1.sub.example.com address into Additional section. Thus NUT may reply to answer client with Authority and Additional section including those values.

```
DNS Client1 (TN)            DNS Server1 (NUT)                  DNS Server7 (TN)
      |                             |                                  |
      |                             |  Before SOA  refresh (180sec)    |
      |                             |  timeout expired                 |
      |                             |----------------------------------->|
      |                             | 1. Standard query                |
      |                             |  QNAME = sec.example.com         |
      |                             |  QTYPE = SOA (0x0006)            |
      |                             |<-----------------------------------|
      |                             | 2. Standard query response       |
      |                             |  QNAME = sec.example.com         |
      |                             |  QTYPE = SOA (0x0006)            |
      |                             |  ANSWER Name =sec.example.com    |
      |                             |  ANSWER Type = SOA (0x0006)      |
      |                             |  ANSWER Serial = 2               |
      |                             |----------------------------------->|
      |                             | 3. Standard query                |
      |                             |  QNAME = sec.example.com         |
      |                             |  QTYPE = IXFR (0x00FB)           |
      |                             |  AUTHORITY Name = sec.example.com |
      |                             |  AUTHORITY Type =SOA (0x0006)    |
      |                             |  AUTHORITY Serial = 1            |
      |                             |<-----------------------------------|
      |                             | 4. Standard query response       |
      |                             |  AA bit = 1                      |
      |                             |  RCODE  = 4                      |
      |                             |  QNAME = sec.example.com         |
      |                             |  QTYPE = IXFR (0x00FB)           |
      |                             |  AUTHORITY Name = sec.example.com |
      |                             |  AUTHORITY Type =SOA (0x0006)    |
      |                             |  AUTHORITY Serial = 2            |
      |                             |----------------------------------->|
      |                             | 5. Standard query                |
      |                             |  QNAME = sec.example.com         |
      |                             |  QTYPE = AXFR (0x00FC)           |
      |                             |  AUTHORITY Name = sec.example.com |
      |                             |  AUTHORITY Type =SOA (0x0006)    |
      |                             |  AUTHORITY Serial = 1            |
```

```
|                              |<-----------------------------------|
|                              | 6. Standard query response         |
|                              |  QNAME = sec.example.com           |
|                              |  QTYPE = AXFR (0x00FC)             |
|                              |                                    |
|                              |  ANSWER Name =sec.example.com      |
|                              |  ANSWER Type = SOA (0x0006)        |
|                              |  ANSWER Serial = 2                 |
|                              |                                    |
|                              |  ANSWER Name =sec.example.com      |
|                              |  ANSWER Type = NS (0x0002)         |
|                              |  ANSWER Nsdname = NS7.sec.example.com |
|                              |                                    |
|                              |  ANSWER Name =sec.example.com      |
|                              |  ANSWER Type = NS (0x0002)         |
|                              |  ANSWER Nsdname = NS1.sec.example.com |
|                              |                                    |
|                              |  ANSWER Name = NS7.sec.example.com |
|                              |  ANSWER Type = A (0x0001)          |
|                              |  ANSWER Address =192.168.0.31      |
|                              |                                    |
|                              |  ANSWER Name = NS7.sec.example.com |
|                              |  ANSWER Type = AAAA (0x001C)       |
|                              |  ANSWER Address = 3ffe:501:ffff:100::31 |
|                              |                                    |
|                              |  ANSWER Name = NS1.sec.example.com |
|                              |  ANSWER Type = A (0x0001)          |
|                              |  ANSWER Address =192.168.0.10      |
|                              |                                    |
|                              |  ANSWER Name = NS1.sec.example.com |
|                              |  ANSWER Type = AAAA (0x001C)       |
|                              |  ANSWER Address = 3ffe:501:ffff:100::10 |
|                              |                                    |
|                              |  ANSWER Name = CL1.sec.example.com |
|                              |  ANSWER Type = A (0x0001)          |
|                              |  ANSWER Address =192.168.0.20      |
|                              |                                    |
|                              |  ANSWER Name = CL2.sec.example.com |
|                              |  ANSWER Type = A (0x0001)          |
|                              |  ANSWER Address =192.168.0.21      |
|----------------------------->|                                    |
| 7. Send standard query       |                                    |
|  QNAME = CL2.sec.example.com |                                    |
|  QTYPE = A                   |                                    |
|<-----------------------------|                                    |
| 8. Standard query response   |                                    |
|  QNAME = CL2.sec.example.com |                                    |
|  QTYPE = A                   |                                    |
|  ANSWER Name = CL2.sec.example.com|                               |
|  ANSWER Type = A (0x0001)    |                                    |
|  ANSWER Address =192.168.0.21|                                    |
v                              v                                    v
```

This test sequence is following.

1. After SOA refresh time expired, DNS Server1 (NUT) transmits standard query QNAME = sec.example.com, Type = SOA to DNS Server7 (TN). (Judgment *1)
2. DNS Server7 (TN) sends standard query response with SOA Serial = 2 to DNS Server1 (NUT).
3. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY Name = sec.example.com, Type = SOA Serial = 1 to DNS Server7 (TN). (Judgment *3)
4. DNS Server7 (TN) sends standard query response with RCODE=4 to DNS Server1 (NUT). (Judgment *6)
5. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = AXFR, including AUTHORITY Name = sec.example.com, Type = SOA Serial = 1 to DNS Server7 (TN). (Judgment *5)
6. DNS Server7 (TN) sends standard query response including only difference RRs previous one to DNS Server1 (NUT). Its difference is that CL2.sec.example.com's address is added as 192.168.0.21.
7. DNS Client1 (TN) sends standard query QNAME = CL2.sec.example.com to DNS Server1 (NUT).
8. DNS Server1 (NUT) transmits standard query response ANSWER Address = 192.168.0.21 to DNS Client1 (TN). (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses

DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	2
	ARCOUNT	4
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

3rd packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	>=1
	ARCOUNT	0

DNS Question section	QNAME	sec.example.com
	QTYPE	***IXFR (0x00FB)***
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	***1***
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

4th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	4
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec

	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com(root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

5th packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	>=1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	***AXFR (0x00FC)***
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com(root + Pointer 0xC00C)
	SERIAL	*1*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec

	MINIMUM	30sec

6th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	9
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com(root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (NS7 + Pointer 0xC02D)

DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
DNS Answer section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Answer section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x0001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	3ffe:501:ffff:100::31
DNS Answer section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Answer section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	AAAA (0x0001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	3ffe:501:ffff:100::10
DNS Answer section	NAME	CL1.sec.example.com (CL1 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.20
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.21

7th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x2000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x2000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	*ANY*
	ARCOUNT	*ANY*

DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	CL2.sec.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC010)
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS7.sec.example.com (NS7 + Pointer 0xC010)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC041)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC041)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC053)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC053)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)

	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

- Termination
  None

Judgment

1. Received standard query with Type=SOA after SOA refresh time expired.
3. Received standard query with Type=IXFR serial=1.
5. Received standard query with Type=AXFR serial=1.
8. Received standard query response QNAME=CL2.sec.example.com and Answer address 192.168.0.21.

References

RFC1995 Incremental Zone Transfer in DNS
2. Brief Description of the Protocol
3. Query Format

5.113. an IXFR client tries to use TCP, if the reply does not fit in a single DNS packet.

Purpose

Verify that a NUT switches to use TCP as IXFR message.

- A client should first make an IXFR query using UDP.
- If the query type is not recognized by the server, an AXFR (preceded by a UDP SOA query) should be tried, ensuring backward compatibility.
- If the query response is a single packet with the entire new zone, or if the server does not have a newer version than the client, everything is done.
- Otherwise, a TCP IXFR query should be tried.

Category

Server (an IXFR client)

Initialization

- **Network Topology**
  Refer the topology "Fig. 33 Topology No.33".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable incremental zone transfer function.

  Example of DNS server configuration on DNS Server1 (NUT):

  - ✧ For IPv4 transport

```
zone "sec.example.com" {
        type slave;
        masters {192.168.0.31;};
        file "s/sec.example.com";
};
```

  - ✧ For IPv6 transport

```
zone "sec.example.com" {
        type slave;
        masters {3ffe:501:ffff:100::31;};
        file "s/sec.example.com";
};
```

  Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS7.sec.example.com.  root.sec.example.com.  (
```

```
        1       ; serial
        180     ; refresh every 3 min
        30      ; retry every 30 sec
        360     ; expire after 6 min
        30      ; Minimum TTL of 30 sec
)
;
        IN      NS      NS7.sec.example.com.
        IN      NS      NS1.sec.example.com.
NS7     IN      A       192.168.0.31
        IN      AAAA    3ffe:501:ffff:100::31
NS1     IN      A       192.168.0.10
        IN      AAAA    3ffe:501:ffff:100::10
;
CL1     IN      A       192.168.0.20
CL2     IN      A       192.168.0.21
```

Pre-test Sequence:

After all zone information are transferred between primary DNS server7 (TN) and slave DNS server1 (NUT), following pre-test sequence is performed.

```
DNS Client1 (TN)            DNS Server1 (NUT)            DNS Server7 (TN)
     |                           |                            |
     |---------------------------->|                            |
     | 1. Send standard query    |                            |
     |  QNAME = CL2.sec.example.com |                          |
     |  QTYPE = A                |                            |
     |<----------------------------|                            |
     | 2. Standard query response |                            |
     |  QNAME = CL2.sec.example.com |                          |
     |  QTYPE = A                |                            |
     |  ANSWER Name              |                            |
     |        = CL2.sec.example.com |                          |
     |  ANSWER Type = A (0x0001) |                            |
     |  ANSWER Address =192.168.0.21|                          |
     |                           |                            |
     v                           v                            v
```

Procedure

This test sequence is following.

NOTE: SOA's parameter and $TTL are same as above sec.example.com zone information. TN includes NS7 and NS1.sub.example.com into Authority as type = NS. Also TN includes NS7 and NS1.sub.example.com address into Additional section. Thus NUT may reply to answer client with Authority and Additional section including those values.

```
DNS Client1 (TN)                    DNS Server1 (NUT)                 DNS Server7 (TN)
     |                                   |                                 |
     |                                   |  Before SOA  refresh (180sec)   |
     |                                   |  timeout expired                |
     |                                   |--------------------------------->|
     |                                   | 1. Standard query               |
     |                                   |    (in UDP)                     |
     |                                   |  QNAME = sec.example.com        |
     |                                   |  QTYPE = SOA (0x0006)           |
     |                                   |<---------------------------------|
     |                                   | 2. Standard query response      |
     |                                   |    (in UDP)                     |
     |                                   |  QNAME = sec.example.com        |
     |                                   |  QTYPE = SOA (0x0006)           |
     |                                   |  ANSWER Name =sec.example.com   |
     |                                   |  ANSWER Type = SOA (0x0006)     |
     |                                   |  ANSWER Serial = 2              |
     |                                   |--------------------------------->|
     |                                   | 3. Standard query               |
     |                                   |    (in UDP)                     |
     |                                   |  QNAME = sec.example.com        |
     |                                   |  QTYPE = IXFR (0x00FB)          |
     |                                   |  AUTHORITY Name = sec.example.com |
     |                                   |  AUTHORITY Type =SOA (0x0006)   |
     |                                   |  AUTHORITY Serial = 1           |
     |                                   |<---------------------------------|
     |                                   | 4. Standard query response      |
     |                                   |    (in UDP)                     |
     |                                   |  QNAME = sec.example.com        |
     |                                   |  QTYPE = IXFR (0x00FB)          |
     |                                   |                                 |
     |                                   |  ANSWER Name =sec.example.com   |
     |                                   |  ANSWER Type = SOA (0x0006)     |
     |                                   |  ANSWER Serial = 2              |
     |                                   |--------------------------------->|
     |                                   | 5. Standard query               |
     |                                   |    (in TCP)                     |
     |                                   |  QNAME = sec.example.com        |
     |                                   |  QTYPE = IXFR (0x00FB)          |
     |                                   |  AUTHORITY Name  = sec.example.cm |
     |                                   |  AUTHORITY Type =SOA (0x0006)   |
     |                                   |  AUTHORITY Serial = 1           |
```

```
    |                                  |<---------------------------------|
    |                                  | 6. Standard query response       |
    |                                  |    (in TCP)                      |
    |                                  |  add new record                  |
    |                                  |  QNAME = sec.example.com         |
    |                                  |  QTYPE = IXFR (0x00FB)           |
    |                                  |                                  |
    |                                  |  ANSWER Name =sec.example.com    |
    |                                  |  ANSWER Type = SOA (0x0006)      |
    |                                  |  ANSWER Serial = 2               |
    |                                  |                                  |
    |                                  |  ANSWER Name =sec.example.com    |
    |                                  |  ANSWER Type = SOA (0x0006)      |
    |                                  |  ANSWER Serial = 1               |
    |                                  |                                  |
    |                                  |  ANSWER Name = CL2.sec.example.com|
    |                                  |  ANSWER Type = A (0x0001)        |
    |                                  |  ANSWER Address =192.168.0.21    |
    |                                  |                                  |
    |                                  |  ANSWER Name =sec.example.com    |
    |                                  |  ANSWER Type = SOA (0x0006)      |
    |                                  |  ANSWER Serial = 2               |
    |                                  |                                  |
    |                                  |  ANSWER Name = CL2.sec.example.com|
    |                                  |  ANSWER Type = A (0x0001)        |
    |                                  |  ANSWER Address =192.168.0.22    |
    |                                  |                                  |
    |                                  |  ANSWER Name =sec.example.com    |
    |                                  |  ANSWER Type =SOA (0x0006)       |
    |                                  |  ANSWER Serial = 2               |
    |---------------------------------->|                                  |
    | 7. Send standard query           |                                  |
    |    (in UDP)                      |                                  |
    |  QNAME = CL2.sec.example.com     |                                  |
    |  QTYPE = A                       |                                  |
    |<----------------------------------|                                  |
    | 8. Standard query response       |                                  |
    |    (in UDP)                      |                                  |
    |  QNAME = CL2.sec.example.com     |                                  |
    |  QTYPE = A                       |                                  |
    |  ANSWER Name = CL2.sec.example.com|                                  |
    |  ANSWER Type = A (0x0001)        |                                  |
    |  ANSWER Address =192.168.0.22    |                                  |
    |                                  |                                  |
    v                                  v                                  v
```

This test sequence is following.

1. After SOA refresh time expired, DNS Server1 (NUT) transmits standard query QNAME = sec.example.com, Type = SOA using UDP to DNS Server7 (TN). (Judgment *1)
2. DNS Server7 (TN) sends standard query response with SOA Serial = 2 using UDP to DNS Server1 (NUT).
3. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY Name = sec.example.com, Type = SOA Serial = 1 using UDP to DNS Server7 (TN). (Judgment *3)
4. DNS Server7 (TN) sends standard query response using UDP to DNS Server1 (NUT) with a single SOA record including serial=2.
5. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY Name = sec.example.com, Type = SOA Serial = 1 using TCP to DNS Server7 (TN). (Judgment *5)
6. DNS Server7 (TN) sends standard query response including only difference RRs previous one using TCP to DNS Server1 (NUT). Its difference is that CL2.sec.example.com's record is changed.
7. DNS Client1 (TN) sends standard query QNAME = CL2.sec.example.com using UDP to DNS Server1 (NUT).
8. DNS Server1 (NUT) transmits standard query response ANSWER Address = 192.168.0.22 using UDP to DNS Client1 (TN). (Judgment *6)

Packet Description

1st packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	2

	ARCOUNT	4
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

3rd packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	>=1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	*IXFR (0x00FB)*
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*1*
	REFRESH	180sec

	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

4th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

5th packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	SV7_NETZ
TCP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	>=1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	***IXFR (0x00FB)***
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	***1***
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

6th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
TCP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0

	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	5
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*1*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.21

DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.22
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

7th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x2000
	QR	0
	OPCODE	0
	AA	0
	TC	0

	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x2000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	*ANY*
	ARCOUNT	*ANY*
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	CL2.sec.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)

	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC010)
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS7.sec.example.com (NS7 + Pointer 0xC010)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC041)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC041)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC053)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC053)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

- **Termination**

  None

Judgment

1. Received standard query with Type=SOA after SOA refresh time expired.
3. Received standard query with Type=IXFR serial=1.
6. Received standard query response QNAME=CL2.sec.example.com and Answer address 192.168.0.22.

References

RFC1995 Incremental Zone Transfer in DNS
2. Brief Description of the Protocol
3. Query Format

5.114. an IXFR server transmits an IXFR response with the incremental message (add)

Purpose

Verify that a NUT sends only the differences required to make that version current.

Category

Server (an IXFR server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 34 Topology No.34".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as master server about sec.example.com zone.
  - ✧ slave server is DNS Server2.
  - ✧ Enable incremental zone transfer function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 192.168.0.11; };
        file "master/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 3ffe:501:ffff:100::11; };
        file "master/sec.example.com";
};
```

  Example of sec.example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
         1              ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
```

```
)
;
          IN      NS      NS1.sec.example.com.
          IN      NS      NS2.sec.example.com.
NS1       IN      A       192.168.0.10
NS1       IN      AAAA    3ffe:501:ffff:100::10
NS2       IN      A       192.168.0.11
NS2       IN      AAAA    3ffe:501:ffff:100::11
;
CL1       IN      A       192.168.0.20
```

Pre-test Sequence:

Update sec.example.com zone like following on DNS Server1 (NUT)

```
$TTL      86400           ; TTL of 1 day
@ IN SOA NS1.sec.example.com.  root.sec.example.com.  (
          2               ; serial
          3600            ; refresh every 1 hr
          900             ; retry every 15 min
          604800          ; expire after a week
          3600            ; Minimum TTL of a 1 hr
)
;
          IN      NS      NS1.sec.example.com.
          IN      NS      NS2.sec.example.com.
NS1       IN      A       192.168.0.10
NS1       IN      AAAA    3ffe:501:ffff:100::10
NS2       IN      A       192.168.0.11
NS2       IN      AAAA    3ffe:501:ffff:100::11
;
CL1       IN      A       192.168.0.20
CL2       IN      A       192.168.0.21
```

Procedure

This test sequence is following.

```
DNS Server1 (NUT)                DNS Server2 (TN)
     |                                |
     |<-------------------------------|
     | 1. Standard query              |
     |  QNAME = sec.example.com       |
     |  QTYPE = IXFR (0x00FB)         |
     |  AUTHORITY Name= sec.example.com |
     |  AUTHORITY Type = SOA (0x0006) |
     |  AUTHORITY Serial = 1          |
     |------------------------------->|
     | 2. Standard query response     |
     |  QNAME = sec.example.com       |
     |  QTYPE = IXFR (0x00FB)         |
     |                                |
     |  ANSWER Name = sec.example.com |
     |  ANSWER Type = SOA (0x0006)    |
     |  ANSWER Serial = 2             |
     |                                |
     | [remove]                       |
     |  ANSWER Name = sec.example.com |
     |  ANSWER Type = SOA (0x0006)    |
     |  ANSWER Serial = 1             |
     |                                |
     | [add]                          |
     |  ANSWER Name = sec.example.com |
     |  ANSWER Type = SOA (0x0006)    |
     |  ANSWER Serial = 2             |
     |                                |
     |  ANSWER Name =CL2.sec.example.com|
     |  ANSWER Type = A (0x0001)      |
     |  ANSWER Address = 192.168.0.21 |
     |                                |
     |  ANSWER Name = sec.example.com |
     |  ANSWER Type = SOA (0x0006)    |
     |  ANSWER Serial = 2             |
     v                                v

This test sequence is following.
1. DNS Server2 (TN) sends standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY
   Name = sec.example.com, Type = SOA, serial = 1 using UDP.
2. DNS Server1 (NUT) transmits standard query response with QNAME = sec.example.com, Type = IXFR, including
   'sec.example.com SOA serial=2', 'sec.example.com SOA serial=1', 'sec.example.com SOA serial=2',
   'CL2.sec.example.com A 192.168.0.21', and 'sec.example.com SOA serial=2' in Answer section to DNS
   Server2 (TN). (Judgment *2)
```

Packet Description

1st packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETZ
	Destination Address	NUT_NETZ

UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*1*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0

	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	4
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	***IXFR (0x00FB)***
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	***2***
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS1.sec.example.com (0xC02D)
	RNAME	root.sec.example.com (0xC033)
	SERIAL	***1***
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS1.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)

	SERIAL	*2*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS1.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*2*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec

- Termination
  None

Judgment

2. DNS Server1 (NUT) transmits standard query response with QNAME = sec.example.com, Type = IXFR, including 'sec.example.com SOA serial=2', 'sec.example.com SOA serial=1', 'sec.example.com SOA serial=2', 'CL2.sec.example.com A 192.168.0.21',and 'sec.example.com SOA serial=2' in Answer section to DNS Server2 (TN).

References

RFC1995 Incremental Zone Transfer in DNS
2. Brief Description of the Protocol
4. Response Format

5.115. an IXFR server transmits an IXFR response with the incremental message (remove)

Purpose

Verify that a NUT sends only the differences required to make that version current.

Category

Server (an IXFR server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 34 Topology No.34".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as master server about sec.example.com zone.
  - ✧ slave server is DNS Server2.
  - ✧ Enable incremental zone transfer function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 192.168.0.11; };
        file "master/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 3ffe:501:ffff:100::11; };
        file "master/sec.example.com";
};
```

  Example of sec.example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.sec.example.com.  root.sec.example.com.  (
         1                ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
```

```
)
;
        IN      NS      NS1.sec.example.com.
        IN      NS      NS2.sec.example.com.
NS1     IN      A       192.168.0.10
NS1     IN      AAAA    3ffe:501:ffff:100::10
NS2     IN      A       192.168.0.11
NS2     IN      AAAA    3ffe:501:ffff:100::11
;
CL1     IN      A       192.168.0.20
CL2     IN      A       192.168.0.21
```

Pre-test Sequence:

Update sec.example.com zone like following on DNS Server1 (NUT)

```
$TTL    86400           ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
        2               ; serial
        3600            ; refresh every 1 hr
        900             ; retry every 15 min
        604800          ; expire after a week
        3600            ; Minimum TTL of a 1 hr
 )
 ;
        IN      NS      NS1.sec.example.com.
        IN      NS      NS2.sec.example.com.
NS1     IN      A       192.168.0.10
NS1     IN      AAAA    3ffe:501:ffff:100::10
NS2     IN      A       192.168.0.11
NS2     IN      AAAA    3ffe:501:ffff:100::11
 ;
CL1     IN      A       192.168.0.20
```

Procedure

This test sequence is following.

```
DNS Server1 (NUT)                  DNS Server2 (TN)
      |                                  |
      |<---------------------------------|
      | 1. Standard query                |
      |  QNAME = sec.example.com         |
      |  QTYPE = IXFR (0x00FB)           |
      |  AUTHORITY Name = sec.example.com |
      |  AUTHORITY Type = SOA (0x0006)   |
      |  AUTHORITY Serial = 1            |
      |--------------------------------->|
      | 2. Standard query response       |
      |  QNAME = sec.example.com         |
      |  QTYPE = IXFR (0x00FB)           |
      |                                  |
      |  ANSWER Name = sec.example.com   |
      |  ANSWER Type = SOA (0x0006)      |
      |  ANSWER Serial = 2               |
      |                                  |
      |  ANSWER Name = sec.example.com   |
      |  ANSWER Type = SOA (0x0006)      |
      |  ANSWER Serial = 1               |
      |                                  |
      |  ANSWER Name = CL2.sec.example.com|
      |  ANSWER Type = A (0x0001)        |
      |  ANSWER Address = 192.168.0.21   |
      |                                  |
      |  ANSWER Name = sec.example.com   |
      |  ANSWER Type = SOA (0x0006)      |
      |  ANSWER Serial = 2               |
      |                                  |
      v                                  v

   This test sequence is following.
   1. DNS Server2(TN) sends standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY Name = sec.example.com,
      Type = SOA, serial = 1 using UDP.
   2. DNS Server1 (NUT) transmits standard query response with QNAME = sec.example.com, Type = IXFR, including
      'sec.example.com SOA serial=2', 'sec.example.com SOA serial=1', 'CL2.sec.example.com A 192.168.0.21', and
      'sec.example.com SOA serial=2' in Answer section to DNS Server2(TN). (Judgment *2)
```

Packet Description

1st packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0

	AA	1
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0x0033)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*1*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	4
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	*IXFR (0x00FB)*
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS1.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*1*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS1.sec.example.com (Pointer 0xC02D)

	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*2*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec

- **Termination**
  None

Judgment

2. DNS Server1(NUT) transmits standard query response with QNAME = sec.example.com, Type = IXFR, including 'sec.example.com SOA serial=2', 'sec.example.com SOA serial=1', 'CL2.sec.example.com A 192.168.0.21', and 'sec.example.com SOA serial=2' in Answer section to DNS Server2 (TN).

References

RFC1995 Incremental Zone Transfer in DNS
2. Brief Description of the Protocol
4. Response Format

5.116. an IXFR server transmits an IXFR response with the incremental message (change)

Purpose

Verify that a NUT sends only the differences required to make that version current.

Category

Server (an IXFR server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 34 Topology No.34".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as master server about sec.example.com zone.
  - ✧ slave server is DNS Server2.
  - ✧ Enable incremental zone transfer function.

  Example of DNS server configuration on DNS Server1 (NUT):

  - ✧ For IPv4 transport

```
 zone "sec.example.com" {
            type master;
            allow-transfer { 192.168.0.11; };
            file "master/sec.example.com";
};
```

  - ✧ For IPv6 transport

```
zone "sec.example.com" {
            type master;
            allow-transfer { 3ffe:501:ffff:100::11; };
            file "master/sec.example.com";
};
```

  Example of sec.example.com zone file:

```
 $TTL     86400            ; TTL of 1 day
 @ IN SOA NS1.sec.example.com.  root.sec.example.com.  (
          1                ; serial
          3600             ; refresh every 1 hr
          900              ; retry every 15 min
          604800           ; expire after a week
          3600             ; Minimum TTL of a 1 hr
```

```
)
;
        IN      NS      NS1.sec.example.com.
        IN      NS      NS2.sec.example.com.
NS1     IN      A       192.168.0.10
NS1     IN      AAAA    3ffe:501:ffff:100::10
NS2     IN      A       192.168.0.11
NS2     IN      AAAA    3ffe:501:ffff:100::11
;
CL1     IN      A       192.168.0.20
CL2     IN      A       192.168.0.21
```

Pre-test Sequence:

Update sec.example.com zone like following on DNS Server1 (NUT)

```
$TTL    86400           ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
        2               ; serial
        3600            ; refresh every 1 hr
        900             ; retry every 15 min
        604800          ; expire after a week
        3600            ; Minimum TTL of a 1 hr
 )
 ;
        IN      NS      NS1.sec.example.com.
        IN      NS      NS2.sec.example.com.
NS1     IN      A       192.168.0.10
NS1     IN      AAAA    3ffe:501:ffff:100::10
NS2     IN      A       192.168.0.11
NS2     IN      AAAA    3ffe:501:ffff:100::11
 ;
CL1     IN      A       192.168.0.20
CL2     IN      A       192.168.0.22
```

Procedure

This test sequence is following.

```
DNS Server1 (NUT)                  DNS Server2 (TN)
      |                                |
      |<-----------------------------------|
      | 1. Standard query              |
      |  QNAME = sec.example.com       |
      |  QTYPE = IXFR (0x00FB)         |
      |  AUTHORITY Name = sec.example.com |
      |  AUTHORITY Type = SOA (0x0006) |
      |  AUTHORITY Serial = 1          |
      |----------------------------------->|
      | 2. Standard query response     |
      |  QNAME = sec.example.com       |
      |  QTYPE = IXFR (0x00FB)         |
      |                                |
      |  ANSWER Name = sec.example.com |
      |  ANSWER Type = SOA (0x0006)    |
      |  ANSWER Serial = 2             |
      |                                |
      | [remove]                       |
      |  ANSWER Name = sec.example.com |
      |  ANSWER Type = SOA (0x0006)    |
      |  ANSWER Serial = 1             |
      |                                |
      |  ANSWER Name = CL2.sec.example.com|
      |  ANSWER Type = A (0x0001)      |
      |  ANSWER Address = 192.168.0.21 |
      |                                |
      | [add]                          |
      |  ANSWER Name = sec.example.com |
      |  ANSWER Type = SOA (0x0006)    |
      |  ANSWER Serial = 2             |
      |                                |
      |  ANSWER Name = CL2.sec.example.com|
      |  ANSWER Type = A (0x0001)      |
      |  ANSWER Address = 192.168.0.22 |
      |                                |
      |  ANSWER Name = sec.example.com |
      |  ANSWER Type = SOA (0x0006)    |
      |  ANSWER Serial = 2             |
      |                                |
      v                                v

This test sequence is following.
  1. DNS Server2 (TN) sends standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY
  Name = sec.example.com, Type = SOA, serial = 1 using UDP.
  2. DNS Server1 (NUT) transmits standard query response with QNAME = sec.example.com, Type = IXFR,
  including 'sec.example.com SOA serial=2', 'sec.example.com SOA serial=1', 'CL2.sec.example.com A
  192.168.0.21',
  'sec.example.com SOA serial=2', 'CL2.sec.example.com A 192.168.0.22',
  and 'sec.example.com SOA serial=2' in Answer section to DNS Server2 (TN). (Judgment *2)
```

Packet Description

1st packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	1
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
UDP Header	Src Port	53
	Dst Port	2000

DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	4
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	*IXFR (0x00FB)*
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS1.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*1*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS1.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*2*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.22
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS1.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*2*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec

- Termination
  None

Judgment

2. DNS Server1 (NUT) transmits standard query response with QNAME = sec.example.com, Type = IXFR, including 'sec.example.com SOA serial=2', 'sec.example.com SOA serial=1', 'CL2.sec.example.com A 192.168.0.21', 'sec.example.com SOA serial=2', 'CL2.sec.example.com A 192.168.0.22', and 'sec.example.com SOA serial=2' in Answer section to DNS Server2 (TN).

References

RFC1995 Incremental Zone Transfer in DNS
2. Brief Description of the Protocol
4. Response Format

5.117. an IXFR server received an IXFR request with an older version number

Purpose

Verify that a NUT sends only the differences required to make that version current

Category

Server (an IXFR server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 34 Topology No.34".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as master server about sec.example.com zone.
  - ✧ slave server is DNS Server2.
  - ✧ Enable incremental zone transfer function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 192.168.0.11; };
        file "master/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 3ffe:501:ffff:100::11; };
        file "master/sec.example.com";
};
```

  Example of sec.example.com zone file:

```
$TTL    86400           ; TTL of 1 day
@ IN SOA NS1.sec.example.com.  root.sec.example.com.  (
        1               ; serial
        3600            ; refresh every 1 hr
        900             ; retry every 15 min
        604800          ; expire after a week
        3600            ; Minimum TTL of a 1 hr
```

```
 )
 ;
         IN      NS      NS1.sec.example.com.
         IN      NS      NS2.sec.example.com.
 NS1     IN      A       192.168.0.10
 NS1     IN      AAAA    3ffe:501:ffff:100::10
 NS2     IN      A       192.168.0.11
 NS2     IN      AAAA    3ffe:501:ffff:100::11
 ;
 CL1     IN      A       192.168.0.20
```

Pre-test Sequence:

Update sec.example.com zone like following on DNS Server1 (NUT)

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.sec.example.com.  root.sec.example.com.  (
         2              ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.sec.example.com.
         IN      NS      NS2.sec.example.com.
NS1      IN      A       192.168.0.10
NS1      IN      AAAA    3ffe:501:ffff:100::10
NS2      IN      A       192.168.0.11
NS2      IN      AAAA    3ffe:501:ffff:100::11
;
CL2      IN      A       192.168.0.21
```

Procedure

This test sequence is following.

```
DNS Server1 (NUT)                  DNS Server2 (TN)
      |                                  |
      |<---------------------------------|
      | 1. Standard query                |
      |  QNAME = sec.example.com         |
      |  QTYPE = IXFR (0x00FB)           |
      |  AUTHORITY Name = sec.example.com |
      |  AUTHORITY Type = SOA (0x0006)   |
      |  AUTHORITY Serial = 1            |
      |--------------------------------->|
      | 2. Standard query response       |
      |  QNAME = sec.example.com         |
      |  QTYPE = IXFR (0x00FB)           |
      |                                  |
      |  ANSWER Name = sec.example.com   |
      |  ANSWER Type = SOA (0x0006)      |
      |  ANSWER Serial = 2               |
      |                                  |
      |  ANSWER Name = sec.example.com   |
      |  ANSWER Type = SOA (0x0006)      |
      |  ANSWER Serial = 1               |
      |                                  |
      |  ANSWER Name = CL1.sec.example.com|
      |  ANSWER Type = A (0x0001)        |
      |  ANSWER Address = 192.168.0.20   |
      |                                  |
      |  ANSWER Name = sec.example.com   |
      |  ANSWER Type = SOA (0x0006)      |
      |  ANSWER Serial = 2               |
      |                                  |
      |  ANSWER Name = CL2.sec.example.com|
      |  ANSWER Type = A (0x0001)        |
      |  ANSWER Address = 192.168.0.21   |
      |                                  |
      |  ANSWER Name = sec.example.com   |
      |  ANSWER Type = SOA (0x0006)      |
      |  ANSWER Serial = 2               |
      v                                  v

This test sequence is following.
  1. DNS Server2 (TN) sends standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY
  Name = sec.example.com, Type = SOA,  serial = 1 using UDP.
  2. DNS Server1 (NUT) transmits standard query response with QNAME = sec.example.com, Type = IXFR,
  including 'sec.example.com SOA serial=2', 'sec.example.com SOA serial=1', 'CL1.sec.example.com A
  192.168.0.20',  'sec.example.com  SOA  serial=2',  'CL2.sec.example.com  A  192.168.0.21',  and
  'sec.example.com SOA serial=2' in Answer section to DNS Server2 (TN). (Judgment *2)
```

Packet Description

1st packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETZ
	Destination Address	NUT_NETZ

UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0x0033)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*1*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0

	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	6
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	***IXFR (0x00FB)***
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	***2***
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC02D)
	RNAME	root.sec.example.com (root + Pointer 0xC033)
	SERIAL	***1***
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec
DNS Answer section	NAME	CL1.sec.example.com (CL1 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.20
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)

	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC02D)
	RNAME	root.sec.example.com (root + Pointer 0xC033)
	SERIAL	*2*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC02D)
	RNAME	root.sec.example.com (root + Pointer 0xC033)
	SERIAL	*2*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec

- **Termination**

  None

Judgment

2. DNS Server1 (NUT) transmits standard query response with QNAME = sec.example.com, Type = IXFR, including 'sec.example.com SOA serial=2', 'sec.example.com SOA serial=1', 'CL1.sec.example.com A 192.168.0.20', 'sec.example.com SOA serial=2', 'CL2.sec.example.com A 192.168.0.21', and 'sec.example.com SOA serial=2' in Answer section to DNS Server2 (TN).

References

RFC1995 Incremental Zone Transfer in DNS

2. Brief Description of the Protocol
4. Response Format

5.118. an IXFR server received an IXFR request with a same version number

Purpose

Verify that a NUT sends only reply to with a single SOA record of the server's current version

Category

Server (an IXFR server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 34 Topology No.34".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as master server about sec.example.com zone.
  - ✧ slave server is DNS Server2.
  - ✧ Enable incremental zone transfer function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 192.168.0.11; };
        file "master/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 3ffe:501:ffff:100::11; };
        file "master/sec.example.com";
};
```

  Example of sec.example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.sec.example.com.  root.sec.example.com.  (
         1                ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
```

```
        3600            ; Minimum TTL of a 1 hr
)
;
        IN      NS      NS1.sec.example.com.
        IN      NS      NS2.sec.example.com.
NS1     IN      A       192.168.0.10
NS1     IN      AAAA    3ffe:501:ffff:100::10
NS2     IN      A       192.168.0.11
NS2     IN      AAAA    3ffe:501:ffff:100::11
;
CL1     IN      A       192.168.0.20
```

Pre-test Sequence:

Update sec.example.com zone like following on DNS Server1 (NUT)

```
$TTL    86400           ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
        2               ; serial
        3600            ; refresh every 1 hr
        900             ; retry every 15 min
        604800          ; expire after a week
        3600            ; Minimum TTL of a 1 hr
)
;
        IN      NS      NS1.sec.example.com.
        IN      NS      NS2.sec.example.com.
NS1     IN      A       192.168.0.10
NS1     IN      AAAA    3ffe:501:ffff:100::10
NS2     IN      A       192.168.0.11
NS2     IN      AAAA    3ffe:501:ffff:100::11
;
CL2     IN      A       192.168.0.21
```

Procedure

This test sequence is following.

```
DNS Server1 (NUT)                    DNS Server2 (TN)
      |                                     |
      |<------------------------------------|
      | 1. Standard query                   |
      |  QNAME = sec.example.com            |
      |  QTYPE = IXFR (0x00FB)              |
      |  AUTHORITY Name = sec.example.com   |
      |  AUTHORITY Type = SOA (0x0006)      |
      |  AUTHORITY Serial = 2               |
      |------------------------------------>|
      | 2. Standard query response          |
      |  QNAME = sec.example.com            |
      |  QTYPE = IXFR (0x00FB)              |
      |                                     |
      |  ANSWER Name = sec.example.com      |
      |  ANSWER Type = SOA (0x0006)         |
      |  ANSWER Serial = 2                  |
      |                                     |
      |  ANSWER Name = sec.example.com      |
      |  ANSWER Type = NS (0x0002)          |
      |  ANSWER Nsdname = NS1.sec.example.com |
      |                                     |
      |  ANSWER Name = sec.example.com      |
      |  ANSWER Type = NS (0x0002)          |
      |  ANSWER Nsdname = NS2.sec.example.com |
      |                                     |
      |  ANSWER Name = NS1.sec.example.com  |
      |  ANSWER Type = A (0x0001)           |
      |  ANSWER Address = 192.168.0.10      |
      |                                     |
      |  ANSWER Name = NS1.sec.example.com  |
      |  ANSWER Type = AAAA (0x001C)        |
      |  ANSWER Address = 3ffe:501:ffff:100::10|
      |                                     |
      |  ANSWER Name = NS2.sec.example.com  |
      |  ANSWER Type = A (0x0001)           |
      |  ANSWER Address = 192.168.0.11      |
      |                                     |
      |  ANSWER Name = NS2.sec.example.com  |
      |  ANSWER Type = AAAA (0x001C)        |
      |  ANSWER Address = 3ffe:501:ffff:100::11|
      |                                     |
      |  ANSWER Name = CL2.sec.example.com  |
      |  ANSWER Type = A (0x0001)           |
      |  ANSWER Address = 192.168.0.21      |
      |                                     |
      v                                     v
```

```
This test sequence is following.
1. DNS Server2 (TN) sends standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY
   Name = sec.example.com, Type = SOA, serial = 2 using UDP.
2. DNS Server1 (NUT) transmits standard query response with QNAME = sec.example.com, Type = IXFR,
  including 'sec.example.com SOA serial=2',
  'sec.example.com NS NS1.sec.example.com',
  'sec.example.com NS NS2.sec.example.com',
  'NS1.sec.example.com A 192.168.0.10',
  'NS1.sec.example.com AAAA 3ffe:501:ffff:100::10',
  'NS2.sec.example.com A 192.168.0.11',
  'NS2.sec.example.com AAAA 3ffe:501:ffff:100::11',
  and
  'CL2.sec.example.com A 192.168.0.21',
  in Answer section to DNS Server2 (TN). (Judgment *2)
```

Packet Description

1st packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0x0033)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)

	SERIAL	*2*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	6
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	*IXFR (0x00FB)*
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	2
	NSDNAME	NS1.sec.example.com (Pointer 0xC02D)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS2.sec.example.com (NS2 + Pointer 0xC00C)
DNS Answer section	NAME	NS1.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Answer section	NAME	NS1.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x0001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	3ffe:501:ffff:100::10
DNS Answer section	NAME	NS2.sec.example.com (Pointer 0xC068)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.11
DNS Answer section	NAME	NS2.sec.example.com (Pointer 0xC068)
	TYPE	AAAA (0x0001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	3ffe:501:ffff:100::11
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.21

- **Termination**
  None

Judgment

2. DNS Server1 (NUT) transmits standard query response with QNAME = sec.example.com, Type = IXFR, including 'sec.example.com SOA serial=2', 'sec.example.com NS NS1.sec.example.com', 'sec.example.com NS NS2.sec.example.com', 'NS1.sec.example.com A 192.168.0.10', 'NS1.sec.example.com AAAA 3ffe:501:ffff:100::10', 'NS2.sec.example.com A 192.168.0.11', 'NS2.sec.example.com AAAA 3ffe:501:ffff:100::11', and 'CL2.sec.example.com A 192.168.0.21', in Answer section to DNS Server2 (TN).

References

RFC1995 Incremental Zone Transfer in DNS
2. Brief Description of the Protocol
4. Response Format

5.119. an IXFR server received an IXFR request with a newer version number

Purpose

Verify that a NUT sends only reply to with a single SOA record of the server's current version

Category

Server (an IXFR server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 34 Topology No.34".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as master server about sec.example.com zone.
  - ✧ slave server is DNS Server2.
  - ✧ Enable incremental zone transfer function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 192.168.0.11; };
        file "master/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 3ffe:501:ffff:100::11; };
        file "master/sec.example.com";
};
```

  Example of sec.example.com zone file:

```
$TTL    86400           ; TTL of 1 day
@ IN SOA NS1.sec.example.com.  root.sec.example.com.  (
        1               ; serial
        3600            ; refresh every 1 hr
        900             ; retry every 15 min
        604800          ; expire after a week
```

```
        3600            ; Minimum TTL of a 1 hr
 )
 ;
        IN      NS      NS1.sec.example.com.
        IN      NS      NS2.sec.example.com.
 NS1    IN      A       192.168.0.10
 NS1    IN      AAAA    3ffe:501:ffff:100::10
 NS2    IN      A       192.168.0.11
 NS2    IN      AAAA    3ffe:501:ffff:100::11
 ;
 CL1    IN      A       192.168.0.20
```

Pre-test Sequence:

Update sec.example.com zone like following on DNS Server1 (NUT)

```
$TTL    86400           ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
        2               ; serial
        3600            ; refresh every 1 hr
        900             ; retry every 15 min
        604800          ; expire after a week
        3600            ; Minimum TTL of a 1 hr
 )
 ;
        IN      NS      NS1.sec.example.com.
        IN      NS      NS2.sec.example.com.
 NS1    IN      A       192.168.0.10
 NS1    IN      AAAA    3ffe:501:ffff:100::10
 NS2    IN      A       192.168.0.11
 NS2    IN      AAAA    3ffe:501:ffff:100::11
 ;
 CL2    IN      A       192.168.0.21
```

Procedure

This test sequence is following.

```
DNS Server1 (NUT)                    DNS Server2 (TN)
      |                                      |
      |<-------------------------------------|
      | 1. Standard query                    |
      |  QNAME = sec.example.com             |
      |  QTYPE = IXFR (0x00FB)               |
      |  AUTHORITY Name = sec.example.com    |
      |  AUTHORITY Type = SOA (0x0006)       |
      |  AUTHORITY Serial = 3                |
      |------------------------------------->|
      | 2. Standard query response           |
      |  QNAME = sec.example.com             |
      |  QTYPE = IXFR (0x00FB)               |
      |                                      |
      |  ANSWER Name = sec.example.com       |
      |  ANSWER Type = SOA (0x0006)          |
      |  ANSWER Serial = 2                   |
      |                                      |
      |  ANSWER Name = sec.example.com       |
      |  ANSWER Type = NS (0x0002)           |
      |  ANSWER Nsdname = NS1.sec.example.com |
      |                                      |
      |  ANSWER Name = sec.example.com       |
      |  ANSWER Type = NS (0x0002)           |
      |  ANSWER Nsdname = NS2.sec.example.com |
      |                                      |
      |  ANSWER Name = NS1.sec.example.com   |
      |  ANSWER Type = A (0x0001)            |
      |  ANSWER Address = 192.168.0.10       |
      |                                      |
      |  ANSWER Name = NS1.sec.example.com   |
      |  ANSWER Type = AAAA (0x001C)         |
      |  ANSWER Address = 3ffe:501:ffff:100::10|
      |                                      |
      |  ANSWER Name = NS2.sec.example.com   |
      |  ANSWER Type = A (0x0001)            |
      |  ANSWER Address = 192.168.0.11       |
      |                                      |
      |  ANSWER Name = NS2.sec.example.com   |
      |  ANSWER Type = AAAA (0x001C)         |
      |  ANSWER Address = 3ffe:501:ffff:100::11|
      |                                      |
      |  ANSWER Name = CL2.sec.example.com   |
      |  ANSWER Type = A (0x0001)            |
      |  ANSWER Address = 192.168.0.21       |
      |                                      |
      v                                      v
```

```
This test sequence is following.

1. DNS Server2 (TN) sends standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY
   Name = sec.example.com, Type = SOA, serial = 2 using UDP.
2. DNS Server1 (NUT) transmits standard query response with QNAME = sec.example.com, Type = IXFR,
   including 'sec.example.com SOA serial=2',
   'sec.example.com NS NS1.sec.example.com',
   'sec.example.com NS NS2.sec.example.com',
   'NS1.sec.example.com A 192.168.0.10',
   'NS1.sec.example.com AAAA 3ffe:501:ffff:100::10',
   'NS2.sec.example.com A 192.168.0.11',
   'NS2.sec.example.com AAAA 3ffe:501:ffff:100::11',
   and
   'CL2.sec.example.com A 192.168.0.21',
   in Answer section to DNS Server2 (TN). (Judgment *2)
```

Packet Description

1st packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0x0033)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)

	SERIAL	*3*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	6
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	*IXFR (0x00FB)*
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	2
	NSDNAME	NS1.sec.example.com (Pointer 0xC02D)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS2.sec.example.com (NS2 + Pointer 0xC00C)
DNS Answer section	NAME	NS1.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Answer section	NAME	NS1.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x0001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	3ffe:501:ffff:100::10
DNS Answer section	NAME	NS2.sec.example.com (Pointer 0xC05A)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.11
DNS Answer section	NAME	NS2.sec.example.com (Pointer 0xC05A)
	TYPE	AAAA (0x0001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	3ffe:501:ffff:100::11
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.21

- **Termination**
  None

Judgment

2. DNS Server1 (NUT) transmits standard query response with QNAME = sec.example.com, Type = IXFR, including 'sec.example.com SOA serial=2',
   'sec.example.com NS NS1.sec.example.com',
   'sec.example.com NS NS2.sec.example.com',
   'NS1.sec.example.com A 192.168.0.10',
   'NS1.sec.example.com AAAA 3ffe:501:ffff:100::10',
   'NS2.sec.example.com A 192.168.0.11',
   'NS2.sec.example.com AAAA 3ffe:501:ffff:100::11',
   and
   'CL2.sec.example.com A 192.168.0.21', in Answer section to DNS Server2 (TN).

References

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5.120. an IXFR server sends a single SOA record of the server's current version, if the UDP reply does not fit in a single DNS packet

Purpose

Verify that a NUT sends only the differences required to make that version current.

- If an IXFR query is via UDP, the IXFR server may attempt to reply using UDP if the entire response can be contained in a single DNS packet.
- If the UDP reply does not fit, the query is responded to with a single SOA record of the server's current version to inform the client that a TCP query should be initiated.

Category

Server (an IXFR server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 34 Topology No.34".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as master server about sec.example.com zone.
  - ✧ slave server is DNS Server2.
  - ✧ Enable incremental zone transfer function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 192.168.0.11; };
        file "master/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 3ffe:501:ffff:100::11; };
        file "master/sec.example.com";
};
```

Example of sec.example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.sec.example.com.  root.sec.example.com.  (
         1                ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.sec.example.com.
         IN      NS       NS2.sec.example.com.
NS1      IN      A        192.168.0.10
NS1      IN      AAAA     3ffe:501:ffff:100::10
NS2      IN      A        192.168.0.11
NS2      IN      AAAA     3ffe:501:ffff:100::11
```

Pre-test Sequence:

Update sec.example.com zone like following on DNS Server1 (NUT)

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.sec.example.com.  root.sec.example.com.  (
         2                ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.sec.example.com.
         IN      NS       NS2.sec.example.com.
NS1      IN      A        192.168.0.10
NS1      IN      AAAA     3ffe:501:ffff:100::10
NS2      IN      A        192.168.0.11
NS2      IN      AAAA     3ffe:501:ffff:100::11
;
CL1      IN      AAAA     3ffe:501:ffff:100::20
CL2      IN      AAAA     3ffe:501:ffff:100::21
CL3      IN      AAAA     3ffe:501:ffff:100::22
CL4      IN      AAAA     3ffe:501:ffff:100::23
CL5      IN      AAAA     3ffe:501:ffff:100::24
CL6      IN      AAAA     3ffe:501:ffff:100::25
CL7      IN      AAAA     3ffe:501:ffff:100::26
```

```
CL8      IN      AAAA     3ffe:501:ffff:100::27
CL9      IN      AAAA     3ffe:501:ffff:100::28
CL10     IN      AAAA     3ffe:501:ffff:100::29
CL11     IN      AAAA     3ffe:501:ffff:100::2a
CL12     IN      AAAA     3ffe:501:ffff:100::2b
CL13     IN      AAAA     3ffe:501:ffff:100::2c
CL14     IN      AAAA     3ffe:501:ffff:100::2d
CL15     IN      AAAA     3ffe:501:ffff:100::2e
CL16     IN      AAAA     3ffe:501:ffff:100::2f
```

Procedure

This test sequence is following.

```
DNS Server1 (NUT)                        DNS Server2 (TN)
      |                                        |
      |<---------------------------------------|
      | 1. Standard query                      |
      |    (in UDP)                            |
      |  QNAME = sec.example.com               |
      |  QTYPE = IXFR (0x00FB)                 |
      |                                        |
      |  AUTHORITY Name = sec.example.com      |
      |  AUTHORITY Type = SOA (0x0006)         |
      |  AUTHORITY Serial = 1                  |
      |--------------------------------------->|
      | 2. Standard query response             |
      |    (in UDP)                            |
      |  QNAME = sec.example.com               |
      |  QTYPE = IXFR (0x00FB)                 |
      |                                        |
      |  ANSWER Name = sec.example.com         |
      |  ANSWER Type = SOA (0x0006)            |
      |  ANSWER Serial = 2                     |
      |<---------------------------------------|
      | 3. Standard query                      |
      |    (in TCP)                            |
      |  QNAME = sec.example.com               |
      |  QTYPE = IXFR (0x00FB)                 |
      |                                        |
      |  AUTHORITY Name = sec.example.com      |
      |  AUTHORITY Type = SOA (0x0006)         |
      |  AUTHORITY Serial = 1                  |
```

```
|---------------------------------------->|
| 4. Standard query response               |
|    (in TCP)                              |
|  QNAME = sec.example.com                 |
|  QTYPE = IXFR (0x00FB)                   |
|                                          |
|  ANSWER Name = sec.example.com           |
|  ANSWER Type = SOA (0x0006)              |
|  ANSWER Serial = 2                       |
|                                          |
| [remove]                                 |
|  ANSWER Name = sec.example.com           |
|  ANSWER Type = SOA (0x0006)              |
|  ANSWER Serial = 1                       |
|                                          |
| [add]                                    |
|  ANSWER Name = sec.example.com           |
|  ANSWER Type = SOA (0x0006)              |
|  ANSWER Serial = 2                       |
|                                          |
|  ANSWER Name = CL1.sec.example.com       |
|  ANSWER Type = AAAA (0x001C)             |
|  ANSWER Address = 3ffe:501:ffff:100::20  |
|                                          |
|  ANSWER Name = CL2.sec.example.com       |
|  ANSWER Type = AAAA (0x001C)             |
|  ANSWER Address = 3ffe:501:ffff:100::21  |
|                                          |
|  ANSWER Name = CL3.sec.example.com       |
|  ANSWER Type = AAAA (0x001C)             |
|  ANSWER Address = 3ffe:501:ffff:100::22  |
|                                          |
|  ANSWER Name = CL4.sec.example.com       |
|  ANSWER Type = AAAA (0x001C)             |
|  ANSWER Address = 3ffe:501:ffff:100::23  |
|                                          |
|  ANSWER Name = CL5.sec.example.com       |
|  ANSWER Type = AAAA (0x001C)             |
|  ANSWER Address = 3ffe:501:ffff:100::24  |
|                                          |
|  ANSWER Name = CL6.sec.example.com       |
|  ANSWER Type = AAAA (0x001C)             |
|  ANSWER Address = 3ffe:501:ffff:100::25  |
|                                          |
|  ANSWER Name = CL7.sec.example.com       |
|  ANSWER Type = AAAA (0x001C)             |
|  ANSWER Address = 3ffe:501:ffff:100::26  |
|                                          |
|  ANSWER Name = CL8.sec.example.com       |
|  ANSWER Type = AAAA (0x001C)             |
|  ANSWER Address = 3ffe:501:ffff:100::27  |
|                                          |
|  ANSWER Name = CL9.sec.example.com       |
|  ANSWER Type = AAAA (0x001C)             |
|  ANSWER Address = 3ffe:501:ffff:100::28  |
|                                          |
|  ANSWER Name = CL10.sec.example.com      |
|  ANSWER Type = AAAA (0x001C)             |
|  ANSWER Address = 3ffe:501:ffff:100::29  |
|                                          |
```

```
      |                                        |
      |  ANSWER Name = CL11.sec.example.com    |
      |  ANSWER Type = AAAA (0x001C)           |
      |  ANSWER Address = 3ffe:501:ffff:100::2a |
      |                                        |
      |  ANSWER Name = CL12.sec.example.com    |
      |  ANSWER Type = AAAA (0x001C)           |
      |  ANSWER Address = 3ffe:501:ffff:100::2b |
      |                                        |
      |  ANSWER Name = CL13.sec.example.com    |
      |  ANSWER Type = AAAA (0x001C)           |
      |  ANSWER Address = 3ffe:501:ffff:100::2c |
      |                                        |
      |  ANSWER Name = CL14.sec.example.com    |
      |  ANSWER Type = AAAA (0x001C)           |
      |  ANSWER Address = 3ffe:501:ffff:100::2d |
      |                                        |
      |  ANSWER Name = CL15.sec.example.com    |
      |  ANSWER Type = AAAA (0x001C)           |
      |  ANSWER Address = 3ffe:501:ffff:100::2e |
      |                                        |
      |  ANSWER Name = CL16.sec.example.com    |
      |  ANSWER Type = AAAA (0x001C)           |
      |  ANSWER Address = 3ffe:501:ffff:100::2f |
      |                                        |
      |  ANSWER Name = sec.example.com         |
      |  ANSWER Type = SOA (0x0006)            |
      |  ANSWER Serial = 2                     |
      v                                        v
```

This test sequence is following.

1. DNS Server2 (TN) sends standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY Name = sec.example.com, Type = SOA, serial = 1 using UDP.
2. DNS Server1 (NUT) transmits standard query response with QNAME = sec.example.com, Type = IXFR, including 'sec.example.com SOA serial=2' in Answer section using UDP to DNS Server2 (TN). (Judgment *2)
3. DNS Server2 (TN) sends standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY Name = sec.example.com, Type = SOA, serial = 1 using TCP.
4. DNS Server1 (NUT) transmits standard query response with QNAME = sec.example.com,Type =IXFR, including 'sec.example.com SOA serial=2',

'sec.example.com SOA serial=1',
'sec.example.com SOA serial=2',
'CL1.sec.example.com AAAA 3ffe:501:ffff:100::20',
'CL2.sec.example.com AAAA 3ffe:501:ffff:100::21',
'CL3.sec.example.com AAAA 3ffe:501:ffff:100::22',
'CL4.sec.example.com AAAA 3ffe:501:ffff:100::23',
'CL5.sec.example.com AAAA 3ffe:501:ffff:100::24',
'CL6.sec.example.com AAAA 3ffe:501:ffff:100::25',
'CL7.sec.example.com AAAA 3ffe:501:ffff:100::26',
'CL8.sec.example.com AAAA 3ffe:501:ffff:100::27',
'CL9.sec.example.com AAAA 3ffe:501:ffff:100::28',
'CL10.sec.example.com AAAA 3ffe:501:ffff:100::29',
'CL11.sec.example.com AAAA 3ffe:501:ffff:100::2a',
'CL12.sec.example.com AAAA 3ffe:501:ffff:100::2b',
'CL13.sec.example.com AAAA 3ffe:501:ffff:100::2c',
'CL14.sec.example.com AAAA 3ffe:501:ffff:100::2d',
'CL15.sec.example.com AAAA 3ffe:501:ffff:100::2e',
'CL16.sec.example.com AAAA 3ffe:501:ffff:100::2f',
and 'sec.example.com SOA serial=2' in Answer section using TCP to DNS Server2 (TN). (Judgment *4)

Packet Description

1st packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0x0033)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	1
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
UDP Header	Src Port	53
	Dst Port	2000

DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	4
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	*IXFR (0x00FB)*
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETZ
	Destination Address	NUT_NETZ
TCP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0x0033)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*1*
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec

4th packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
TCP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	4
	NSCOUNT	0
	ARCOUNT	0
DNS Question	QNAME	sec.example.com

section	**QTYPE**	***IXFR (0x00FB)***
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	***2***
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC02D)
	RNAME	root.sec.example.com (root + Pointer 0xC033)
	SERIAL	***1***
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS1.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	***2***
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec
DNS Answer section	NAME	CL1.sec.example.com (CL1 + Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::20
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::21
DNS Answer section	NAME	CL3.sec.example.com (CL3 + Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::22
DNS Answer section	NAME	CL4.sec.example.com (CL4 + Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::23
DNS Answer section	NAME	CL5.sec.example.com (CL5 + Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::24
DNS Answer section	NAME	CL6.sec.example.com (CL6 + Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::25
DNS Answer section	NAME	CL7.sec.example.com (CL7 + Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::26
DNS Answer section	NAME	CL8.sec.example.com (CL8 + Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::27
DNS Answer section	NAME	CL9.sec.example.com (CL9 + Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::28
DNS Answer section	NAME	CL10.sec.example.com (CL10 + Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::29
DNS Answer section	NAME	CL11.sec.example.com (CL11 + Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::2a
DNS Answer section	NAME	CL12.sec.example.com (CL12 + Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::2b
DNS Answer section	NAME	CL13.sec.example.com (CL13 + Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::2c
DNS Answer section	NAME	CL14.sec.example.com (CL14 + Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::2d
DNS Answer section	NAME	CL15.sec.example.com (CL15 + Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::2e
DNS Answer section	NAME	CL16.sec.example.com (CL16 + Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::2f
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS1.sec.example.com (NS1 + Pointer 0xC02D)
	RNAME	root.sec.example.com (root + Pointer 0xC033)
	SERIAL	***2***
	REFRESH	3600sec
	RETRY	900sec
	EXPIRE	604800sec
	MINIMUM	3600sec

- **Termination**
  None

Judgment

2. DNS Server1 (NUT) transmits standard query response with QNAME = sec.example.com, Type = IXFR, including 'sec.example.com SOA serial=2' in Answer section using UDP to DNS Server2 (TN).
4. DNS Server1 (NUT) transmits standard query response with QNAME = sec.example.com, Type = IXFR, including 'sec.example.com SOA serial=2',
   'sec.example.com SOA serial=1',
   'sec.example.com SOA serial=2',
   'CL1.sec.example.com AAAA 3ffe:501:ffff:100::20',
   'CL2.sec.example.com AAAA 3ffe:501:ffff:100::21',
   'CL3.sec.example.com AAAA 3ffe:501:ffff:100::22',
   'CL4.sec.example.com AAAA 3ffe:501:ffff:100::23',
   'CL5.sec.example.com AAAA 3ffe:501:ffff:100::24',
   'CL6.sec.example.com AAAA 3ffe:501:ffff:100::25',
   'CL7.sec.example.com AAAA 3ffe:501:ffff:100::26',
   'CL8.sec.example.com AAAA 3ffe:501:ffff:100::27',
   'CL9.sec.example.com AAAA 3ffe:501:ffff:100::28',
   'CL10.sec.example.com AAAA 3ffe:501:ffff:100::29',
   'CL11.sec.example.com AAAA 3ffe:501:ffff:100::2a',

'CL12.sec.example.com AAAA 3ffe:501:ffff:100::2b',
'CL13.sec.example.com AAAA 3ffe:501:ffff:100::2c',
'CL14.sec.example.com AAAA 3ffe:501:ffff:100::2d',
'CL15.sec.example.com AAAA 3ffe:501:ffff:100::2e',
'CL16.sec.example.com AAAA 3ffe:501:ffff:100::2f',
and 'sec.example.com SOA serial=2' in Answer section using TCP to DNS Server2 (TN).

References

RFC1995 Incremental Zone Transfer in DNS
2. Brief Description of the Protocol
4. Response Format

5.121. an IXFR client sends an IXFR message (remove/add/change, condense)

Purpose

Verify that a NUT sends an IXFR message to get a new information about zone.

- If an IXFR client, which likely has an older version of a zone, thinks it needs new information about the zone through SOA refresh timeout, it sends an IXFR message containing the SOA serial number of its, presumably outdated, copy of the zone.
- The query type value of IXFR assigned by IANA is 251.
- The IXFR query packet format is the same as that of a normal DNS query, but with the query type being IXFR and the authority section containing the SOA record of client's version of the zone.

Category

Server (an IXFR client)

Initialization

- **Network Topology**
  Refer the topology "Fig. 33 Topology No.33".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable incremental zone transfer function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type slave;
        masters {192.168.0.31;};
        file "s/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type slave;
        masters {3ffe:501:ffff:100::31;};
        file "s/sec.example.com";
};
```

Transferred sec.example.com zone information:

```
$TTL     6400    ; TTL of 1 day
@ IN SOA NS7.sec.example.com.  root.sec.example.com.  (
         1       ; serial
         180     ; refresh every 3 min
         30      ; retry every 30 sec
         360     ; expire after 6 min
         30      ; Minimum TTL of 30 sec
)
;
         IN      NS       NS7.sec.example.com.
         IN      NS       NS1.sec.example.com.
NS7      IN      A        192.168.0.31
         IN      AAAA     3ffe:501:ffff:100::31
NS1      IN      A        192.168.0.10
         IN      AAAA     3ffe:501:ffff:100::10
;
CL1      IN      A        192.168.0.20
CL2      IN      A        192.168.0.21
```

Pre-test Sequence:

After all zone information are transferred between primary DNS server7 (TN) and slave DNS server1 (NUT), following pre-test sequence is performed.

```
DNS Client1 (TN)                DNS Server1 (NUT)         DNS Server7 (TN)
     |                                 |                         |
     |--------------------------------->|                         |
     | 1. Send standard query           |                         |
     |  QNAME = CL2.sec.example.com     |                         |
     |  QTYPE = A                       |                         |
     |<---------------------------------|                         |
     | 2. Standard query response       |                         |
     |  QNAME = CL2.sec.example.com     |                         |
     |  QTYPE = A                       |                         |
     |  ANSWER Name = CL2.sec.example.com|                        |
     |  ANSWER Type = A (0x0001)        |                         |
     |  ANSWER Address = 192.168.0.21   |                         |
     |                                  |                         |
     v                                  v                         v
```

Procedure

This test sequence is following.

NOTE: SOA's parameter and $TTL are same as above sec.example.com zone information. TN includes NS7 and NS1.sub.example.com into Authority as type = NS. Also TN includes NS7 and NS1.sub.example.com address into

Additional section. Thus NUT may reply to answer client with Authority and Additional section including those values.

```
DNS Client1 (TN)            DNS Server1 (NUT)             DNS Server7 (TN)
     |                            |                            |
     |                            |  Before SOA  refresh (180sec)|
     |                            |  timeout expired             |
     |                            |----------------------------->|
     |                            | 1. Standard query            |
     |                            |  QNAME = sec.example.com     |
     |                            |  QTYPE = SOA (0x0006)        |
     |                            |<-----------------------------|
     |                            | 2. Standard query response   |
     |                            |  QNAME = sec.example.com     |
     |                            |  QTYPE = SOA (0x0006)        |
     |                            |  ANSWER Name =sec.example.com|
     |                            |  ANSWER Type = SOA (0x0006)  |
     |                            |  ANSWER Serial = 3           |
     |                            |----------------------------->|
     |                            | 3. Standard query            |
     |                            |  QNAME = sec.example.com     |
     |                            |  QTYPE = IXFR (0x00FB)       |
     |                            |  AUTHORITY Name = sec.example.com|
     |                            |  AUTHORITY Type = SOA(0x0006)|
     |                            |  AUTHORITY Serial = 1        |
     |                            |<-----------------------------|
     |                            | 4. Standard query response   |
     |                            |  add new record              |
     |                            |  QNAME = sec.example.com     |
     |                            |  QTYPE = IXFR (0x00FB)       |
     |                            |                              |
     |                            |  ANSWER Name =sec.example.com|
     |                            |  ANSWER Type = SOA (0x0006)  |
     |                            |  ANSWER Serial = 3           |
     |                            |                              |
     |                            |  [remove]                    |
     |                            |  ANSWER Name =sec.example.com|
     |                            |  ANSWER Type = SOA (0x0006)  |
     |                            |  ANSWER Serial = 1           |
     |                            |                              |
     |                            |  ANSWER Name = CL2.sec.example.com|
     |                            |  ANSWER Type = A (0x0001)    |
     |                            |  ANSWER Address =192.168.0.21|
     |                            |                              |
     |                            |  [add]                       |
     |                            |  ANSWER Name =sec.example.com|
     |                            |  ANSWER Type = SOA (0x0006)  |
     |                            |  ANSWER Serial = 3           |
     |                            |                              |
     |                            |  ANSWER Name = CL2.sec.example.com|
     |                            |  ANSWER Type = A (0x0001)    |
     |                            |  ANSWER Address =192.168.0.23|
     |                            |                              |
     |                            |  ANSWER Name =sec.example.com|
     |                            |  ANSWER Type = SOA (0x0006)  |
     |                            |  ANSWER Serial = 3           |
```

```
        |----------------------------->|                              |
        | 5. Send standard query       |                              |
        |  QNAME = CL2.sec.example.com |                              |
        |  QTYPE = A                   |                              |
        |<-----------------------------|                              |
        | 6. Standard query response   |                              |
        |  QNAME = CL2.sec.example.com |                              |
        |  QTYPE = A                   |                              |
        |  ANSWER Name = CL2.sec.example.com|                         |
        |  ANSWER Type = A (0x0001)    |                              |
        |  ANSWER Address =192.168.0.23|                              |
        |                              |                              |
        v                              v                              v
```

This test sequence is following.

1. After SOA refresh time expired, DNS Server1 (NUT) transmits standard query QNAME=sec.example.com, Type = SOA to DNS Server7 (TN).(Judgment *1)
2. DNS Server7 (TN) sends standard query response with SOA Serial = 3 to DNS Server1 (NUT).
3. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY Name = sec.example.com, Type = SOA Serial = 1 to DNS Server7 (TN). (Judgment *3)
4. DNS Server7 (TN) sends standard query response including only difference RRs previous one to DNS Server1 (NUT). Its difference is that CL2.sec.example.com's record is removed, and CL2.sec.example.com's record is added again. After that, CL2.sec.example.com's record is changed. But this message is condensed.
5. DNS Client1 (TN) sends standard query QNAME = CL2.sec.example.com to DNS Server1 (NUT).
6. DNS Server1 (NUT) transmits standard query response ANSWER Address = 192.168.0.23 to DNS Client1 (TN). (Judgment *6)

Packet Description

1st packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0

DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	2
	ARCOUNT	4
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*3*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec

	RDLENGTH	2
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

3rd packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0

	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	>=1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	*IXFR (0x00FB)*
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*1*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

4th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	5
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	IXFR (0x00FB)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*3*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*1*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	24
	MNAME	NS7.sec.example.com (Pointer 0xC02D)

	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*3*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Answer section	NAME	CL2.sec.example.com (CL2 + Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.23
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (Pointer 0xC02D)
	RNAME	root.sec.example.com (Pointer 0xC033)
	SERIAL	*3*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

5th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x2000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x2000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	*ANY*
	ARCOUNT	*ANY*
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	CL2.sec.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.23
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC010)
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)

	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	6
	NSDNAME	NS7.sec.example.com (NS7 + Pointer 0xC010)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC041)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC041)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC053)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC053)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

- **Termination**
  None

Judgment

1. Received standard query with Type=SOA after SOA refresh time expired.
3. Received standard query with Type=IXFR serial=1.
6. Received standard query response QNAME=CL2.sec.example.com and Answer address 192.168.0.23.

References

RFC1995 Incremental Zone Transfer in DNS
2. Brief Description of the Protocol
3. Query Format

5.122. an IXFR client sends an IXFR message through NOTIFY mechanism

Purpose

Verify that a NUT sends an IXFR message to get new information about zone.

- If an IXFR client, which likely has an older version of a zone, thinks it needs new information about the zone through the NOTIFY mechanism, it sends an IXFR message containing the SOA serial number of its, presumably outdated, copy of the zone.
- The query type value of IXFR assigned by IANA is 251.
- The IXFR query packet format is the same as that of a normal DNS query, but with the query type being IXFR and the authority section containing the SOA record of client's version of the zone.

Category

Server (an IXFR client)

Initialization

- **Network Topology**
  Refer the topology "Fig. 33 Topology No.33".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable incremental zone transfer function.
  - ✧ Enable Notify mechanism function.

  Example of DNS server configuration on DNS Server1 (NUT):

  - ✧ For IPv4 transport

```
zone "sec.example.com" {
        type slave;
        masters {192.168.0.31;};
        file "s/sec.example.com";
};
```

  - ✧ For IPv6 transport

```
zone "sec.example.com" {
        type slave;
        masters {3ffe:501:ffff:100::31;};
        file "s/sec.example.com";
};
```

Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS7.sec.example.com.  root.sec.example.com.  (
         1       ; serial
         180     ; refresh every 3 min
         30      ; retry every 30 sec
         360     ; expire after 6 min
         30      ; Minimum TTL of 30 sec
)
;
         IN      NS       NS7.sec.example.com.
         IN      NS       NS1.sec.example.com.
         IN      MX       10       NS7
NS7      IN      A        192.168.0.31
         IN      AAAA     3ffe:501:ffff:100::31
NS1      IN      A        192.168.0.10
         IN      AAAA     3ffe:501:ffff:100::10
;
CL1      IN      A        192.168.0.20
CL2      IN      A        192.168.0.21
```

Pre-test Sequence:

After all zone information are transferred between primary DNS server7 (TN) and slave DNS server1 (NUT), following pre-test sequence is performed.

```
DNS Client1 (TN)                DNS Server1 (NUT)          DNS Server7 (TN)
     |                                |                          |
     |-------------------------------->|                          |
     | 1. Send standard query          |                          |
     |  RD bit = 0                     |                          |
     |  QNAME = CL2.sec.example.com    |                          |
     |  QTYPE = A                      |                          |
     |<--------------------------------|                          |
     | 2. Standard query response      |                          |
     |  AA bit = 0                     |                          |
     |  RD bit = 0                     |                          |
     |  RA bit = 1                     |                          |
     |  QNAME = CL2.sec.example.com    |                          |
     |  QTYPE = A                      |                          |
     |  ANSWER Name=CL2.sec.example.com|                          |
     |  ANSWER Type = A (0x0001)       |                          |
     |  ANSWER Address =192.168.0.21   |                          |
     |                                 |                          |
     v                                 v                          v
```

Procedure

This test sequence is following.

NOTE: SOA's parameter and TTL are same as above sec.example.com zone information. TN includes NS7 and NS1.sub.example.com into Authority section as type = NS. Also TN includes NS7 and NS1.sub.example.com address into Additional section. Thus NUT may reply to answer client with Authority and Additional section including those values.

```
DNS Client1 (TN)            DNS Server1 (NUT)             DNS Server7 (TN)
     |                             |                             |
     |                             |                             |
     |                             |<----------------------------|
     |                             | 1. A NOTIFY request         |
     |                             |  OPCODE = NOTIFY (4)        |
     |                             |  QNAME = sec.example.com    |
     |                             |  QTYPE = SOA (0x0006)       |
     |                             |  ANSWER Name =sec.example.com|
     |                             |  ANSWER Type = SOA (0x0006)  |
     |                             |  ANSWER Serial = 2          |
     |                             |---------------------------->|
     |                             | 2. A NOTIFY response        |
     |                             |  OPCODE = NOTIFY (4)        |
     |                             |  QNAME = sec.example.com    |
     |                             |  QTYPE = SOA (0x0006)       |
     |                             |---------------------------->|
     |                             | 3. Standard query           |
     |                             |  QNAME = sec.example.com    |
     |                             |  QTYPE = SOA (0x0006)       |
     |                             |<----------------------------|
     |                             | 4. Standard query response  |
     |                             |  QNAME = sec.example.com    |
     |                             |  QTYPE = SOA (0x0006)       |
     |                             |  ANSWER Name =sec.example.com|
     |                             |  ANSWER Type = SOA (0x0006)  |
     |                             |  ANSWER Serial = 2          |
     |                             |---------------------------->|
     |                             | 5. Standard query           |
     |                             |  QNAME = sec.example.com    |
     |                             |  QTYPE = IXFR (0x00FB)      |
     |                             |  AUTHORITY Name             |
     |                             |       = sec.example.com     |
     |                             |  AUTHORITY Type =SOA (0x0006)|
     |                             |  AUTHORITY Serial = 1       |
     |                             |                             |
     v                             v                             v

This test sequence is following.
1. DNS Server7 (TN) sends a NOTIFY request with Answer type SOA, serial = 2 to DNS Server1 (NUT).
2. DNS Server1 (NUT) transmits a NOTIFY response
   with QNAME = sec.example.com, Type = SOA to DNS Server7 (TN). (Judgment *1)
3. DNS Server1 (NUT) transmits standard query
   QNAME = sec.example.com, Type = SOA to DNS Server7 (TN). (Judgment *2)
4. DNS Server7 (TN) sends standard query response with SOA serial = 2 to DNS Server1 (NUT).
5. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = IXFR, including AUTHORITY
   Name = sec.example.com, Type = SOA serial = 1 to DNS Server7 (TN). (Judgment *3)
```

Packet Description

1st packet.

A NOTIFY request from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	4
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

2nd packet.

A NOTIFY response from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	53
	Dst Port	1000

DNS Header	ID	0x1000
	QR	1
	OPCODE	***4***
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

3rd packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	2
	ARCOUNT	4
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)

	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

5th packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
TCP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	>=1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	***IXFR (0x00FB)***
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	***1***
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

- Termination
  None

Judgment

2. Received a NOTIFY response with OPCODE=NOTIFY(4).
3. Received standard query with Type=SOA after a NOTIFY response received.
5. Received standard query with Type=IXFR serial=1 using TCP.

References

RFC1995 Incremental Zone Transfer in DNS
2. Brief Description of the Protocol
3. Query Format
4. Response Format

5.123. a master ignores message if fields are not to be filled with binary zero(0)

Purpose

If UDP is used, a master periodically sends a NOTIFY request to a slave until either too many copies have been sent (a "timeout"), an ICMP message indicating that the port is unreachable, or until a NOTIFY response is received from the slave with a matching query ID, QNAME, IP source address, and UDP source port number.

The interval between transmissions, and the total number of retransmissions, should be operational parameters specifiable by the name server administrator, perhaps on a per-zone basis.
Reasonable defaults are a 60 second interval (or timeout if using TCP), and a maximum of 5 retransmissions (for UDP). It is considered reasonable to use additive or exponential backoff for the retry interval.

Category

Server (AXFR/IXFR server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 34 Topology No.34".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable zone transfer function.
  - ✧ Enable Notify mechanism function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 192.168.0.30; };
        also-notify    { 192.168.0.30; };
        file "master/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 3ffe:501:ffff:100::30; };
```

```
          also-notify    { 3ffe:501:ffff:100::30; };
          file "master/sec.example.com";
  };
```

Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS1.sec.example.com.  root.sec.example.com.  (
         1       ; serial
         180     ; refresh every 3 min
         30      ; retry every 30 sec
         360     ; expire after 6 min
         30      ; Minimum TTL of 30 sec
)
;
         IN      NS       NS1.sec.example.com.
         IN      NS       NS2.sec.example.com.
NS1      IN      A        192.168.0.10
         IN      AAAA     3ffe:501:ffff:100::10
NS2      IN      A        192.168.0.30
         IN      AAAA     3ffe:501:ffff:100::30
;
CL1      IN      A        192.168.0.20
```

Pre-test Sequence:

Update sec.example.com zone like following on DNS Server1 (NUT)

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS1.sec.example.com.  root.sec.example.com.  (
         2       ; serial
         3600    ; refresh every 1 hr
         900     ; retry every 15 min
         604800  ; expire after a week
         3600    ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.sec.example.com.
         IN      NS       NS2.sec.example.com.
NS1      IN      A        192.168.0.10
NS1      IN      AAAA     3ffe:501:ffff:100::10
NS2      IN      A        192.168.0.30
NS2      IN      AAAA     3ffe:501:ffff:100::30
;
CL1      IN      A        192.168.0.20
CL2      IN      A        192.168.0.21
```

Procedure

This test sequence is following.

```
     DNS Server1 (NUT)            DNS Server2 (TN)
         |                                |
         |------------------------------>|
         | 1. NOTIFY requests (in UDP)  |
         |  ID = X                       |
         |  QR = 0                       |
         |  OPCODE = NOTIFY (4)          |
         |  QDCOUNT >  0                 |
         |  ANCOUNT >= 0                 |
         |  NSCOUNT >= 0                 |
         |  ARCOUNT >= 0                 |
         |  QNAME = sec.example.com      |
         |  QTYPE = SOA (0x0006)         |
         |<------------------------------|
         | 2. A NOTIFY response (in UDP)|
         |  ID = X                       |
         |  QR = 1                       |
         |  OPCODE = NOTIFY (4)          |
         |  AA = 1                       |
         |  TC = 1                       |
         |  RD = 1                       |
         |  RA = 1                       |
         |  Z = 7                        |
         |  RCODE = 15                   |
         |  QNAME = sec.example.com      |
         |  QTYPE = SOA (0x0006)         |
         |------------------------------>|
         | 3. no response                |
         |    for 60 seconds             |
         v                               v
   This test sequence is following.
   1. DNS Server1 (NUT) sends a NOTIFY request with ID=X to DNS Server2 (TN). (Judgment *3)
   2. DNS Server2 (TN) sends a NOTIFY response with ID=X to DNS Server1 (NUT).
   3. DNS Server1 (NUT) doesn't sends a NOTIFY request to DNS Server2 (TN) for 60 seconds. (Judgment *5)
```

Packet Description

1st packet.

A NOTIFY request from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	4
	AA	1
	TC	0
	RD	0
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	>=0
	NSCOUNT	>=0
	ARCOUNT	>=0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

A NOTIFY request from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	same as Src Port of 1st packet
DNS Header	ID	same value as 3rd packet
	QR	1
	OPCODE	4
	AA	1
	TC	1
	RD	1
	RA	1
	Z	7
	RCODE	15
	QDCOUNT	1
	ANCOUNT	>=0
	NSCOUNT	>=0
	ARCOUNT	>=0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

1. DNS Server1 (NUT) sends a NOTIFY request to DNS Server2 (TN).
3. DNS Server1 (NUT) doesn't sends a NOTIFY request to DNS Server2 (TN) for 60 seconds.

References

RFC1996 DNS NOTIFY
3. NOTIFY Message

5.124. a slave ignores message if fields are not to be filled with binary zero(0)

Purpose

Verify that a NUT sends a NOTIFY response back to the NOTIFY request's source.

NOTIFY is similar to QUERY in that it has a request message with the header QR flag "clear" and a response message with QR "set". The response message contains no useful information, but its reception by the master is an indication that the slave has received the NOTIFY and that the master can remove the slave from any retry queue for this NOTIFY event.

Category

Server (an IXFR client)

Initialization

- **Network Topology**
  Refer the topology "Fig. 33 Topology No.33".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable incremental zone transfer function.
  - ✧ Enable Notify mechanism function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type slave;
        masters {192.168.0.31;};
        file "s/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type slave;
        masters {3ffe:501:ffff:100::31;};
        file "s/sec.example.com";
};
```

  Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
```

```
@ IN SOA NS7.sec.example.com. root.sec.example.com. (
         1       ; serial
         180     ; refresh every 3 min
         30      ; retry every 30 sec
         360     ; expire after 6 min
         30      ; Minimum TTL of 30 sec
)
;
         IN      NS      NS7.sec.example.com.
         IN      NS      NS1.sec.example.com.
         IN      MX      10   NS7
NS7      IN      A       192.168.0.31
         IN      AAAA    3ffe:501:ffff:100::31
NS1      IN      A       192.168.0.10
         IN      AAAA    3ffe:501:ffff:100::10
;
CL1      IN      A       192.168.0.20
CL2      IN      A       192.168.0.21
```

Pre-test Sequence:

After all zone information are transferred between primary DNS server7 (TN) and slave DNS server1 (NUT), following pre-test sequence is performed.

```
DNS Client1 (TN)            DNS Server1 (NUT)           DNS Server7 (TN)
     |                                  |                       |
     |----------------------------------->|                       |
     | 1. Send standard query           |                       |
     |  RD bit = 0                      |                       |
     |  QNAME = CL2.sec.example.com     |                       |
     |  QTYPE = A                       |                       |
     |                                  |                       |
     |<-----------------------------------|                       |
     | 2. Standard query response       |                       |
     |  AA bit = 0                      |                       |
     |  RD bit = 0                      |                       |
     |  RA bit = 1                      |                       |
     |  QNAME = CL2.sec.example.com     |                       |
     |  QTYPE = A                       |                       |
     |  ANSWER Name = CL2.sec.example.com |                       |
     |  ANSWER Type = A (0x0001)        |                       |
     |  ANSWER Address = 192.168.0.21   |                       |
     |                                  |                       |
     v                                  v                       v
```

Procedure

This test sequence is following.

NOTE: SOA's parameter and $TTL are same as above sec.example.com zone information. TN includes NS7 and NS1.sub.example.com into Authority section as type = NS. Also TN includes NS7 and NS1.sub.example.com address into Additional section. Thus NUT may reply to answer client with Authority and Additional section including those values.

```
DNS Client1 (TN)            DNS Server1 (NUT)             DNS Server7 (TN)
     |                             |                              |
     |                             |<-----------------------------|
     |                             | 1. A NOTIFY request          |
     |                             |  OPCODE = NOTIFY (4)         |
     |                             |  AA = 1                      |
     |                             |  TC = 1                      |
     |                             |  RD = 1                      |
     |                             |  RA = 1                      |
     |                             |  Z = 7                       |
     |                             |  RCODE = 15                  |
     |                             |  QNAME = sec.example.com     |
     |                             |  QTYPE = SOA (0x0006)        |
     |                             |----------------------------->|
     |                             | 2. A NOTIFY response         |
     |                             |  OPCODE = NOTIFY (4)         |
     |                             |  QNAME = sec.example.com     |
     |                             |  QTYPE = SOA (0x0006)        |
     |                             |                              |
     v                             v                              v

This test sequence is following.
  1. DNS Server7 (TN) sends NOTIFY request to DNS Server1 (NUT).
  2. DNS Server1 (NUT) sends NOTIFY request to DNS Server7 (TN). (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	4
	AA	1
	TC	1
	RD	1
	RA	1

	Z	7
	RCODE	15
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	4
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. DNS Server1 (NUT) sends NOTIFY request to DNS Server7 (TN).

References

RFC1996 DNS NOTIFY
3. NOTIFY Message

5.125. Slave server sends a NOTIFY response back to the NOTIFY request's source

Purpose

Verify that a NUT sends a NOTIFY response back to the NOTIFY request's source. NOTIFY is similar to QUERY in that it has a request message with the header QR flag "clear" and a response message with QR "set". The response message contains no useful information, but its reception by the master is an indication that the slave has received the NOTIFY and that the master can remove the slave from any retry queue for this NOTIFY event.

Category

Server (an IXFR client)

Initialization

- **Network Topology**
  Refer the topology "Fig. 33 Topology No.33".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable incremental zone transfer function.
  - ✧ Enable Notify mechanism function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type slave;
        masters {192.168.0.31;};
        file "s/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type slave;
        masters {3ffe:501:ffff:100::31;};
        file "s/sec.example.com";
};
```

  Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS7.sec.example.com.  root.sec.example.com.  (
```

```
        1       ; serial
        180     ; refresh every 3 min
        30      ; retry every 30 sec
        360     ; expire after 6 min
        30      ; Minimum TTL of 30 sec
)
;
        IN      NS      NS7.sec.example.com.
        IN      NS      NS1.sec.example.com.
        IN      MX      10        NS7
NS7     IN      A       192.168.0.31
        IN      AAAA    3ffe:501:ffff:100::31
NS1     IN      A       192.168.0.10
        IN      AAAA    3ffe:501:ffff:100::10
;
CL1     IN      A       192.168.0.20
CL2     IN      A       192.168.0.21
```

Pre-test Sequence:

After all zone information are transferred between primary DNS server7 (TN) and slave DNS server1 (NUT), following pre-test sequence is performed.

```
DNS Client1 (TN)                DNS Server1 (NUT)         DNS Server7 (TN)
     |                                |                         |
     |------------------------------->|                         |
     | 1. Send standard query         |                         |
     |  RD bit = 0                    |                         |
     |  QNAME = CL2.sec.example.com   |                         |
     |  QTYPE = A                     |                         |
     |<-------------------------------|                         |
     | 2. Standard query response     |                         |
     |  AA bit = 0                    |                         |
     |  RD bit = 0                    |                         |
     |  RA bit = 1                    |                         |
     |  QNAME = CL2.sec.example.com   |                         |
     |  QTYPE = A                     |                         |
     |  ANSWER Name=CL2.sec.example.com|                        |
     |  ANSWER Type = A (0x0001)      |                         |
     |  ANSWER Address = 192.168.0.21 |                         |
     |                                |                         |
     v                                v                         v
```

Procedure

This test sequence is following.

NOTE: SOA's parameter and $TTL are same as above sec.example.com zone information. TN includes NS7 and NS1.sub.example.com into Authority

section as type = NS. Also TN includes NS7 and NS1.sub.example.com address into Additional section. Thus NUT may reply to answer client with Authority and Additional section including those values.

```
DNS Client1 (TN)            DNS Server1 (NUT)             DNS Server7 (TN)
      |                            |                             |
      |                            |<----------------------------|
      |                            | 1. A NOTIFY request         |
      |                            |  OPCODE = NOTIFY (4)        |
      |                            |  QNAME = sec.example.com    |
      |                            |  QTYPE = SOA (0x0006)       |
      |                            |---------------------------->|
      |                            | 2. A NOTIFY response        |
      |                            |  OPCODE = NOTIFY (4)        |
      |                            |  QNAME = sec.example.com    |
      |                            |  QTYPE = SOA (0x0006)       |
      |                            |                             |
      v                            v                             v

This test sequence is following.
1. DNS Server7 (TN) sends NOTIFY request to DNS Server1 (NUT).
2. DNS Server1 (NUT) sends NOTIFY request to DNS Server7 (TN).(Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	4
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	4
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

- Termination
  None

Judgment

2. DNS Server1 (NUT) sends NOTIFY request to DNS Server7 (TN).

References

RFC1996 DNS NOTIFY
3. NOTIFY Message

5.126. Master server sends a NOTIFY query

Purpose

Verify that a NUT sends NOTIFY message

When a master has updated one or more RRs in which slave servers may be interested, the master may send the changed RR's name, class, type, and optionally, new RDATA(s), to each known slave server using a best efforts protocol based on the NOTIFY opcode.

Category

Server (AXFR/IXFR server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 34 Topology No.34".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable zone transfer function.
  - ✧ Enable Notify mechanism function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 192.168.0.30; };
        also-notify    { 192.168.0.30; };
        file "master/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 3ffe:501:ffff:100::30; };
        also-notify    { 3ffe:501:ffff:100::30; };
        file "master/sec.example.com";
};
```

  Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
```

```
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
         1       ; serial
         180     ; refresh every 3 min
         30      ; retry every 30 sec
         360     ; expire after 6 min
         30      ; Minimum TTL of 30 sec
)
;
         IN      NS      NS1.sec.example.com.
         IN      NS      NS2.sec.example.com.
NS1      IN      A       192.168.0.10
         IN      AAAA    3ffe:501:ffff:100::10
NS2      IN      A       192.168.0.30
         IN      AAAA    3ffe:501:ffff:100::30
;
CL1      IN      A       192.168.0.20
```

Pre-test Sequence:

Update sec.example.com zone like following on DNS Server1 (NUT)

```
TTL      86400   ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
         2       ; serial
         3600    ; refresh every 1 hr
         900     ; retry every 15 min
         604800  ; expire after a week
         3600    ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.sec.example.com.
         IN      NS      NS2.sec.example.com.
NS1      IN      A       192.168.0.10
NS1      IN      AAAA    3ffe:501:ffff:100::10
NS2      IN      A       192.168.0.30
NS2      IN      AAAA    3ffe:501:ffff:100::30
;
CL1      IN      A       192.168.0.20
CL2      IN      A       192.168.0.21
```

Procedure

This test sequence is following.

```
DNS Server1 (NUT)           DNS Server2 (TN)
    |                             |
    |----------------------------->|
    | 1. A NOTIFY request         |
    |    (in TCP|UDP)             |
    |                             |
    |  QR = 0                     |
    |  OPCODE = NOTIFY (4)        |
    |  QDCOUNT >  0               |
    |  ANCOUNT >= 0               |
    |  NSCOUNT >= 0               |
    |  ARCOUNT >= 0               |
    |  QNAME = sec.example.com    |
    |  QTYPE = SOA (0x0006)       |
    |                             |
    v                             v

This test sequence is following.
1. DNS Server1 (NUT) sends a NOTIFY request DNS Server2 (TN). (Judgment *1)
```

Packet Description

1st packet.

A NOTIFY request from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
TCP|UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	4
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	>=0
	NSCOUNT	>=0
	ARCOUNT	>=0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

1. DNS Server1 (NUT) sends a NOTIFY request DNS Server2 (TN).

References

RFC1996 DNS NOTIFY
3. NOTIFY Message

5.127. a master continue to offer name service during the NOTIFY transaction

Purpose

If TCP is used, both master and slave must continue to offer name service during the transaction, even when the TCP transaction is not making progress. The NOTIFY request is sent once, and a "timeout" is said to have occurred if no NOTIFY response is received within a reasonable interval.

The interval between transmissions, and the total number of retransmissions, should be operational parameters specifiable by the name server administrator, perhaps on a per-zone basis. Reasonable defaults are a 60 second interval (or timeout if using TCP), and a maximum of 5 retransmissions (for UDP). It is considered reasonable to use additive or exponential backoff for the retry interval.

Category

Server (AXFR/IXFR server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 34 Topology No.34".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable zone transfer function.
  - ✧ Enable Notify mechanism function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 192.168.0.30; };
        also-notify    { 192.168.0.30; };
        file "master/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 3ffe:501:ffff:100::30; };
        also-notify    { 3ffe:501:ffff:100::30; };
```

```
          file "master/sec.example.com";
};
```

Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
         1       ; serial
         180     ; refresh every 3 min
         30      ; retry every 30 sec
         360     ; expire after 6 min
         30      ; Minimum TTL of 30 sec
)
;
         IN      NS      NS1.sec.example.com.
         IN      NS      NS2.sec.example.com.
NS1      IN      A       192.168.0.10
         IN      AAAA    3ffe:501:ffff:100::10
NS2      IN      A       192.168.0.30
         IN      AAAA    3ffe:501:ffff:100::30
;
CL1      IN      A       192.168.0.20
```

Pre-test Sequence:

Update sec.example.com zone like following on DNS Server1 (NUT)

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
         2       ; serial
         3600    ; refresh every 1 hr
         900     ; retry every 15 min
         604800  ; expire after a week
         3600    ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.sec.example.com.
         IN      NS      NS2.sec.example.com.
NS1      IN      A       192.168.0.10
NS1      IN      AAAA    3ffe:501:ffff:100::10
NS2      IN      A       192.168.0.30
NS2      IN      AAAA    3ffe:501:ffff:100::30
;
CL1      IN      A       192.168.0.20
CL2      IN      A       192.168.0.21
```

Procedure

This test sequence is following.

```
DNS Server1 (NUT)                  DNS Server2 (TN)
    |                                   |
    |----------------------------------->|
    | 1. NOTIFY requests                |
    |    (in TCP)                       |
    |  QR = 0                           |
    |  OPCODE = NOTIFY (4)              |
    |  QDCOUNT >  0                     |
    |  ANCOUNT >= 0                     |
    |  NSCOUNT >= 0                     |
    |  ARCOUNT >= 0                     |
    |  QNAME = sec.example.com          |
    |  QTYPE = SOA (0x0006)             |
    |<-----------------------------------|
    | 2. Send standard query            |
    |  QNAME = CL2.sec.example.com      |
    |  QTYPE = A                        |
    |----------------------------------->|
    | 3. Standard query response        |
    |  QNAME = CL2.sec.example.com      |
    |  QTYPE = A                        |
    |  ANSWER Name = CL2.sec.example.com |
    |  ANSWER Type = A (0x0001)         |
    |  ANSWER Address = 192.168.0.21    |
    |                                   |
    v                                   v

This test sequence is following.
1. DNS Server1 (NUT) sends a NOTIFY request to DNS Server2 (TN).(Judgment *1)
2. DNS Server2 (TN) sends a standard request QNAME=CL2.sec.example.com QTYPE=A to DNS Server1 (TN).
3. DNS Server1 (NUT) sends a standard reply CL2.sec.example.com A 192.168.0.21 to DNS Server2 (TN).
   (Judgment *3)
```

Packet Description

1st packet.

A NOTIFY request from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
TCP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	4
	AA	1
	TC	0
	RD	0
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	>=0
	NSCOUNT	>=0
	ARCOUNT	>=0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

A standard request from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETZ
	Destination Address	NUT_NETZ
TCP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

A standard response from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
TCP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0

	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	2
	ARCOUNT	4
DNS Question section	QNAME	CL2.sec.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	CL2.sec.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.21
DNS Authority section	NAME	sec.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.sec.example.com. (NS1 + Pointer 0xC010)
DNS Authority section	NAME	sec.example.com
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS2.sec.example.com. (NS2 + Pointer 0xC010)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC041)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	NSDNAME	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC041)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16

	NSDNAME	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS2.sec.example.com (Pointer 0xC053)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	NSDNAME	192.168.0.30
DNS Additional section	NAME	NS2.sec.example.com (Pointer 0xC053)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	3ffe:501:ffff:100::30

- **Termination**
  None

Judgment

1. DNS Server1 (NUT) sends a NOTIFY request to DNS Server2 (TN).
3. DNS Server1 (NUT) sends a standard reply CL2.sec.example.com A 192.168.0.21 to DNS Server2 (TN).

References

RFC1996 DNS NOTIFY
3. NOTIFY Message

5.128. a slave sends a once a NOTIFY request until timeout

Purpose

If TCP is used, both master and slave must continue to offer name service during the transaction, even when the TCP transaction is not making progress. The NOTIFY request is sent once, and a "timeout" is said to have occurred if no NOTIFY response is received within a reasonable interval.

> The interval between transmissions, and the total number of retransmissions, should be operational parameters specifiable by the name server administrator, perhaps on a per-zone basis. Reasonable defaults are a 60 second interval (or timeout if using TCP), and a maximum of 5 retransmissions (for UDP). It is considered reasonable to use additive or exponential backoff for the retry interval.

Category

Server (AXFR/IXFR server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 34 Topology No.34".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable zone transfer function.
  - ✧ Enable Notify mechanism function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 192.168.0.30; };
        also-notify    { 192.168.0.30; };
        file "master/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 3ffe:501:ffff:100::30; };
        also-notify    { 3ffe:501:ffff:100::30; };
```

```
          file "master/sec.example.com";
};
```

Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
         1       ; serial
         180     ; refresh every 3 min
         30      ; retry every 30 sec
         360     ; expire after 6 min
         30      ; Minimum TTL of 30 sec
)
;
         IN      NS      NS1.sec.example.com.
         IN      NS      NS2.sec.example.com.
NS1      IN      A       192.168.0.10
         IN      AAAA    3ffe:501:ffff:100::10
NS2      IN      A       192.168.0.30
         IN      AAAA    3ffe:501:ffff:100::30
;
CL1      IN      A       192.168.0.20
```

Pre-test Sequence:

Update sec.example.com zone like following on DNS Server1 (NUT)

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
         2       ; serial
         3600    ; refresh every 1 hr
         900     ; retry every 15 min
         604800  ; expire after a week
         3600    ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.sec.example.com.
         IN      NS      NS2.sec.example.com.
NS1      IN      A       192.168.0.10
NS1      IN      AAAA    3ffe:501:ffff:100::10
NS2      IN      A       192.168.0.30
NS2      IN      AAAA    3ffe:501:ffff:100::30
;
CL1      IN      A       192.168.0.20
CL2      IN      A       192.168.0.21
```

Procedure

This test sequence is following.

```
    DNS Server1 (NUT)            DNS Server2 (TN)
        |                             |
        |----------------------------->|
        | 1. NOTIFY requests           |
        |    (in TCP)                  |
        |  QR = 0                      |
        |  OPCODE = NOTIFY (4)         |
        |  QDCOUNT >  0                |
        |  ANCOUNT >= 0                |
        |  NSCOUNT >= 0                |
        |  ARCOUNT >= 0                |
        |  QNAME = sec.example.com     |
        |  QTYPE = SOA (0x0006)        |
        |----------------------------->|
        | 2. no response               |
        |    for 60 seconds            |
        |                              |
        v                              v

 This test sequence is following.
 1. DNS Server1 (NUT) sends a NOTIFY request to DNS Server2 (TN). (Judgment *1)
 2. DNS Server1 (NUT) doesn't sends a NOTIFY request to DNS Server2 (TN) for 60 seconds. (Judgment *2)
```

Packet Description

1st packet.

A NOTIFY request from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
TCP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	4
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	>=0
	NSCOUNT	>=0
	ARCOUNT	>=0
DNS Question section	QNAME	sec.example.com

	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

1. DNS Server1 (NUT) sends a NOTIFY request to DNS Server2 (TN).
2. DNS Server1 (NUT) doesn't sends a NOTIFY request to DNS Server2 (TN) for 60 seconds.

References

RFC1996 DNS NOTIFY
3. NOTIFY Message

5.129. a master periodically sends a NOTIFY request to a slave until timeout

Purpose

If UDP is used, a master periodically sends a NOTIFY request to a slave until either too many copies have been sent (a "timeout"), an ICMP message indicating that the port is unreachable, or until a NOTIFY response is received from the slave with a matching query ID, QNAME, IP source address, and UDP source port number.

The interval between transmissions, and the total number of retransmissions, should be operational parameters specifiable by the name server administrator, perhaps on a per-zone basis.
Reasonable defaults are a 60 second interval (or timeout if using TCP), and a maximum of 5 retransmissions (for UDP). It is considered reasonable to use additive or exponential backoff for the retry interval.

Category

Server (AXFR/IXFR server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 34 Topology No.34".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable zone transfer function.
  - ✧ Enable Notify mechanism function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 192.168.0.30; };
        also-notify    { 192.168.0.30; };
        file "master/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
    type master;
    allow-transfer { 3ffe:501:ffff:100::30; };
```

```
      also-notify    { 3ffe:501:ffff:100::30; };
      file "master/sec.example.com";
};
```

Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
         1       ; serial
         180     ; refresh every 3 min
         30      ; retry every 30 sec
         360     ; expire after 6 min
         30      ; Minimum TTL of 30 sec
)
;
         IN      NS      NS1.sec.example.com.
         IN      NS      NS2.sec.example.com.
NS1      IN      A       192.168.0.10
         IN      AAAA    3ffe:501:ffff:100::10
NS2      IN      A       192.168.0.30
         IN      AAAA    3ffe:501:ffff:100::30
;
CL1      IN      A       192.168.0.20
```

Pre-test Sequence:

Update sec.example.com zone like following on DNS Server1 (NUT)

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
         2       ; serial
         3600    ; refresh every 1 hr
         900     ; retry every 15 min
         604800  ; expire after a week
         3600    ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.sec.example.com.
         IN      NS      NS2.sec.example.com.
NS1      IN      A       192.168.0.10
NS1      IN      AAAA    3ffe:501:ffff:100::10
NS2      IN      A       192.168.0.30
NS2      IN      AAAA    3ffe:501:ffff:100::30
;
CL1      IN      A       192.168.0.20
CL2      IN      A       192.168.0.21
```

Procedure

This test sequence is following.

```
DNS Server1 (NUT)            DNS Server2 (TN)
    |                              |
    |------------------------------>|
    |------------------------------>|
    |------------------------------>|
    |------------------------------>|
    |------------------------------>|
    | 1. 5 NOTIFY requests         |
    |    every 60 seconds          |
    |    (in UDP)                  |
    |  QR = 0                      |
    |  OPCODE = NOTIFY (4)         |
    |  QDCOUNT >  0                |
    |  ANCOUNT >= 0                |
    |  NSCOUNT >= 0                |
    |  ARCOUNT >= 0                |
    |  QNAME = sec.example.com     |
    |  QTYPE = SOA (0x0006)        |
    |                              |
    v                              v

This test sequence is following.
1. DNS Server1 (NUT) sends a NOTIFY request 5 times to DNS Server2 (TN) every 60 seconds. (Judgment *1)
```

Packet Description

1st packet.

A NOTIFY request from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	4
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	>=0
	NSCOUNT	>=0
	ARCOUNT	>=0

DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

1. DNS Server1 (NUT) sends a NOTIFY request 5 times to DNS Server2 (TN) every 60 seconds.

References

RFC1996 DNS NOTIFY
3. NOTIFY Message

5.130. a master periodically sends a NOTIFY request to a slave until ICMP message indicating

Purpose

If UDP is used, a master periodically sends a NOTIFY request to a slave until either too many copies have been sent (a "timeout"), an ICMP message indicating that the port is unreachable, or until a NOTIFY response is received from the slave with a matching query ID, QNAME, IP source address, and UDP source port number.

The interval between transmissions, and the total number of retransmissions, should be operational parameters specifiable by the name server administrator, perhaps on a per-zone basis. Reasonable defaults are a 60 second interval (or timeout if using TCP), and a maximum of 5 retransmissions (for UDP). It is considered reasonable to use additive or exponential backoff for the retry interval.

Category

Server (AXFR/IXFR server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 34 Topology No.34".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable zone transfer function.
  - ✧ Enable Notify mechanism function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 192.168.0.30; };
        also-notify    { 192.168.0.30; };
        file "master/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 3ffe:501:ffff:100::30; };
```

```
        also-notify    { 3ffe:501:ffff:100::30; };
        file "master/sec.example.com";
};
```

Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
         1       ; serial
         180     ; refresh every 3 min
         30      ; retry every 30 sec
         360     ; expire after 6 min
         30      ; Minimum TTL of 30 sec
)
;
         IN      NS      NS1.sec.example.com.
         IN      NS      NS2.sec.example.com.
NS1      IN      A       192.168.0.10
         IN      AAAA    3ffe:501:ffff:100::10
NS2      IN      A       192.168.0.30
         IN      AAAA    3ffe:501:ffff:100::30
;
CL1      IN      A       192.168.0.20
```

Pre-test Sequence:

Update sec.example.com zone like following on DNS Server1 (NUT)

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
         2       ; serial
         3600    ; refresh every 1 hr
         900     ; retry every 15 min
         604800  ; expire after a week
         3600    ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.sec.example.com.
         IN      NS      NS2.sec.example.com.
NS1      IN      A       192.168.0.10
NS1      IN      AAAA    3ffe:501:ffff:100::10
NS2      IN      A       192.168.0.30
NS2      IN      AAAA    3ffe:501:ffff:100::30
;
CL1      IN      A       192.168.0.20
CL2      IN      A       192.168.0.21
```

Procedure

This test sequence is following.

```
DNS Server1 (NUT)            DNS Server2 (TN)
    |                             |
    |----------------------------->|
    | 1. NOTIFY requests           |
    |    (in UDP)                  |
    |  QR = 0                      |
    |  OPCODE = NOTIFY (4)         |
    |  QDCOUNT >  0                |
    |  ANCOUNT >= 0                |
    |  NSCOUNT >= 0                |
    |  ARCOUNT >= 0                |
    |  QNAME = sec.example.com     |
    |  QTYPE = SOA (0x0006)        |
    |<-----------------------------|
    | 2. ICMP port unreachable     |
    |----------------------------->|
    | 3. no response               |
    |    for 60 seconds            |
    |                              |
    v                              v

This test sequence is following.
1. DNS Server1 (NUT) sends a NOTIFY request to DNS Server2 (TN).(Judgment *1)
2. DNS Server2 (TN) sends a ICMP port unreachable to DNS Server1 (NUT).
3. DNS Server1 (NUT) doesn't sends a NOTIFY request to DNS Server2 (TN) for 60 seconds. (Judgment *3)
```

Packet Description

1st packet.

A NOTIFY request from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	4
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	>=0
	NSCOUNT	>=0

	ARCOUNT	>=0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

ICMP port unreachable from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETZ
	Destination Address	NUT_NETZ
ICMP Header	Type	ICMPv4: 3, ICMPv6: 1
	Code	ICMPv4: 3, ICMPv6: 4
Message Body	contents of 1st packet from IP header	

- **Termination**
  None

Judgment

1. DNS Server1 (NUT) sends a NOTIFY request to DNS Server2 (TN).
3. DNS Server1 (NUT) doesn't sends a NOTIFY request to DNS Server2 (TN) for 60 seconds.

References

RFC1996 DNS NOTIFY
3. NOTIFY Message

5.131. a master periodically sends a NOTIFY request to a slave until a NOTIFY response is received

Purpose

If UDP is used, a master periodically sends a NOTIFY request to a slave until either too many copies have been sent (a "timeout"), an ICMP message indicating that the port is unreachable, or until a NOTIFY response is received from the slave with a matching query ID, QNAME, IP source address, and UDP source port number.

The interval between transmissions, and the total number of retransmissions, should be operational parameters specifiable by the name server administrator, perhaps on a per-zone basis.
Reasonable defaults are a 60 second interval (or timeout if using TCP), and a maximum of 5 retransmissions (for UDP). It is considered reasonable to use additive or exponential backoff for the retry interval.

Category

Server (AXFR/IXFR server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 34 Topology No.34".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable zone transfer function.
  - ✧ Enable Notify mechanism function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 192.168.0.30; };
        also-notify    { 192.168.0.30; };
        file "master/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 3ffe:501:ffff:100::30; };
        also-notify    { 3ffe:501:ffff:100::30; };
```

```
            file "master/sec.example.com";
};
```

Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
         1       ; serial
         180     ; refresh every 3 min
         30      ; retry every 30 sec
         360     ; expire after 6 min
         30      ; Minimum TTL of 30 sec
)
;
         IN      NS      NS1.sec.example.com.
         IN      NS      NS2.sec.example.com.
NS1      IN      A       192.168.0.10
         IN      AAAA    3ffe:501:ffff:100::10
NS2      IN      A       192.168.0.30
         IN      AAAA    3ffe:501:ffff:100::30
;
CL1      IN      A       192.168.0.20
```

Pre-test Sequence:

Update sec.example.com zone like following on DNS Server1 (NUT)

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
         2       ; serial
         3600    ; refresh every 1 hr
         900     ; retry every 15 min
         604800  ; expire after a week
         3600    ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.sec.example.com.
         IN      NS      NS2.sec.example.com.
NS1      IN      A       192.168.0.10
NS1      IN      AAAA    3ffe:501:ffff:100::10
NS2      IN      A       192.168.0.30
NS2      IN      AAAA    3ffe:501:ffff:100::30
;
CL1      IN      A       192.168.0.20
CL2      IN      A       192.168.0.21
```

Procedure

This test sequence is following.

```
DNS Server1 (NUT)           DNS Server2 (TN)
    |                           |
    |---------------------------->|
    | 1. NOTIFY requests          |
    |    (in UDP)                 |
    |  ID = X                     |
    |  QR = 0                     |
    |  OPCODE = NOTIFY (4)        |
    |  QDCOUNT >  0               |
    |  ANCOUNT >= 0               |
    |  NSCOUNT >= 0               |
    |  ARCOUNT >= 0               |
    |  QNAME = sec.example.com    |
    |  QTYPE = SOA (0x0006)       |
    |<----------------------------|
    | 2. A NOTIFY response        |
    |    (in UDP)                 |
    |  ID = Y                     |
    |  QR = 1                     |
    |  OPCODE = NOTIFY (4)        |
    |  QNAME = sec.example.com    |
    |  QTYPE = SOA (0x0006)       |
    |                             |
    |  ===> 60 seconds after <===  |
    |---------------------------->|
    | 3. NOTIFY requests          |
    |    (in UDP)                 |
    |  ID = X                     |
    |  QR = 0                     |
    |  OPCODE = NOTIFY (4)        |
    |  QDCOUNT >  0               |
    |  ANCOUNT >= 0               |
    |  NSCOUNT >= 0               |
    |  ARCOUNT >= 0               |
    |  QNAME = sec.example.com    |
    |  QTYPE = SOA (0x0006)       |
    |<----------------------------|
    | 4. A NOTIFY response        |
    |    (in UDP)                 |
    |  ID = X                     |
    |  QR = 1                     |
    |  OPCODE = NOTIFY (4)        |
    |  QNAME = sec.example.com    |
    |  QTYPE = SOA (0x0006)       |
    |---------------------------->|
    | 5. no response              |
    |    for 60 seconds           |
    v                             v

This test sequence is following.
1. DNS Server1 (NUT) sends a NOTIFY request with ID=X to DNS Server2 (TN). (Judgment *1)
2. DNS Server2 (TN) sends a NOTIFY response with ID=Y to DNS Server1 (NUT).
3. DNS Server1 (NUT) sends a NOTIFY request with ID=X to DNS Server2 (TN). (Judgment *3)
4. DNS Server2 (TN) sends a NOTIFY response with ID=X to DNS Server1 (NUT).
5. DNS Server1 (NUT) doesn't sends a NOTIFY request to DNS Server2 (TN) for 60 seconds. (Judgment *5)
```

Packet Description

1st packet.

A NOTIFY request from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	4
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	>=0
	NSCOUNT	>=0
	ARCOUNT	>=0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

A NOTIFY request from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	same as Src Port of 1st packet
DNS Header	ID	any different value than 1st packet
	QR	1
	OPCODE	4
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	>=0
	NSCOUNT	>=0

	ARCOUNT	>=0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

3rd packet.

A NOTIFY request from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	4
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	>=0
	NSCOUNT	>=0
	ARCOUNT	>=0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

4th packet.

A NOTIFY request from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	same as Src Port of 1st packet
DNS Header	ID	same value as 3rd packet
	QR	1
	OPCODE	4
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	>=0
	NSCOUNT	>=0
	ARCOUNT	>=0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

1. DNS Server1 (NUT) sends a NOTIFY request to DNS Server2 (TN).
3. DNS Server1 (NUT) sends a NOTIFY request to DNS Server2 (TN).
5. DNS Server1 (NUT) doesn't sends a NOTIFY request to DNS Server2 (TN) for 60 seconds.

References

RFC1996 DNS NOTIFY
3. NOTIFY Message

5.132. ANCOUNT=0 and the answer section differs from the slave's local data

Purpose

Verify that a NUT sends an IXFR message to get new information about zone.

If ANCOUNT=0, or ANCOUNT>0 and the answer section differs from the slave's local data, then the slave should query its known masters to retrieve the new data.

Category

Server (an IXFR client)

Initialization

- **Network Topology**
  Refer the topology "Fig. 33 Topology No.33".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable incremental zone transfer function.
  - ✧ Enable Notify mechanism function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type slave;
        masters {192.168.0.31;};
        file "s/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type slave;
        masters {3ffe:501:ffff:100::31;};
        file "s/sec.example.com";
};
```

  Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS7.sec.example.com.  root.sec.example.com.  (
         1       ; serial
         180     ; refresh every 3 min
```

```
        30      ; retry every 30 sec
        360     ; expire after 6 min
        30      ; Minimum TTL of 30 sec
)
;
        IN      NS      NS7.sec.example.com.
        IN      NS      NS1.sec.example.com.
        IN      MX      10   NS7
NS7     IN      A       192.168.0.31
        IN      AAAA    3ffe:501:ffff:100::31
NS1     IN      A       192.168.0.10
        IN      AAAA    3ffe:501:ffff:100::10
;
CL1     IN      A       192.168.0.20
CL2     IN      A       192.168.0.21
```

Pre-test Sequence:

After all zone information are transferred between primary DNS server7 (TN) and slave DNS server1 (NUT), following pre-test sequence is performed.

```
DNS Client1 (TN)                DNS Server1 (NUT)          DNS Server7 (TN)
     |                                  |                          |
     |---------------------------------->|                          |
     | 1. Send standard query            |                          |
     |  RD bit = 0                       |                          |
     |  QNAME = CL2.sec.example.com      |                          |
     |  QTYPE = A                        |                          |
     |<----------------------------------|                          |
     | 2. Standard query response        |                          |
     |  AA bit = 0                       |                          |
     |  RD bit = 0                       |                          |
     |  RA bit = 1                       |                          |
     |  QNAME = CL2.sec.example.com      |                          |
     |  QTYPE = A                        |                          |
     |  ANSWER Name = CL2.sec.example.com|                          |
     |  ANSWER Type = A (0x0001)         |                          |
     |  ANSWER Address = 192.168.0.21    |                          |
     v                                   v                          v
```

Procedure

This test sequence is following.

NOTE: SOA's parameter and $TTL are same as above sec.example.com zone information. TN includes NS7 and NS1.sub.example.com into Authority section as type = NS. Also TN includes NS7 and NS1.sub.example.com address into Additional section. Thus NUT may reply to answer client with Authority and Additional section including those values.

```
DNS Client1 (TN)            DNS Server1 (NUT)             DNS Server7 (TN)
      |                            |                              |
      |                            |<-----------------------------|
      |                            | 1. A NOTIFY request          |
      |                            |  OPCODE = NOTIFY (4)         |
      |                            |  QNAME = sec.example.com     |
      |                            |  QTYPE = SOA (0x0006)        |
      |                            |----------------------------->|
      |                            | 2. A NOTIFY response         |
      |                            |  OPCODE = NOTIFY (4)         |
      |                            |  QNAME = sec.example.com     |
      |                            |  QTYPE = SOA (0x0006)        |
      |                            |----------------------------->|
      |                            | 3. Standard query            |
      |                            |  QNAME = sec.example.com     |
      |                            |  QTYPE = SOA (0x0006)        |
      |                            |  ANSWER Name =sec.example.com|
      |                            |  ANSWER Type = SOA (0x0006)  |
      |                            |  ANSWER Serial = 1           |
      |                            |<-----------------------------|
      |                            | 4. Standard query response   |
      |                            |  QNAME = sec.example.com     |
      |                            |  QTYPE = SOA (0x0006)        |
      |                            |  ANSWER Name =sec.example.com|
      |                            |  ANSWER Type = SOA (0x0006)  |
      |                            |  ANSWER Serial = 2           |
      |                            |----------------------------->|
      |                            | 5. Standard query            |
      |                            |  QNAME = sec.example.com     |
      |                            |  QTYPE = IXFR (0x00FB) or    |
      |                            |          AXFR (0x00FC)       |
      |                            |  AUTHORITY Name = sec.example.com|
      |                            |  AUTHORITY Type =SOA (0x0006)|
      |                            |  AUTHORITY Serial = 1        |
      v                            v                              v

This test sequence is following.
1. DNS Server7 (TN) sends NOTIFY request to DNS Server1 (NUT).
2. DNS Server1 (NUT) sends NOTIFY request to DNS Server7 (TN).(Judgment *2)
3. DNS Server1 (NUT) sends standard query response with SOA serial = 1 to DNS Server7 (TN). (Judgment *3)
4. DNS Server7 (TN) sends standard query response with "sec.example.com SOA serial=2".
5. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = IXFR or AXFR, including
   AUTHORITY Name = sec.example.com, Type = SOA serial = 1 to DNS Server7 (TN). (Judgment *5)
```

Packet Description

1st packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	4
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	4
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

3rd packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	2
	ARCOUNT	4
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec

	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

5th packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	>=1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	***IXFR (0x00FB)***
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33

	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	***1***
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

- **Termination**
  None

Judgment

2. DNS Server1 (NUT) sends NOTIFY request to DNS Server7 (TN).
3. DNS Server1 (NUT) sends standard query response with SOA serial = 1 to DNS Server7 (TN).
5. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = IXFR or AXFR, including AUTHORITY Name = sec.example.com, Type = SOA serial = 1 to DNS Server7 (TN).

References

RFC1996 DNS NOTIFY
3. NOTIFY Message

5.133. ANCOUNT>0 and the answer section differs from the slave's local data

Purpose

Verify that a NUT sends an IXFR message to get new information about zone.

If ANCOUNT=0, or ANCOUNT>0 and the answer section differs from the slave's local data, then the slave should query its known masters to retrieve the new data.

Category

Server (an IXFR client)

Initialization

- **Network Topology**
  Refer the topology "Fig. 33 Topology No.33".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable incremental zone transfer function.
  - ✧ Enable Notify mechanism function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type slave;
        masters {192.168.0.31;};
        file "s/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type slave;
        masters {3ffe:501:ffff:100::31;};
        file "s/sec.example.com";
};
```

  Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS7.sec.example.com.  root.sec.example.com.  (
         1       ; serial
         180     ; refresh every 3 min
```

```
        30      ; retry every 30 sec
        360     ; expire after 6 min
        30      ; Minimum TTL of 30 sec
)
;
        IN      NS      NS7.sec.example.com.
        IN      NS      NS1.sec.example.com.
        IN      MX      10   NS7
NS7     IN      A       192.168.0.31
        IN      AAAA    3ffe:501:ffff:100::31
NS1     IN      A       192.168.0.10
        IN      AAAA    3ffe:501:ffff:100::10
;
CL1     IN      A       192.168.0.20
CL2     IN      A       192.168.0.21
```

Pre-test Sequence:

After all zone information are transferred between primary DNS server7 (TN) and slave DNS server1 (NUT), following pre-test sequence is performed.

```
DNS Client1 (TN)                    DNS Server1 (NUT)       DNS Server7 (TN)
     |                                  |                       |
     |---------------------------------->|                       |
     | 1. Send standard query            |                       |
     |  RD bit = 0                       |                       |
     |  QNAME = CL2.sec.example.com      |                       |
     |  QTYPE = A                        |                       |
     |<----------------------------------|                       |
     | 2. Standard query response        |                       |
     |  AA bit = 0                       |                       |
     |  RD bit = 0                       |                       |
     |  RA bit = 1                       |                       |
     |  QNAME = CL2.sec.example.com      |                       |
     |  QTYPE = A                        |                       |
     |  ANSWER Name = CL2.sec.example.com|                       |
     |  ANSWER Type = A (0x0001)         |                       |
     |  ANSWER Address = 192.168.0.21    |                       |
     |                                   |                       |
     v                                   v                       v
```

Procedure

This test sequence is following.

NOTE: SOA's parameter and $TTL are same as above sec.example.com zone information. TN includes NS7 and NS1.sub.example.com into Authority section as type = NS. Also TN includes NS7 and NS1.sub.example.com address into Additional section. Thus NUT may reply to answer client with Authority and Additional section including those values.

```
    DNS Client1 (TN)             DNS Server1 (NUT)             DNS Server7 (TN)
         |                              |                              |
         |                              |<-----------------------------|
         |                              | 1. A NOTIFY request          |
         |                              |  OPCODE = NOTIFY (4)         |
         |                              |  QNAME = sec.example.com     |
         |                              |  QTYPE = SOA (0x0006)        |
         |                              |  ANSWER Name = sec.example.com|
         |                              |  ANSWER Type = SOA (0x0006)  |
         |                              |  ANSWER Serial = 2           |
         |                              |----------------------------->|
         |                              | 2. A NOTIFY response         |
         |                              |  OPCODE = NOTIFY (4)         |
         |                              |  QNAME = sec.example.com     |
         |                              |  QTYPE = SOA (0x0006)        |
         |                              |----------------------------->|
         |                              | 3. Standard query            |
         |                              |  QNAME = sec.example.com     |
         |                              |  QTYPE = SOA (0x0006)        |
         |                              |  ANSWER Name= sec.example.com|
         |                              |  ANSWER Type = SOA (0x0006)  |
         |                              |  ANSWER Serial = 1           |
         |                              |<-----------------------------|
         |                              | 4. Standard query response   |
         |                              |  QNAME = sec.example.com     |
         |                              |  QTYPE = SOA (0x0006)        |
         |                              |  ANSWER Name= sec.example.com|
         |                              |  ANSWER Type = SOA (0x0006)  |
         |                              |  ANSWER Serial = 2           |
         |                              |----------------------------->|
         |                              | 5. Standard query            |
         |                              |  QNAME = sec.example.com     |
         |                              |  QTYPE = IXFR (0x00FB) or    |
         |                              |          AXFR (0x00FC)       |
         |                              |  AUTHORITY Name              |
         |                              |       = sec.example.com      |
         |                              |  AUTHORITY Type =SOA (0x0006)|
         |                              |  AUTHORITY Serial = 1        |
         |                              |                              |
         v                              v                              v

   This test sequence is following.
   1. DNS Server7 (TN) sends NOTIFY request to DNS Server1 (NUT).
   2. DNS Server1 (NUT) sends NOTIFY request to DNS Server7 (TN). (Judgment *2)
   3. DNS Server1 (NUT) sends standard query response with SOA serial = 1 to DNS Server7 (TN). (Judgment
         *3)
   4. DNS Server7 (TN) sends standard query response with "sec.example.com SOA serial=2".
   5. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = IXFR or AXFR, including
         AUTHORITY Name = sec.example.com, Type = SOA serial = 1 to DNS Server7 (TN). (Judgment *5)
```

Packet Description

1st packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000

	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	4
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

2nd packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	4
	AA	1
	TC	0
	RD	0

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

3rd packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1

	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	2
	ARCOUNT	4
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS1.sec.example.com (NS1 + Pointer 0xC00C)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	2
	NSDNAME	NS7.sec.example.com (Pointer 0xC02D)
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec

	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.sec.example.com (Pointer 0xC05A)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::10
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.0.31
DNS Additional section	NAME	NS7.sec.example.com (Pointer 0xC02D)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:100::31

5th packet.

Standard query from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	>=1
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	***IXFR (0x00FB)***

	QCLASS	IN (0x0001)
DNS Authority section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*1*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

- **Termination**
  None

Judgment

2. DNS Server1 (NUT) sends NOTIFY request to DNS Server7 (TN).
3. DNS Server1 (NUT) sends standard query response with SOA serial = 1 to DNS Server7 (TN).
5. DNS Server1 (NUT) transmits standard query with QNAME = sec.example.com, Type = IXFR or AXFR, including AUTHORITY Name = sec.example.com, Type = SOA serial = 1 to DNS Server7 (TN).

References

RFC1996 DNS NOTIFY
3. NOTIFY Message

5.134. a slave ignores a NOTIFY request from a unknown master for the zone

Purpose

Verify that a NUT ignores NOTIFY request from unknown node.

If a slave receives a NOTIFY request from a host that is not a known master for the zone containing the QNAME, it should ignore the request and produce an error message in its operations log.

Category

Server (an AXFR/IXFR client)

Initialization

- **Network Topology**
  Refer the topology "Fig.35 Topology No.35".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable incremental zone transfer function.
  - ✧ Enable Notify mechanism function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type slave;
        masters {192.168.0.31;};
        file "s/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type slave;
        masters {3ffe:501:ffff:100::31;};
        file "s/sec.example.com";
};
```

  Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS7.sec.example.com. root.sec.example.com. (
         1       ; serial
```

```
        180     ; refresh every 3 min
        30      ; retry every 30 sec
        360     ; expire after 6 min
        30      ; Minimum TTL of 30 sec
)
;
        IN      NS      NS7.sec.example.com.
        IN      NS      NS1.sec.example.com.
        IN      MX      10   NS7
NS7     IN      A       192.168.0.31
        IN      AAAA    3ffe:501:ffff:100::31
NS1     IN      A       192.168.0.10
        IN      AAAA    3ffe:501:ffff:100::10
;
CL1     IN      A       192.168.0.20
CL2     IN      A       192.168.0.21
```

Pre-test Sequence:

After all zone information are transferred between primary DNS server7 (TN) and slave DNS server1 (NUT), following pre-test sequence is performed.

```
DNS Client1 (TN)          DNS Server1 (NUT)  DNS Server7 (TN)  DNS Server8 (TN)
 |                                 |             |             |
 |---------------------------------->|             |             |
 | 1. Send standard query          |             |             |
 |  RD bit = 0                     |             |             |
 |  QNAME = CL2.sec.example.com    |             |             |
 |  QTYPE = A                      |             |             |
 |<----------------------------------|             |             |
 | 2. Standard query response      |             |             |
 |  AA bit = 0                     |             |             |
 |  RD bit = 0                     |             |             |
 |  RA bit = 1                     |             |             |
 |  QNAME = CL2.sec.example.com    |             |             |
 |  QTYPE = A                      |             |             |
 |  ANSWER Name = CL2.sec.example.com|             |             |
 |  ANSWER Type = A (0x0001)       |             |             |
 |  ANSWER Address =192.168.0.21   |             |             |
 |                                 |             |             |
 v                                 v             v             v
```

Procedure

This test sequence is following.

NOTE: SOA's parameter and TTL are same as above sec.example.com zone information. TN includes NS7 and NS1.sub.example.com into Authority section as type = NS. Also TN includes NS7 and NS1.sub.example.com address into Additional section. Thus NUT may reply to answer client with Authority and Additional section including those values.

```
DNS Client1 (TN)    DNS Server1 (NUT)       DNS Server7 (TN)       DNS Server8 (TN)
 |                   |                       |                      |
 |                   |<----------------------------------------------------------|
 |                   |                       | 1. A NOTIFY request  |
 |                   |                       |  OPCODE = NOTIFY (4) |
 |                   |                       |  QNAME = sec.example.com |
 |                   |                       |  QTYPE = SOA (0x0006) |
 |                   |                       |  ANSWER Name=sec.example.com|
 |                   |                       |  ANSWER Type = SOA (0x0006) |
 |                   |                       |  ANSWER Serial = 2 |
 |                   |-----------------------------------------X  |
 |                   | 2. no response        |                      |
 |                   |                       |                      |
 |                   |<----------------------|                      |
 |                   | 3. A NOTIFY request   |                      |
 |                   |  OPCODE = NOTIFY (4)  |                      |
 |                   |  QNAME = sec.example.com |                   |
 |                   |  QTYPE = SOA (0x0006) |                      |
 |                   |  ANSWER Name = sec.example.com |             |
 |                   |  ANSWER Type=SOA (0x0006)|                   |
 |                   |  ANSWER Serial = 2    |                      |
 |                   |---------------------->|                      |
 |                   | 4. A NOTIFY response  |                      |
 |                   |  OPCODE = NOTIFY (4)  |                      |
 |                   |  QNAME = sec.example.com |                   |
 |                   |  QTYPE = SOA (0x0006) |                      |
 |                   |                       |                      |
 v                   v                       v                      v

This test sequence is following.
1. DNS Server8 (TN) sends a NOTIFY request with Answer type SOA, serial = 2 to DNS Server1 (NUT).
2. DNS Server1 (NUT) ignore NOTIFY request from DNS Server8 (TN).(Judgment *2)
3. DNS Server7 (TN) sends a NOTIFY request with Answer type SOA, serial = 2 to DNS Server1 (NUT).
4. DNS Server1 (NUT) transmits a NOTIFY response with QNAME = sec.example.com, Type = SOA to DNS Server7
   (TN). (Judgment *4)
```

Packet Description

1st packet.

A NOTIFY request from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV8_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	4
	AA	0
	TC	0
	RD	0
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

3rd packet.

A NOTIFY request from DNS Server7 (TN) to Server1 (NUT)		
IP Header	Source Address	SV7_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	1000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	4
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	0
	ARCOUNT	0
DNS Question	QNAME	sec.example.com

section	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	sec.example.com (Pointer 0xC00C)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	33
	MNAME	NS7.sec.example.com (NS7 + Pointer 0xC00C)
	RNAME	root.sec.example.com (root + Pointer 0xC00C)
	SERIAL	*2*
	REFRESH	180sec
	RETRY	30sec
	EXPIRE	600sec
	MINIMUM	30sec

4th packet.

A NOTIFY response from DNS Server1 (NUT) to Server7 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV7_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1000
	QR	1
	OPCODE	*4*
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

- Termination
  None

Judgment

2. DNS Server1 (NUT) ignore NOTIFY request from DNS Server8.
4. DNS Server1 (NUT) transmits a NOTIFY response with QNAME = sec.example.com, Type = SOA to DNS Server7 (TN).

References

RFC1996 DNS NOTIFY
3. NOTIFY Message

5.135. a master receives a NOTIMP (unimplemented feature error) message

Purpose

If a NOTIFY request is received by a slave who does not implement the NOTIFY opcode, it will respond with a NOTIMP (unimplemented feature error) message. A master server who receives such a NOTIMP should consider the NOTIFY transaction complete for that slave.

Category

Server (AXFR/IXFR server)

Initialization

- **Network Topology**
  Refer the topology "Fig. 34 Topology No.34".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's: (NUT)
  - ✧ zone file to response query from TN.
  - ✧ configuration file as slave server about sec.example.com zone.
  - ✧ Enable zone transfer function.
  - ✧ Enable Notify mechanism function.

  Example of DNS server configuration on DNS Server1 (NUT):

  ✧ For IPv4 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 192.168.0.30; };
        also-notify    { 192.168.0.30; };
        file "master/sec.example.com";
};
```

  ✧ For IPv6 transport

```
zone "sec.example.com" {
        type master;
        allow-transfer { 3ffe:501:ffff:100::30; };
        also-notify    { 3ffe:501:ffff:100::30; };
        file "master/sec.example.com";
};
```

  Transferred sec.example.com zone information:

```
$TTL     86400   ; TTL of 1 day
@ IN SOA NS1.sec.example.com. root.sec.example.com. (
```

```
          1       ; serial
          180     ; refresh every 3 min
          30      ; retry every 30 sec
          360     ; expire after 6 min
          30      ; Minimum TTL of 30 sec
)
;
          IN      NS      NS1.sec.example.com.
          IN      NS      NS2.sec.example.com.
NS1       IN      A       192.168.0.10
          IN      AAAA    3ffe:501:ffff:100::10
NS2       IN      A       192.168.0.30
          IN      AAAA    3ffe:501:ffff:100::30
;
CL1       IN      A       192.168.0.20
```

Pre-test Sequence:

Update sec.example.com zone like following on DNS Server1 (NUT)

```
$TTL      86400   ; TTL of 1 day
@ IN SOA NS1.sec.example.com.  root.sec.example.com.  (
          2       ; serial
          3600    ; refresh every 1 hr
          900     ; retry every 15 min
          604800  ; expire after a week
          3600    ; Minimum TTL of a 1 hr
)
;
          IN      NS      NS1.sec.example.com.
          IN      NS      NS2.sec.example.com.
NS1       IN      A       192.168.0.10
NS1       IN      AAAA    3ffe:501:ffff:100::10
NS2       IN      A       192.168.0.30
NS2       IN      AAAA    3ffe:501:ffff:100::30
;
CL1       IN      A       192.168.0.20
CL2       IN      A       192.168.0.21
```

Procedure

This test sequence is following.

```
DNS Server1 (NUT)            DNS Server2 (TN)
    |                              |
    |----------------------------->|
    | 1. NOTIFY requests           |
    |    (in UDP)                  |
    |  QR = 0                      |
    |  OPCODE = NOTIFY (4)         |
    |  QDCOUNT >  0                |
    |  ANCOUNT >= 0                |
    |  NSCOUNT >= 0                |
    |  ARCOUNT >= 0                |
    |  QNAME = sec.example.com     |
    |  QTYPE = SOA (0x0006)        |
    |<-----------------------------|
    | 2. A NOTIFY response         |
    |    (in UDP)                  |
    |  QR = 1                      |
    |  RCODE = 4                   |
    |  QNAME = sec.example.com     |
    |  QTYPE = SOA (0x0006)        |
    |----------------------------->|
    | 3. no response               |
    |    for 60 seconds            |
    |                              |
    v                              v

This test sequence is following.
1. DNS Server1 (NUT) sends a NOTIFY request with to DNS Server2 (TN). (Judgment *1)
2. DNS Server2 (TN) sends a standard response with RCODE=4 to DNS Server1 (NUT).
3. DNS Server1 (NUT) doesn't sends a NOTIFY request to DNS Server2 (TN) for 60 seconds. (Judgment *3)
```

Packet Description

1st packet.

A NOTIFY request from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETZ
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	4
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0

	QDCOUNT	1
	ANCOUNT	>=0
	NSCOUNT	>=0
	ARCOUNT	>=0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

2nd packet.

A NOTIFY request from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	same as Src Port of 1st packet
DNS Header	ID	same value as 3rd packet
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	4
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sec.example.com
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

1. DNS Server1 (NUT) sends a NOTIFY request to DNS Server2 (TN).
3. DNS Server1 (NUT) doesn't sends a NOTIFY request to DNS Server2 (TN) for 60 seconds.

References

RFC1996 DNS NOTIFY
  3. NOTIFY Message

5.136. UDP Source Address Selection

Purpose

Verify that a NUT selects the correct Source Address.

- Servers when responding to queries using UDP must cause the reply to be sent with the source address field in the IP header set to the address that was in the destination address field of the IP header of the packet containing the query causing the response.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 36 Topology No.36".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
NS1      IN      A        192.168.0.11
;
A        IN      A        192.168.1.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
    |                                     |
    |------------------------------------->|
    |   1. Send standard query            |
    |   *Destination address=192.168.0.10 |
    |       QNAME=A.example.com           |
    |       QTYPE=A                       |
    |<-------------------------------------|
    |   2. Standard query response        |
    |   *Source address=192.168.0.10      |
    |       A=192.168.1.10                |
    |------------------------------------->|
    |   3. Send standard query            |
    |   *Destination address=192.168.0.11 |
    |       QNAME=A.example.com           |
    |       QTYPE=A                       |
    |<-------------------------------------|
    |   4. Standard query response        |
    |   *Source address=192.168.0.11      |
    |       A=192.168.1.10                |
    v                                     v

1. TN send standard query QNAME=A.example.com, QTYPE=A to NUT that destination address=192.168.0.10.
2. NUT reply query response w/ A=192.168.1.10 to TN that source address=192.168.0.10(Judgment *2)
3. TN send standard query QNAME=A.example.com, QTYPE=A to NUT that destination address=192.168.0.11.
4. NUT reply query response w/ A=192.168.1.10 to TN that source address=192.168.0.11(Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.11

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NET
	Destination Address	NUT_NETZ2
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ2
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0

	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.11
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**

  None

Judgment

2. Received standard query response w/ A=192.168.1.10 that source address=192.168.0.10.
4. Received standard query response w/ A=192.168.1.10 that source address=192.168.0.11.

References

RFC2181 Clarifications to the DNS Specification
4.1. UDP Source Address Selection

5.137. Port number selection

Purpose

Verify that a NUT selects the correct Port number.

- Replies to all queries must be directed to the port from which they were sent. When queries are received via TCP this is an inherent part of the transport protocol. For queries received by UDP the server must take note of the source port and use that as the destination port in the response. Replies should always be sent from the port to which they were directed. Except in extraordinary circumstances, this will be the well known port assigned for DNS queries.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig.1　Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL  86400                ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600           ; serial
      3600                 ; refresh every 1 hr
      900                  ; retry every 15 min
      604800               ; expire after a week
      3600                 ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
```

Procedure

This test sequence is following.

```
     DNS Client1 (TN)                      DNS Server1 (NUT)
         |                                     |
         |------------------------------------->|
         |   1. Send standard query            |
         |   *Source Port=2000                 |
         |       QNAME=A.example.com           |
         |       QTYPE=A                       |
         |<-------------------------------------|
         |   2. Standard query response        |
         |   *Destination Port=2000            |
         |       A=192.168.1.10                |
         |------------------------------------->|
         |   3. Send standard query            |
         |   *Source Port=2001                 |
         |       QNAME=A.example.com           |
         |       QTYPE=A                       |
         |<-------------------------------------|
         |   4. Standard query response        |
         |   *Destination Port=2001            |
         |       A=192.168.1.10                |
         v                                     v

     1. TN send standard query QNAME=A.example.com, QTYPE=A to NUT that source port=2000.
     2. NUT reply query response w/ A=192.168.1.10 to TN that destination port=2000 (Judgment *2)
     3. TN send standard query QNAME=A.example.com, QTYPE=A to NUT that source port=2001.
     4. NUT reply query response w/ A=192.168.1.10 to TN that destination port=2001 (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NET
	Destination Address	NUT_NETZ
UDP Header	Src Port	2001
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2001
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0

	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response w/ A=192.168.1.10 that destination port=2000.
3. Received standard query response w/ A=192.168.1.10 that destination port=2001.

References

RFC2181 Clarifications to the DNS Specification
4.2. Port Number Selection

5.138. Sending RRs from an RRSet

Purpose

Verify that a NUT returns all records in the associated RRSet.

- A query for a specific (or non-specific) label, class, and type, will always return all records in the associated RRSet - whether that be one or more RRs.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1　Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
A        IN      A        192.168.1.11
```

Procedure

```
This test sequence is following.

   DNS Client1 (TN)                        DNS Server1 (NUT)
       |                                       |
       |-------------------------------------->|
       |   1. Send standard query              |
       |        QNAME=A.example.com            |
       |        QTYPE=A                        |
       |<--------------------------------------|
       |   2. Standard query response          |
       |        A=192.168.1.10                 |
       |        A=192.168.1.11                 |
       v                                       v

    1. TN send standard query QNAME=A.example.com, QTYPE=A to NUT.
    2. NUT reply query response w/ A=192.168.1.10,192.168.1.11 to TN. (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ

UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response w/ A=192.168.1.10, 192.168.1.11.

References

RFC2181 Clarifications to the DNS Specification
5.1. Sending RRs from an RRSet

5.139. TTLs of all RRs in an RRSet must be the same

Purpose

Verify that a NUT returns all records in the associated RRSet.

- Consequently the use of differing TTLs in an RRSet is hereby deprecated, the TTLs of all RRs in an RRSet must be the same.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1　Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A     600        IN       A        192.168.1.10
A     300        IN       A        192.168.1.11
```

Procedure

This test sequence is following.

```
    DNS Client1 (TN)                      DNS Server1 (NUT)
        |                                     |
        |------------------------------------->|
        |   1. Send standard query            |
        |       QNAME=A.example.com           |
        |       QTYPE=A                       |
        |<-------------------------------------|
        |   2. Standard query response        |
        |       A=192.168.1.10                |
        |       *TTL=600 or 300               |
        |       A=192.168.1.11                |
        |       *TTL=600 or 300               |
        |       *Value of TTL must be same.   |
        v                                     v

  1. TN send standard query QNAME=A.example.com, QTYPE=A to NUT.
  2. NUT reply query response w/ A=192.168.1.10,192.168.1.11 to TN that have same value as TTL. (Judgment
     *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	600 or 300
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	600 or 300
	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC04B)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response w/ A=192.168.1.10, 192.168.1.11 that have same value as TTL.
   *TTL of all RRs in Answer Section must be same.

References

RFC2181 Clarifications to the DNS Specification
5.2. TTLs of RRs in an RRSet

5.140. Treat Differing TTLs from non-authoritative source as error

Purpose

Verify that a NUT treats as an error, when receive response containing RRs from an RRSet with differing TTLs.

- Should a client receive a response containing RRs from an RRSet with differing TTLs, it should treat this as an error. If the RRSet concerned is from a non-authoritative source for this data, the client should simply ignore the RRSet, and if the values were required, seek to acquire them from an authoritative source. Clients that are configured to send all queries to one, or more, particular servers should treat those servers as authoritative for this purpose.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 29 Topology No.29".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20
For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
 $TTL    86400            ; TTL of 1 day
 @ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                   <-------------- TN --------------->
DNS Client1 (TN)                  DNS Server1 (NUT)            DNS Server2  DNS Server3 DNS Server4
 |                                 |                                 |           |           |
 |---------------------------------->|                                 |           |           |
 | 1. Send standard query          |                                 |           |           |
 |  QNAME=A.example.org            |                                 |           |           |
 |  QTYPE=A                        |                                 |           |           |
 |                                 |---------------------------------->|           |           |
 |                                 | 2.Recv standard query           |           |           |
 |                                 |  QNAME=A.example.org            |           |           |
 |                                 |  QTYPE=A                        |           |           |
 |                                 |<----------------------------------|           |           |
 |                                 | 3.Send standard query response  |           |           |
 |                                 |  QNAME=A.example.org            |           |           |
 |                                 |  QTYPE=A                        |           |           |
 |                                 |  AUTHORITY Name=org             |           |           |
 |                                 |  AUTHORITY Name Server          |           |           |
 |                                 |              = NS3.example.org  |           |           |
 |                                 |  ADDITIONAL Name =NS3.example.org |         |           |
 |                                 |  ADDITIONAL Address =192.168.1.30 |         |           |
 |                                 |                                 v           |           |
 |                                 |---------------------------------------------->|           |
 |                                 |         4.Recv standard query               |           |
 |                                 |          QNAME=A.example.org                |           |
 |                                 |          QTYPE=A                            |           |
 |                                 |<----------------------------------------------|           |
 |                                 |         5.Send standard query response      |           |
 |                                 |          AA=0                               |           |
 |                                 |          QNAME=A.example.org                |           |
 |                                 |          QTYPE=A                            |           |
 |                                 |          ANSWER Name=A.example.org          |           |
 |                                 |          ANSWER Address=192.168.1.10        |           |
 |                                 |          ANSWER TTL=600                     |           |
 |                                 |          ANSWER Address=192.168.1.11        |           |
 |                                 |          ANSWER TTL=300                     |           |
 |                                 |          AUTHORITY Name=example.org         |           |
 |                                 |          AUTHORITY Name Server=NS4.example.org|         |
 |                                 |          ADDITIONAL Name = NS4.example.org  |           |
 |                                 |          ADDITIONAL Address = 192.168.1.40  |           |
 |                                 |                                             v           |
 | X  <------------------------------|                                                       |
 | 6.Standard query response       |                                                       |
 |  QNAME= A.example.org           |                                                       |
 |  QTYPE=A                        |                                                       |
 |  ANSWER Name=A.example.org      |                                                       |
 |  ANSWER Address=192.168.1.10    |                                                       |
 |  ANSWER TTL=ANY                 |                                                       |
 |  ANSWER Name=A.example.org      |                                                       |
 |  ANSWER Address=192.168.1.11    |                                                       |
 |  ANSWER TTL=ANY                 |                                                       |
 |  AUTHORITY Name=example.org     |                                                       |
 |  AUTHORITY Name Server          |                                                       |
 |              = NS4.example.org  |                                                       |
 |  ADDITIONAL Name = NS4.example.org|                                                     |
 |  ADDITIONAL Address = 192.168.1.40|                                                     |
 v                                 v                                                       v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, ANSWER Address=192.168.1.10(TTL=600) and 192.168.1.11(TTL=300), AUTHORITY Name Server=NS4.example.org.
6. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0

	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	600
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	300
	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0

	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**

  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Not received standard query response.

References

RFC2181 Clarifications to the DNS Specification
5.2. TTLs of RRs in an RRSet

5.141. Differing TTLs from non-authoritative source

Purpose

Verify that a NUT treats as an error, when receive response containing RRs from an RRSet with differing TTLs from a non-authoritative source.

- Should a client receive a response containing RRs from an RRSet with differing TTLs, it should treat this as an error. If the RRSet concerned is from a non-authoritative source for this data, the client should simply ignore the RRSet, and if the values were required, seek to acquire them from an authoritative source. Clients that are configured to send all queries to one, or more, particular servers should treat those servers as authoritative for this purpose.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 29 Topology No.29".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20
For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                <-------------- TN --------------->
DNS Client1 (TN)          DNS Server1 (NUT)           DNS Server2 DNS Server3 DNS   Server4
 |                         |                                |            |             |
 |------------------------->|                                |            |             |
 | 1.Send standard query   |                                |            |             |
 |  QNAME=A.example.org    |                                |            |             |
 |  QTYPE=A                |                                |            |             |
 |                         |------------------------------->|            |             |
 |                         | 2.Recv standard query          |            |             |
 |                         |  QNAME=A.example.org           |            |             |
 |                         |  QTYPE=A                       |            |             |
 |                         |<-------------------------------|            |             |
 |                         | 3.Send standard query response|            |             |
 |                         |  QNAME=A.example.org           |            |             |
 |                         |  QTYPE=A                       |            |             |
 |                         |  AUTHORITY Name=org            |            |             |
 |                         |  AUTHORITY Name Server         |            |             |
 |                         |            =NS3.example.org    |            |             |
 |                         |  ADDITIONAL Name               |            |             |
 |                         |            =NS3.example.org    |            |             |
 |                         |  ADDITIONAL Address            |            |             |
 |                         |            =192.168.1.30       |            |             |
 |                         |                                v            |             |
 |                         |------------------------------------------->|             |
 |                         |            4.Recv standard query           |             |
 |                         |             QNAME=A.example.org            |             |
 |                         |             QTYPE=A                        |             |
 |                         |<-------------------------------------------|             |
 |                         |            5.Send standard query response  |             |
 |                         |             AA=0                           |             |
 |                         |             QNAME=A.example.org            |             |
 |                         |             QTYPE=A                        |             |
 |                         |             ANSWER Name=A.example.org      |             |
 |                         |             ANSWER Address=192.168.1.10    |             |
 |                         |             ANSWER TTL=600                 |             |
 |                         |             ANSWER Address=192.168.1.11    |             |
 |                         |             ANSWER TTL=300                 |             |
 |                         |             AUTHORITY Name=example.org     |             |
 |                         |             AUTHORITY Name Server          |             |
 |                         |                    = NS4.example.org       |             |
 |                         |             ADDITIONAL Name=NS4.example.org|             |
 |                         |             ADDITIONAL Address=192.168.1.40|             |
 |                         |                                            v             |
 |                         |------------------------------------------------------------>|
 |                         |                       6.Send standard query                |
 |                         |                        QNAME=A.example.org                 |
 |                         |                        QTYPE=A                             |
 |                         |<------------------------------------------------------------|
 |                         |                       7.Send standard query response       |
 |                         |                        QNAME=A.example.org                 |
 |                         |                        QTYPE=A                             |
 |                         |                        ANSWER Name=A.example.org           |
 |                         |                        ANSWER Address=192.168.1.10         |
 |                         |                        AUTHORITY Name=example.org          |
 |                         |                        AUTHORITY Name Server               |
 |                         |                            = NS4.example.org               |
 |                         |                        ADDITIONAL Name=NS4.example.org     |
 |                         |                        ADDITIONAL Addres =192.168.1.40     |
```

```
|<----------------------------|                                                  |
| 8.Standard query response   |                                                  |
|  QNAME= A.example.org       |                                                  |
|  QTYPE=A                    |                                                  |
|  ANSWER Name=A.example.org  |                                                  |
|  ANSWER Address=192.168.1.10|                                                  |
|  AUTHORITY Name=example.org |                                                  |
|  AUTHORITY Name Server      |                                                  |
|   = NS4.example.org         |                                                  |
|  ADDITIONAL Name            |                                                  |
|   = NS4.example.org         |                                                  |
|  ADDITIONAL Address         |                                                  |
|   = 192.168.1.40            |                                                  |
|                             |                                                  |
v                             v                                                  v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3(TN: NS3.example.org)(Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, ANSWER Address=192.168.1.10(TTL=600) and 192.168.1.11(TTL=300), AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4(TN: NS4.example.org)(Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	600
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	300
	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4

	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1

	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1

	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response.

References

RFC2181 Clarifications to the DNS Specification
5.2. TTLs of RRs in an RRSet

5.142. Differing TTLs from authoritative source

Purpose

Verify that a NUT uses the value of the lowest TTL in the RRSet, when receive response containing RRs from an RRSet with differing TTLs from a authoritative source.

- Should an authoritative source send such a malformed RRSet, the client should treat the RRs for all purposes as if all TTLs in the RRSet had been set to the value of the lowest TTL in the RRSet.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 29 Topology No.29".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20

For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                  <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)     DNS Server2 DNS Server3 DNS Server4
 |                           |                          |           |           |
 |--------------------------->|                          |           |           |
 | 1.Send standard query      |                          |           |           |
 |  QNAME=A.example.org       |                          |           |           |
 |  QTYPE=A                   |                          |           |           |
 |                            |------------------------->|           |           |
 |                            | 2.Recv standard query    |           |           |
 |                            |  QNAME=A.example.org     |           |           |
 |                            |  QTYPE=A                 |           |           |
 |                            |<-------------------------|           |           |
 |                            | 3.Send standard query response|      |           |
 |                            |  QNAME=A.example.org     |           |           |
 |                            |  QTYPE=A                 |           |           |
 |                            |  AUTHORITY Name=org      |           |           |
 |                            |  AUTHORITY Name Server   |           |           |
 |                            |            =NS3.example.org|         |           |
 |                            |  ADDITIONAL Name         |           |           |
 |                            |            =NS3.example.org|         |           |
 |                            |  ADDITIONAL Address      |           |           |
 |                            |            =192.168.1.30 |           |           |
 |                            |                          v           |           |
 |                            |------------------------------------>|           |
 |                            |            4.Recv standard query     |           |
 |                            |             QNAME=A.example.org      |           |
 |                            |             QTYPE=A                  |           |
 |                            |<------------------------------------|           |
 |                            |            5.Send standard query response|      |
 |                            |             QNAME=A.example.org      |           |
 |                            |             QTYPE=A                  |           |
 |                            |             AUTHORITY Name=example.org|          |
 |                            |             AUTHORITY Name Server    |           |
 |                            |                    = NS4.example.org|          |
 |                            |             ADDITIONAL Name          |           |
 |                            |                    = NS4.example.org|          |
 |                            |             ADDITIONAL Address       |           |
 |                            |                    = 192.168.1.40    |           |
 |                            |                                     v           |
 |                            |------------------------------------------------>|
 |                            |                       6.Send standard query      |
 |                            |                        QNAME=A.example.org       |
 |                            |                        QTYPE=A                   |
```

```
|                            |<-----------------------------------------------------|
|                            |                        7.Send standard query response|
|                            |                         QNAME=A.example.org          |
|                            |                         QTYPE=A                      |
|                            |                         ANSWER Name=A.example.org    |
|                            |                         ANSWER Address=192.168.1.10  |
|                            |                         ANSWER TTL=600               |
|                            |                         ANSWER Address=192.168.1.11  |
|                            |                         ANSWER TTL=300               |
|                            |                         AUTHORITY Name=example.org   |
|                            |                         AUTHORITY Name Server        |
|                            |                             = NS4.example.org        |
|                            |                         ADDITIONAL Name              |
|                            |                             = NS4.example.org        |
|                            |                         ADDITIONAL Address           |
|                            |                             = 192.168.1.40           |
|<---------------------------|                                                      |
| 8.Standard query response  |                                                      |
|  QNAME= A.example.org      |                                                      |
|  QTYPE=A                   |                                                      |
|  ANSWER Name=A.example.org |                                                      |
|  ANSWER Address=192.168.1.10|                                                     |
|  ANSWER TTL=300            |                                                      |
|  ANSWER Address=192.168.1.11|                                                     |
|  ANSWER TTL=300            |                                                      |
|  AUTHORITY Name=example.org |                                                     |
|  AUTHORITY Name Server     |                                                      |
|   = NS4.example.org        |                                                      |
|  ADDITIONAL Name           |                                                      |
|   = NS4.example.org        |                                                      |
|  ADDITIONAL Address        |                                                      |
|   = 192.168.1.40           |                                                      |
|                            |                                                      |
v                            v                                                      v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10(TTL=600) and 192.168.1.11(TTL=300).
8. NUT transmits query response to DNS Client1 (TN) that ANSWER TTL=300.(Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53

DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY

	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1

	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	600
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	300
	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53

	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	300
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	300
	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response that has TTLs=300.

References

RFC2181 Clarifications to the DNS Specification
5.2. TTLs of RRs in an RRSet

5.143. Never merge RRs from response with RRs in cashe

Purpose

Verify that a NUT never merges RRs from a response with RRs in the cache to RRset

- Servers must never merge RRs from a response with RRs in their cache to form an RRSet. If a response contains data that would form an RRSet with data in a server's cache the server must either ignore the RRs in the response, or discard the entire RRSet currently in the cache, as appropriate.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 37 Topology No.37".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600      ; serial
         3600            ; refresh every 1 hr
         900             ; retry every 15 min
         604800          ; expire after a week
         3600            ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                        <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)            DNS Server2 DNS Server3 DNS Server4
  |                          |                                |           |           |
  |--------------------------->|                              |           |           |
  | 1. Send standard query   |                                |           |           |
  |  QNAME=A.example.org     |                                |           |           |
  |  QTYPE=A                 |                                |           |           |
  |                          |--------------------------------->|         |           |
  |                          | 2.Recv standard query          |           |           |
  |                          |  QNAME=A.example.org           |           |           |
  |                          |  QTYPE=A                       |           |           |
  |                          |<---------------------------------|         |           |
  |                          | 3.Send standard query response |           |           |
  |                          |  QNAME=A.example.org           |           |           |
  |                          |  QTYPE=A                       |           |           |
  |                          |  AUTHORITY Name=org            |           |           |
  |                          |  AUTHORITY Name Server         |           |           |
  |                          |            =NS3.example.org    |           |           |
  |                          |  ADDITIONAL Name =NS3.example.org|         |           |
  |                          |  ADDITIONAL Address =192.168.1.30|         |           |
  |                          |                                v           |           |
  |                          |---------------------------------------------->|         |
  |                          |      4.Recv standard query                  |           |
  |                          |       QNAME=A.example.org                   |           |
  |                          |       QTYPE=A                               |           |
  |                          |<----------------------------------------------|         |
  |                          |      5.Send standard query response         |           |
  |                          |       QNAME=A.example.org                   |           |
  |                          |       QTYPE=A                               |           |
  |                          |       AUTHORITY Name=example.org            |           |
  |                          |       AUTHORITY Name Server = NS4.example.org|          |
  |                          |       ADDITIONAL Name = NS4.example.org     |           |
  |                          |       ADDITIONAL Address = 192.168.1.40     |           |
  |                          |                                           v           |
  |                          |-------------------------------------------------------->|
  |                          |                6.Send standard query                    |
  |                          |                 QNAME=A.example.org                     |
  |                          |                 QTYPE=A                                 |
  |                          |<--------------------------------------------------------|
  |                          |                7.Send standard query response           |
  |                          |                  QNAME=A.example.org                    |
  |                          |                  QTYPE=A                                |
  |                          |                  ANSWER Name=A.example.org              |
  |                          |                  ANSWER Address=192.168.1.10            |
  |                          |                  AUTHORITY Name=example.org             |
  |                          |                  AUTHORITY Name Server                  |
  |                          |                      = NS4.example.org                  |
  |                          |                  ADDITIONAL Name = NS4.example.org      |
  |                          |                  ADDITIONAL Address = 192.168.1.41      |
```

```
|<----------------------------|                                                  |
| 8.Standard query response   |                                                  |
|  QNAME= A.example.org       |                                                  |
|  QTYPE=A                    |                                                  |
|  ANSWER Name=A.example.org  |                                                  |
|  ANSWER Address=192.168.1.10|                                                  |
|  AUTHORITY Name=example.org |                                                  |
|  AUTHORITY Name Server      |                                                  |
|   = NS4.example.org         |                                                  |
|  ADDITIONAL Name = NS4.example.org |                                           |
|  ADDITIONAL Address = 192.168.1.41 |                                           |
|---------------------------->|                                                  |
| 9.Send standard query       |                                                  |
|  QNAME=NS4.example.org      |                                                  |
|  QTYPE=A                    |                                                  |
|<----------------------------|                                                  |
|10.Standard query response   |                                                  |
|  QNAME=NS4.example.org      |                                                  |
|  QTYPE=A                    |                                                  |
|  ANSWER Name=NS4.example.org|                                                  |
|  ANSWER Address=192.168.1.40|                                                  |
|              or             |                                                  |
|  ANSWER Address=192.168.1.41|                                                  |
|  AUTHORITY Name=example.org |                                                  |
|  AUTHORITY Name Server      |                                                  |
|   = NS4.example.org         |                                                  |
|  ADDITIONAL Name = NS4.example.org |                                           |
|  ADDITIONAL Address         |                                                  |
|   = 192.168.1.40            |                                                  |
|            or               |                                                  |
|   = 192.168.1.41            |                                                  |
v                             v                                                  v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2(TN:root name server)(Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
8. NUT transmits query response to DNS Client1 (TN). (Judgment *8)
9. TN send standard query QNAME=NS4.example.org, QTYPE=A to NUT.
10. NUT transmits query response to DNS Client1 (TN). (Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000

	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY

	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)

	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.41

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.41

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0

	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	NS4.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.40 or 192.168.1.41
DNS Authority section	NAME	example.org (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	6
	NSDNAME	NS4.example.org (Pointer 0xC00C)

DNS Additional section	NAME	NS4.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.40 or 192.168.1.41

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response.
10. Received standard query response.

References

RFC2181 Clarifications to the DNS Specification
5.4. Receiving RRSets

5.144. Update the TTL in cache with the TTL of the received answer

Purpose

Verify that a NUT updates the TTL in cache with the TTL of the received answer.

- If a server receives an answer containing an RRSet that is identical to that in its cache, with the possible exception of the TTL value, it may, optionally, update the TTL in its cache with the TTL of the received answer. It should do this if the received answer would be considered more authoritative (as discussed in the next section) than the previously cached answer.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 38 Topology No.38".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600      ; serial
         3600            ; refresh every 1 hr
         900             ; retry every 15 min
         604800          ; expire after a week
         3600            ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                   <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)       DNS Server2 DNS Server3 DNS Server4
 |                           |                            |           |           |
 |---------------------------->|                            |           |           |
 | 1. Send standard query    |                            |           |           |
 |  QNAME=A.example.org      |                            |           |           |
 |  QTYPE=A                  |                            |           |           |
 |                           |----------------------------->|           |           |
 |                           | 2.Recv standard query      |           |           |
 |                           |  QNAME=A.example.org       |           |           |
 |                           |  QTYPE=A                   |           |           |
 |                           |<-----------------------------|           |           |
 |                           | 3.Send standard query response|           |           |
 |                           |  QNAME=A.example.org       |           |           |
 |                           |  QTYPE=A                   |           |           |
 |                           |  AUTHORITY Name=org        |           |           |
 |                           |  AUTHORITY Name Server     |           |           |
 |                           |            =NS3.example.org |           |           |
 |                           |  ADDITIONAL Name           |           |           |
 |                           |            =NS3.example.org |           |           |
 |                           |  ADDITIONAL Address        |           |           |
 |                           |            =192.168.1.30   |           |           |
 |                           |                            v           |           |
 |                           |------------------------------------------>|           |
 |                           |             4.Recv standard query        |           |
 |                           |              QNAME=A.example.org         |           |
 |                           |              QTYPE=A                     |           |
 |                           |<------------------------------------------|           |
 |                           |             5.Send standard query response|           |
 |                           |              QNAME=A.example.org         |           |
 |                           |              QTYPE=A                     |           |
 |                           |              AUTHORITY Name=example.org  |           |
 |                           |              AUTHORITY Name Server       |           |
 |                           |                     = NS4.example.org    |           |
 |                           |              ADDITIONAL Name             |           |
 |                           |                     = NS4.example.org    |           |
 |                           |              ADDITIONAL Address          |           |
 |                           |                     = 192.168.1.40       |           |
 |                           |                                          v           |
 |                           |-------------------------------------------------------->|
 |                           |                       6.Send standard query          |
 |                           |                        QNAME=A.example.org           |
 |                           |                        QTYPE=A                       |
```

```
|                              |<-----------------------------------------------------|
|                              |                        7.Send standard query response|
|                              |                        QNAME=A.example.org           |
|                              |                        QTYPE=A                       |
|                              |                        ANSWER Name=A.example.org     |
|                              |                        ANSWER Address=192.168.1.10   |
|                              |                        AUTHORITY Name=example.org    |
|                              |                        AUTHORITY Name Server         |
|                              |                            = NS4.example.org         |
|                              |                        ADDITIONAL Name               |
|                              |                            = NS4.example.org         |
|                              |                        ADDITIONAL Address            |
|                              |                            = 192.168.1.40            |
|                              |                        ADDITIONAL TTL=600            |
|                              |                        ADDITIONAL Address            |
|                              |                            = 192.168.1.41            |
|                              |                        ADDITIONAL TTL=600            |
|<-----------------------------|                                                      |
| 8.Standard query response    |                                                      |
|  QNAME= A.example.org        |                                                      |
|  QTYPE=A                     |                                                      |
|  ANSWER Name=A.example.org   |                                                      |
|  ANSWER Address=192.168.1.10 |                                                      |
|  AUTHORITY Name=example.org  |                                                      |
|  AUTHORITY Name Server       |                                                      |
|   = NS4.example.org          |                                                      |
|  ADDITIONAL Name             |                                                      |
|   = NS4.example.org          |                                                      |
|  ADDITIONAL Address          |                                                      |
|   = 192.168.1.40             |                                                      |
|  ADDITIONAL TTL=600          |                                                      |
|  ADDITIONAL Address          |                                                      |
|   = 192.168.1.41             |                                                      |
|  ADDITIONAL TTL=600          |                                                      |
|----------------------------->|                                                      |
| 9.Send standard query        |                                                      |
|  QNAME=B.example.org         |                                                      |
|  QTYPE=A                     |                                                      |
|                              |----------------------------------------------------->|
|                              |                       10.Send standard query         |
|                              |                        QNAME=B.example.org           |
|                              |                        QTYPE=A                       |
|                              |<-----------------------------------------------------|
|                              |                       11.Send standard query response|
|                              |                        QNAME=B.example.org           |
|                              |                        QTYPE=A                       |
|                              |                        ANSWER Name=B.example.org     |
|                              |                        ANSWER Address=192.168.1.11   |
|                              |                        AUTHORITY Name=example.org    |
|                              |                        AUTHORITY Name Server         |
|                              |                            = NS4.example.org         |
|                              |                        ADDITIONAL Name               |
|                              |                            = NS4.example.org         |
|                              |                        ADDITIONAL Address            |
|                              |                            = 192.168.1.40            |
|                              |                        ADDITIONAL TTL=1 day          |
|                              |                        ADDITIONAL Address            |
|                              |                            = 192.168.1.41            |
|                              |                        ADDITIONAL TTL=1 day          |
```

```
|<-----------------------------|                                          |
|12.Standard query response    |                                          |
|  QNAME= B.example.org        |                                          |
|  QTYPE=A                     |                                          |
|  ANSWER Name=B.example.org   |                                          |
|  ANSWER Address=192.168.1.11 |                                          |
|  AUTHORITY Name=example.org  |                                          |
|  AUTHORITY Name Server       |                                          |
|   = NS4.example.org          |                                          |
|  ADDITIONAL Name             |                                          |
|   = NS4.example.org          |                                          |
|  ADDITIONAL Address          |                                          |
|   = 192.168.1.40             |                                          |
|  ADDITIONAL TTL=1 day        |                                          |
|  ADDITIONAL Address          |                                          |
|   = 192.168.1.41             |                                          |
|  ADDITIONAL TTL=1 day        |                                          |
|----------------------------->|                                          |
| 13. Send standard query      |                                          |
|  QNAME=A.example.org         |                                          |
|  QTYPE=A                     |                                          |
|<-----------------------------|                                          |
| 14.Standard query response   |                                          |
|  QNAME= A.example.org        |                                          |
|  QTYPE=A                     |                                          |
|  ANSWER Name=A.example.org   |                                          |
|  ANSWER Address=192.168.1.10 |                                          |
|  AUTHORITY Name=example.org  |                                          |
|  AUTHORITY Name Server       |                                          |
|   = NS4.example.org          |                                          |
|  ADDITIONAL Name             |                                          |
|   = NS4.example.org          |                                          |
|  ADDITIONAL Address          |                                          |
|   = 192.168.1.40             |                                          |
|  ADDITIONAL TTL=more than 600|                                          |
|  ADDITIONAL Address          |                                          |
|   = 192.168.1.41             |                                          |
|  ADDITIONAL TTL=more than 600|                                          |
|                              |                                          |
v                              v                                          v

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org)
   (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
   (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
8. NUT transmits query response to DNS Client1 (TN). (Judgment *8)
9. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
10. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
   (Judgment *10)
11. TN send query response to ANSWER Name=B.example.org, ANSWER Address=192.168.1.11.
12. NUT transmits query response to DNS Client1 (TN). (Judgment *12)
13. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
14. NUT transmits query response to DNS Client1 (TN). (Judgment *14)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	600
	RDLENGTH	4
	ADDRESS	192.168.1.40
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	600
	RDLENGTH	4

	ADDRESS	192.168.1.41

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	600
	RDLENGTH	4
	ADDRESS	192.168.1.40

DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	600
	RDLENGTH	4
	ADDRESS	192.168.1.41

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0

	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

11th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.41

12th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.41

13th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1002
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)

	QCLASS	IN (0x0001)

14th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1002
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	More than 600
	RDLENGTH	4
	ADDRESS	192.168.1.40

DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	More than 600
	RDLENGTH	4
	ADDRESS	192.168.1.41

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response.
10. Received standard query including QNAME=B.example.org, QTYPE=A.
12. Received standard query response.
14. Received standard query response.

References

RFC2181 Clarifications to the DNS Specification
5.4. Receiving RRSets

5.145. Server makes a judgment by the reliability of data (Data from the answer section of an authoritative answer v.s. Data from the authority section of an authoritative answer)

Purpose

Verify that a NUT treats the reliability of the various data correctly.

When considering whether to accept an RRSet in a reply, or retain an RRSet already in its cache instead, a server should consider the relative likely trustworthiness of the various data. An authoritative answer from a reply should replace cached data that had been obtained from additional information in an earlier reply.
However additional information from a reply will be ignored if the cache contains data from an authoritative answer or a zone file.

The accuracy of data available is assumed from its source.
Trustworthiness shall be, in order from most to least:

+ Data from a primary zone file, other than glue data,
+ Data from a zone transfer, other than glue,
+ The authoritative data included in the answer section of an authoritative reply.
+ Data from the authority section of an authoritative answer,
+ Glue from a primary zone, or glue from a zone transfer,
+ Data from the answer section of a non-authoritative answer, and non-authoritative data from the answer section of authoritative answers,
+ Additional information from an authoritative answer, Data from the authority section of a non-authoritative answer, Additional information from non-authoritative answers.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 15 Topology No.15".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
.                    3600000        IN      NS      A.ROOT.NET.
```

```
 A.ROOT.NET.              3600000                    A        192.168.1.20
For IPv6
 .                        3600000          IN        NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA      3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
NS1      IN        A         192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                   <-------------- TN --------------->
 DNS Client1 (TN)           DNS Server1 (NUT)      DNS Server2 DNS Server3 DNS Server4
  |                          |                           |           |           |
  |--------------------------->|                           |           |           |
  | 1.Send standard query    |                           |           |           |
  |  QNAME=example.org       |                           |           |           |
  |  QTYPE=NS                |                           |           |           |
  |                          |----------------------------->|           |           |
  |                          | 2.Recv standard query     |           |           |
  |                          |  QNAME=example.org        |           |           |
  |                          |  QTYPE=NS                 |           |           |
  |                          |<-----------------------------|           |           |
  |                          | 3.Send standard query response|           |           |
  |                          |  QNAME=example.org        |           |           |
  |                          |  QTYPE=NS                 |           |           |
  |                          |  AUTHORITY Name=org       |           |           |
  |                          |  AUTHORITY Name Server    |           |           |
  |                          |            =NS3.example.org |           |           |
  |                          |  ADDITIONAL Name          |           |           |
  |                          |            =NS3.example.org |           |           |
  |                          |  ADDITIONAL Address       |           |           |
  |                          |            =192.168.1.30  |           |           |
  |                          |                           v           |           |
  |                          |------------------------------------------>|           |
  |                          |          4.Recv standard query          |           |
  |                          |           QNAME=example.org             |           |
  |                          |           QTYPE=NS                      |           |
```

```
|                            |<-----------------------------------------|           |
|                            |          5.Send standard query response  |           |
|                            |           QNAME=example.org              |           |
|                            |           QTYPE=NS                       |           |
|                            |           AUTHORITY Name=example.org     |           |
|                            |           AUTHORITY Name Server          |           |
|                            |                  = NS4.example.org       |           |
|                            |           ADDITIONAL Name=NS4.example.org|           |
|                            |           ADDITIONAL Address=192.168.1.40|           |
|                            |                                       v  |           |
|                            |------------------------------------------------------>|
|                            |                     6. Send standard query            |
|                            |                      QNAME=example.org                |
|                            |                      QTYPE=NS                         |
|                            |<------------------------------------------------------|
|                            |                     7. Send standard query response   |
|                            |                      QNAME=example.org                |
|                            |                      QTYPE=NS                         |
|                            |                      ANSWER Name=example.org          |
|                            |                      ANSWER Nsdname=NS4.example.org   |
|                            |                      ANSWER TTL=1 day                 |
|                            |                      ADDITIONAL Name                  |
|                            |                          = NS4.example.org            |
|                            |                      ADDITIONAL Address               |
|                            |                          = 192.168.1.40               |
|<---------------------------|                                                       |
| 8.Standard query response  |                                                       |
|  QNAME=example.org         |                                                       |
|  QTYPE=NS                  |                                                       |
|  ANSWER Name=example.org   |                                                       |
|  ANSWER Nsdname            |                                                       |
|             =NS4.example.org|                                                      |
|  ADDITIONAL Name           |                                                       |
|   = NS4.example.org        |                                                       |
|  ADDITIONAL Address        |                                                       |
|   = 192.168.1.40           |                                                       |
|--------------------------->|                                                       |
| 9. Send standard query     |                                                       |
|  QNAME=A.example.org       |                                                       |
|  QTYPE=A                   |                                                       |
|                            |------------------------------------------------------>|
|                            |                    10. Send standard query            |
|                            |                      QNAME=A.example.org              |
|                            |                      QTYPE=A                          |
|                            |<------------------------------------------------------|
|                            |                    11.Send standard query response    |
|                            |                      QNAME=A.example.org              |
|                            |                      QTYPE=A                          |
|                            |                      ANSWER Name=A.example.org        |
|                            |                      ANSWER Address=192.168.1.10      |
|                            |                      AUTHORITY Name=example.org       |
|                            |                      AUTHORITY Name Server            |
|                            |                          = NS4.example.org            |
|                            |                      AUTHORITY TTL=600                |
|                            |                      ADDITIONAL Name                  |
|                            |                          = NS4.example.org            |
|                            |                      ADDITIONAL Address               |
|                            |                          = 192.168.1.40               |
```

```
|<----------------------------|                                                |
|12.Standard query response   |                                                |
|  QNAME=A.example.org        |                                                |
|  QTYPE=A                    |                                                |
|  ANSWER Name=A.example.org  |                                                |
|  ANSWER Address=192.168.1.10|                                                |
|  AUTHORITY Name=example.org |                                                |
|  AUTHORITY Name Server      |                                                |
|   = NS4.example.org         |                                                |
|  AUTHORITY TTL=ANY          |                                                |
|  ADDITIONAL Name            |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Address         |                                                |
|   = 192.168.1.40            |                                                |
|                             |                                                |
//     wait 15 seconds        //                                              //
|                             |                                                |
|---------------------------->|                                                |
| 13.Send standard query      |                                                |
|  QNAME=example.org          |                                                |
|  QTYPE=NS                   |                                                |
|<----------------------------|                                                |
| 14.Standard query response  |                                                |
|  QNAME=example.org          |                                                |
|  QTYPE=NS                   |                                                |
|  ANSWER Name=example.org    |                                                |
|  ANSWER Nsdname             |                                                |
|             =NS4.example.org|                                                |
|  ANSWER TTL=more than 600   |                                                |
|  ADDITIONAL Name            |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Address         |                                                |
|   = 192.168.1.40            |                                                |
|                             |                                                |
v                             v                                                v
```

1. TN send standard query QNAME=example.org, QTYPE=NS to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=example.org, QTYPE=NS to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=example.org, QTYPE=NS to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=example.org, ANSWER Nsdname=NS4.example.org.
8. NUT transmits query response to DNS Client1 (TN). (Judgment *8)
9. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
10. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *10)
11. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
12. NUT transmits query response to DNS Client1 (TN). (Judgment *12)
13. TN send standard query QNAME=example.org, QTYPE=NS to NUT.
14. NUT transmits query response to DNS Client1 (TN). (Judgment *14)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	ANY
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC014)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00C)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00C)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	0
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00C)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0

	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00C)
DNS Authority section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	2
	NSDNAME	NS4.example.org (Pointer 0xC029)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0

	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

11th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses

	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	600
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

12th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1

	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

13th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1002
	QR	0
	OPCODE	0

	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

14th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1002
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	more than 600
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0x00C)

DNS Authority section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	6
	NSDNAME	NS4.example.org (Pointer 0xC0029)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=example.org, QTYPE=NS.
4. Received standard query including QNAME=example.org, QTYPE=NS.
6. Received standard query including QNAME=example.org, QTYPE=NS.
8. Received standard query response.
10. Received standard query including QNAME=A.example.org, QTYPE=A.
12. Received standard query response.
14. Received standard query response.

References

RFC2181 Clarifications to the DNS Specification
5.4.1. Ranking data

5.146. Server makes a judgment by the reliability of data (Data from the answer section of an authoritative answer v.s. Non-authoritative data from the answer section of an authoritative answer)

Purpose

Verify that a NUT treats the reliability of the various data correctly.

When considering whether to accept an RRSet in a reply, or retain an RRSet already in its cache instead, a server should consider the relative likely trustworthiness of the various data. An authoritative answer from a reply should replace cached data that had been obtained from additional information in an earlier reply. However additional information from a reply will be ignored if the cache contains data from an authoritative answer or a zone file.

The accuracy of data available is assumed from its source.

Trustworthiness shall be, in order from most to least:

+ Data from a primary zone file, other than glue data,
+ Data from a zone transfer, other than glue,
+ The authoritative data included in the answer section of an authoritative reply.
+ Data from the authority section of an authoritative answer,
+ Glue from a primary zone, or glue from a zone transfer,
+ Data from the answer section of a non-authoritative answer, and non-authoritative data from the answer section of authoritative answers,
+ Additional information from an authoritative answer, Data from the authority section of a non-authoritative answer, Additional information from non-authoritative answers.

Category

Caching Server

Initialization

- **Network Topology**

  Refer the topology "Fig. 22 Topology No.22".

  AP server1 has a domain name "A.example.org".

- **Setup**

  Set the DNS Server1's (NUT) address as above mentioned Network Topology.

  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
.                    3600000    IN    NS    A.ROOT.NET.
A.ROOT.NET.          3600000          A     192.168.1.20
```

For IPv6

```
 .                          3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.                3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
     IN       NS      NS1.example.com.
NS1  IN       A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                        <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)            DNS Server2 DNS Server3 DNS Server4
  |                            |                              |           |           |
  |----------------------------->|                              |           |           |
  | 1.Send standard query      |                              |           |           |
  |  QNAME=A.example.org       |                              |           |           |
  |  QTYPE=A                   |                              |           |           |
  |                            |--------------------------------->|           |           |
  |                            | 2.Recv standard query        |           |           |
  |                            |  QNAME=A.example.org         |           |           |
  |                            |  QTYPE=A                     |           |           |
  |                            |<---------------------------------|           |           |
  |                            | 3.Send standard query response |           |           |
  |                            |  QNAME=A.example.org         |           |           |
  |                            |  QTYPE=A                     |           |           |
  |                            |  AUTHORITY Name=org          |           |           |
  |                            |  AUTHORITY Name Server       |           |           |
  |                            |            =NS3.example.org  |           |           |
  |                            |  ADDITIONAL Name=NS3.example.org |           |           |
  |                            |  ADDITIONAL Address=192.168.1.30 |           |           |
  |                            |                              v           |           |
  |                            |---------------------------------------------->|           |
  |                            |            4.Recv standard query           |           |
  |                            |             QNAME=A.example.org            |           |
  |                            |             QTYPE=A                        |           |
  |                            |<----------------------------------------------|           |
  |                            |            5.Send standard query response  |           |
  |                            |             QNAME=A.example.org            |           |
  |                            |             QTYPE=A                        |           |
  |                            |             AUTHORITY Name=example.org     |           |
  |                            |             AUTHORITY Name Server          |           |
  |                            |                    = NS4.example.org       |           |
  |                            |             ADDITIONAL Name=NS4.example.org |           |
  |                            |             ADDITIONAL Address=192.168.1.40 |           |
  |                            |                                        v           |
```

```
|                              |-------------------------------------------------------->|
|                              |                      6.Send standard query              |
|                              |                       QNAME=A.example.org               |
|                              |                       QTYPE=A                           |
|                              |<--------------------------------------------------------|
|                              |                      7.Send standard query response     |
|                              |                       QNAME=A.example.org               |
|                              |                       QTYPE=A                           |
|                              |                       ANSWER Name=A.example.org         |
|                              |                       ANSWER Address=192.168.1.10       |
|                              |                       ANSWER TTL=1 day                  |
|                              |                       AUTHORITY Name=example.org        |
|                              |                       AUTHORITY Name Server             |
|                              |                           = NS4.example.org             |
|                              |                       ADDITIONAL Name = NS4.example.org |
|                              |                       ADDITIONAL Address = 192.168.1.40 |
|<-----------------------------|                                                         |
| 8.Standard query response    |                                                         |
|  QNAME= A.example.org        |                                                         |
|  QTYPE=A                     |                                                         |
|  ANSWER Name=A.example.org   |                                                         |
|  ANSWER Address=192.168.1.10|                                                         |
|  ANSWER TTL=1 day            |                                                         |
|  AUTHORITY Name=example.org  |                                                         |
|  AUTHORITY Name Server       |                                                         |
|   = NS4.example.org          |                                                         |
|  ADDITIONAL Name = NS4.example.org |                                                  |
|  ADDITIONAL Address = 192.168.1.40 |                                                  |
|----------------------------->|                                                         |
| 9. Send standard query       |                                                         |
|  QNAME=B.example.org         |                                                         |
|  QTYPE=A                     |                                                         |
|                              |-------------------------------------------------------->|
|                              |                     10. Send standard query             |
|                              |                       QNAME=B.example.org               |
|                              |                       QTYPE=A                           |
|                              |<--------------------------------------------------------|
|                              |                     11. Send standard query response    |
|                              |                       QNAME=B.example.org               |
|                              |                       QTYPE=A                           |
|                              |                       ANSWER Name=B.example.org         |
|                              |                       ANSWER Type=CNAME                 |
|                              |                       ANSWER Primary Name               |
|                              |                                  =A.example.org         |
|                              |                       ANSWER Name=A.example.org         |
|                              |                       ANSWER Type=A                     |
|                              |                       ANSWER Address=192.168.1.10       |
|                              |                       ANSWER TTL=600                    |
|                              |                       AUTHORITY Name=example.org        |
|                              |                       AUTHORITY Name Server             |
|                              |                           = NS4.example.org             |
|                              |                       AUTHORITY TTL=1 day               |
|                              |                       ADDITIONAL Name = NS4.example.org |
|                              |                       ADDITIONAL Address = 192.168.1.40 |
```

```
 |<----------------------------|                                                |
 |12.Standard query response   |                                                |
 |  QNAME= B.example.org       |                                                |
 |  QTYPE=A                    |                                                |
 |  ANSWER Name=B.example.org  |                                                |
 |  ANSWER Type=CNAME          |                                                |
 |  ANSWER Primary Name        |                                                |
 |             =A.example.org  |                                                |
 |  ANSWER Type=A              |                                                |
 |  ANSWER Address=192.168.1.10|                                                |
 |  ANSWER TTL=ANY             |                                                |
 |  AUTHORITY Name=example.org |                                                |
 |  AUTHORITY Name Server      |                                                |
 |   = NS4.example.org         |                                                |
 |  ADDITIONAL Name            |                                                |
 |   = NS4.example.org         |                                                |
 |  ADDITIONAL Address         |                                                |
 |   = 192.168.1.40            |                                                |
 |                             |                                                |
 //     wait 15 seconds        //                                               //
 |                             |                                                |
 |---------------------------->|                                                |
 | 13.Send standard query      |                                                |
 |  QNAME=A.example.org        |                                                |
 |  QTYPE=A                    |                                                |
 |<----------------------------|                                                |
 | 14.Standard query response  |                                                |
 |  QNAME=A.example.org        |                                                |
 |  QTYPE=A                    |                                                |
 |  ANSWER Name=A.example.org  |                                                |
 |  ANSWER Address=192.168.1.10|                                                |
 |  ANSWER TTL=more than 600   |                                                |
 |  AUTHORITY Name=example.org |                                                |
 |  AUTHORITY Name Server      |                                                |
 |   = NS4.example.org         |                                                |
 |  ADDITIONAL Name            |                                                |
 |   = NS4.example.org         |                                                |
 |  ADDITIONAL Address         |                                                |
 |   = 192.168.1.40            |                                                |
 v                             v                                                v
1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server)(Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org)
   (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
   (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
8. NUT transmits query response to DNS Client1 (TN). (Judgment *8)
9. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
10. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
   (Judgment *10)
11. TN send query response to ANSWER Name=B.example.org, ANSWER Type=CNAME.
12. NUT transmits query response to DNS Client1 (TN). (Judgment *12)
13. TN send standard query QNAME=example.org, QTYPE=NS to NUT.
14. NUT transmits query response to DNS Client1 (TN). (Judgment *14)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ

UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000

	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

11th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	Primary Name	A.example.org (A + Pointer 0xC00E)
DNS Answer section	NAME	A.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	600
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

12th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	Primary Name	A.example.org (Pointer 0xC00E)
DNS Answer section	NAME	A.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)

	TTL	ANY
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

13th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1002
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

14th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1002
	QR	1
	OPCODE	0

	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	more than 600
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**

  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response.
10. Received standard query including QNAME=B.example.org, QTYPE=A.
12. Received standard query response.
14. Received standard query response.

References

RFC2181 Clarifications to the DNS Specification
5.4.1. Ranking data

5.147. Server makes a judgment by the reliability of data (Data from the answer section of an authoritative answer v.s. Data from the additional section of an authoritative answer)

Purpose

Verify that a NUT treats the reliability of the various data correctly.

When considering whether to accept an RRSet in a reply, or retain an RRSet already in its cache instead, a server should consider the relative likely trustworthiness of the various data. An authoritative answer from a reply should replace cached data that had been obtained from additional information in an earlier reply. However additional information from a reply will be ignored if the cache contains data from an authoritative answer or a zone file.

The accuracy of data available is assumed from its source.
Trustworthiness shall be, in order from most to least:

+ Data from a primary zone file, other than glue data,
+ Data from a zone transfer, other than glue,
+ The authoritative data included in the answer section of an authoritative reply.
+ Data from the authority section of an authoritative answer,
+ Glue from a primary zone, or glue from a zone transfer,
+ Data from the answer section of a non-authoritative answer, and non-authoritative data from the answer section of authoritative answers,
+ Additional information from an authoritative answer, Data from the authority section of a non-authoritative answer, Additional information from non-authoritative answers.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 15 Topology No.15".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
.                    3600000        IN      NS      A.ROOT.NET.
```

```
 A.ROOT.NET.              3600000                    A        192.168.1.20
For IPv6
 .                        3600000          IN        NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA      3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                        <-------------- TN --------------->
 DNS Client1 (TN)            DNS Server1 (NUT)           DNS Server2 DNS Server3 DNS Server4
  |                           |                                |          |          |
  |---------------------------->|                                |          |          |
  | 1.Send standard query       |                                |          |          |
  |  QNAME=NS4.example.org      |                                |          |          |
  |  QTYPE=A                    |                                |          |          |
  |                             |--------------------------------->|          |          |
  |                             | 2.Recv standard query          |          |          |
  |                             |  QNAME=NS4.example.org         |          |          |
  |                             |  QTYPE=A                       |          |          |
  |                             |<---------------------------------|          |          |
  |                             | 3.Send standard query response |          |          |
  |                             |  QNAME=NS4.example.org         |          |          |
  |                             |  QTYPE=A                       |          |          |
  |                             |  AUTHORITY Name=org            |          |          |
  |                             |  AUTHORITY Name Server         |          |          |
  |                             |            =NS3.example.org    |          |          |
  |                             |  ADDITIONAL Name=NS3.example.org |          |          |
  |                             |  ADDITIONAL Address=192.168.1.30 |          |          |
  |                             |                                v          |          |
  |                             |------------------------------------------->|          |
  |                             |             4.Recv standard query          |          |
  |                             |              QNAME=NS4.example.org         |          |
  |                             |              QTYPE=A                       |          |
  |                             |                                            |          |
```

```
|                            |<-------------------------------------------|          |
|                            |            5.Send standard query response  |          |
|                            |             QNAME=NS4.example.org          |          |
|                            |             QTYPE=A                        |          |
|                            |             AUTHORITY Name=example.org     |          |
|                            |             AUTHORITY Name Server          |          |
|                            |                    = NS4.example.org       |          |
|                            |             ADDITIONAL Name=NS4.example.org|          |
|                            |             ADDITIONAL Address=192.168.1.40|          |
|                            |                                         v          |
|                            |------------------------------------------------------>|
|                            |                     6.Send standard query              |
|                            |                      QNAME=NS4.example.org             |
|                            |                      QTYPE=A                           |
|                            |<------------------------------------------------------|
|                            |                     7.Send standard query response     |
|                            |                      QNAME=NS4.example.org             |
|                            |                      QTYPE=A                           |
|                            |                      ANSWER Name=NS4.example.org       |
|                            |                      ANSWER Address=192.168.1.40       |
|                            |                      ANSWER TTL=1 day                  |
|                            |                      AUTHORITY Name=example.org        |
|                            |                      AUTHORITY Name Server             |
|                            |                          = NS4.example.org             |
|<---------------------------|                                                        |
| 8.Standard query response  |                                                        |
|  QNAME=NS4.example.org     |                                                        |
|  QTYPE=A                   |                                                        |
|  ANSWER Name=NS4.example.org|                                                       |
|  ANSWER Address=192.168.1.40|                                                       |
|  AUTHORITY Name=example.org |                                                       |
|  AUTHORITY Name Server     |                                                        |
|   = NS4.example.org        |                                                        |
|--------------------------->|                                                        |
| 9.Send standard query      |                                                        |
|  QNAME=A.example.org       |                                                        |
|  QTYPE=A                   |                                                        |
|                            |------------------------------------------------------>|
|                            |                    10.Send standard query              |
|                            |                      QNAME=A.example.org               |
|                            |                      QTYPE=A                           |
|                            |<------------------------------------------------------|
|                            |                    11.Send standard query response     |
|                            |                      QNAME=A.example.org               |
|                            |                      QTYPE=A                           |
|                            |                      ANSWER Name=A.example.org         |
|                            |                      ANSWER Address=192.168.1.10       |
|                            |                      AUTHORITY Name=example.org        |
|                            |                      AUTHORITY Name Server             |
|                            |                          = NS4.example.org             |
|                            |                      ADDITIONAL Name= NS4.example.org  |
|                            |                      ADDITIONAL Address = 192.168.1.40|
|                            |                      ADDITIONAL TTL=600                |
|                            |                                                        |
```

```
|<----------------------------|                                                |
|12.Standard query response   |                                                |
|  QNAME=A.example.org        |                                                |
|  QTYPE=A                    |                                                |
|  ANSWER Name=A.example.org  |                                                |
|  ANSWER Address=192.168.1.10|                                                |
|  AUTHORITY Name=example.org |                                                |
|  AUTHORITY Name Server      |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Name            |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Address         |                                                |
|   = 192.168.1.40            |                                                |
|  ADDITIONAL TTL=ANY         |                                                |
|                             |                                                |
//     wait 15 seconds        //                                              //
|                             |                                                |
|---------------------------->|                                                |
| 13.Send standard query      |                                                |
|  QNAME=NS4.example.org      |                                                |
|  QTYPE=A                    |                                                |
|<----------------------------|                                                |
| 14.Standard query response  |                                                |
|  QNAME=NS4.example.org      |                                                |
|  QTYPE=A                    |                                                |
|  ANSWER Name=NS4.example.org|                                                |
|  ANSWER Address=192.168.1.40|                                                |
|  ANSWER TTL=more than 600   |                                                |
|  AUTHORITY Name=example.org |                                                |
|  AUTHORITY Name Server      |                                                |
v                             v                                                v
```

1. TN send standard query QNAME=NS4.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=NS4.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=NS4.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=NS4.example.org, ANSWER Address=192.168.1.40.
8. NUT transmits query response to DNS Client1 (TN). (Judgment *8)
9. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
10. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *10)
11. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
12. NUT transmits query response to DNS Client1 (TN). (Judgment *12)
13. TN send standard query QNAME=NS4.example.org, QTYPE=A to NUT.
14. NUT transmits query response to DNS Client1 (TN). (Judgment *14)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ

UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC018)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC010)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC01D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY

	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	2
	NSDNAME	NS4.example.org (Pointer 0xC00C)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1

	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	NS4.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40
DNS Authority section	NAME	example.org (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	2
	NSDNAME	NS4.example.org (Pointer 0xC00C)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1

	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	NS4.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40
DNS Authority section	NAME	example.org (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	2
	NSDNAME	NS4.example.org (Pointer 0xC00C)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

11th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	600
	RDLENGTH	4
	ADDRESS	192.168.1.40

12th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0

	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.40

13th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1002
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

14th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1002
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	NS4.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	more than 600
	RDLENGTH	4
	ADDRESS	192.168.1.40
DNS Authority section	NAME	example.org (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	2
	NSDNAME	NS4.example.org (Pointer 0xC00C)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC00C)

	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.40

- Termination
  None

Judgment

2. Received standard query including QNAME=NS4.example.org, QTYPE=A.
4. Received standard query including QNAME=NS4.example.org, QTYPE=A.
6. Received standard query including QNAME=NS4.example.org, QTYPE=A.
8. Received standard query response.
10. Received standard query including QNAME=A.example.org, QTYPE=A.
12. Received standard query response.
14. Received standard query response.

References

RFC2181 Clarifications to the DNS Specification
5.4.1. Ranking data

5.148. Server makes a judgment by the reliability of data (Data from the authority section of an authoritative answer v.s. Data from the answer section of a non-authoritative answer)

Purpose

Verify that a NUT treats the reliability of the various data correctly.

When considering whether to accept an RRSet in a reply, or retain an RRSet already in its cache instead, a server should consider the relative likely trustworthiness of the various data. An authoritative answer from a reply should replace cached data that had been obtained from additional information in an earlier reply. However additional information from a reply will be ignored if the cache contains data from an authoritative answer or a zone file.

The accuracy of data available is assumed from its source.

Trustworthiness shall be, in order from most to least:

+ Data from a primary zone file, other than glue data,
+ Data from a zone transfer, other than glue,
+ The authoritative data included in the answer section of an authoritative reply.
+ Data from the authority section of an authoritative answer,
+ Glue from a primary zone, or glue from a zone transfer,
+ Data from the answer section of a non-authoritative answer, and non-authoritative data from the answer section of authoritative answers,
+ Additional information from an authoritative answer, Data from the authority section of a non-authoritative answer, Additional information from non-authoritative answers.

Category

Caching Server

Initialization

- **Network Topology**

  Refer the topology "Fig. 15 Topology No.15".

- **Setup**

  Set the DNS Server1's (NUT) address as above mentioned Network Topology.

  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

.	3600000	IN	NS	A.ROOT.NET.
A.ROOT.NET.	3600000		A	192.168.1.20

For IPv6

```
 .                        3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
NS1      IN        A         192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                  <-------------- TN --------------->
DNS Client1 (TN)              DNS Server1 (NUT)             DNS Server2 DNS Server3 DNS Server4
  |                                |                                |           |           |
  |--------------------------------->|                                |           |           |
  | 1.Send standard query          |                                |           |           |
  |  QNAME=example.org             |                                |           |           |
  |  QTYPE=NS                      |                                |           |           |
  |                                |--------------------------------->|           |           |
  |                                | 2.Recv standard query          |           |           |
  |                                |  QNAME=example.org             |           |           |
  |                                |  QTYPE=NS                      |           |           |
  |                                |<---------------------------------|           |           |
  |                                | 3.Send standard query response |           |           |
  |                                |  QNAME=example.org             |           |           |
  |                                |  QTYPE=NS                      |           |           |
  |                                |  AUTHORITY Name=org            |           |           |
  |                                |  AUTHORITY Name Server         |           |           |
  |                                |            =NS3.example.org    |           |           |
  |                                |  ADDITIONAL Name=NS3.example.org|          |           |
  |                                |  ADDITIONAL Address=192.168.1.30|          |           |
  |                                |                                v           |           |
  |                                |---------------------------------------------->|           |
  |                                |            4.Recv standard query           |           |
  |                                |             QNAME=example.org              |           |
  |                                |             QTYPE=NS                       |           |
  |                                |                                           |           |
```

```
|                                  |<-----------------------------------------|           |
|                                  |            5.Send standard query response  |           |
|                                  |             AA=0                           |           |
|                                  |             QNAME=example.org              |           |
|                                  |             QTYPE=NS                       |           |
|                                  |             ANSWER Name=example.org        |           |
|                                  |             ANSWER Nsdname=NS4.example.org |           |
|                                  |             ANSWER TTL=600                 |           |
|                                  |             ADDITIONAL Name=NS4.example.org |          |
|                                  |             ADDITIONAL Address=192.168.1.40 |          |
|                                  |                                         v  |           |
|<---------------------------------|                                            |
| 6.Standard query response        |                                            |
|  QNAME=example.org               |                                            |
|  QTYPE=NS                        |                                            |
|  ANSWER Name=example.org         |                                            |
|  ANSWER Nsdname=NS4.example.org  |                                            |
|  ANSWER TTL=600                  |                                            |
|  ADDITIONAL Name= NS4.example.org|                                            |
|  ADDITIONAL Address =192.168.1.40|                                            |
|--------------------------------->|                                            |
| 7. Send standard query           |                                            |
|  QNAME=A.example.org             |                                            |
|  QTYPE=A                         |                                            |
|                                  |------------------------------------------->|
|                                  |                     8.Send standard query  |
|                                  |                       QNAME=A.example.org  |
|                                  |                       QTYPE=A              |
|                                  |<-------------------------------------------|
|                                  |                     9.Send standard query response |
|                                  |                       QNAME=A.example.org  |
|                                  |                       QTYPE=A              |
|                                  |                       ANSWER Name=A.example.org |
|                                  |                       ANSWER Address=192.168.1.10 |
|                                  |                       AUTHORITY Name=example.org |
|                                  |                       AUTHORITY Name Server |
|                                  |                           = NS4.example.org |
|                                  |                       AUTHORITY TTL=1 day  |
|                                  |                       ADDITIONAL Name = NS4.example.org|
|                                  |                       ADDITIONAL Address = 192.168.1.40|
|<---------------------------------|                                            |
|10.Standard query response        |                                            |
|  QNAME=A.example.org             |                                            |
|  QTYPE=A                         |                                            |
|  ANSWER Name=A.example.org       |                                            |
|  ANSWER Address=192.168.1.10     |                                            |
|  AUTHORITY Name=example.org      |                                            |
|  AUTHORITY Name Server           |                                            |
|   = NS4.example.org              |                                            |
|  AUTHORITY TTL=ANY               |                                            |
|  ADDITIONAL Name=NS4.example.org |                                            |
|  ADDITIONAL Address=192.168.1.40 |                                            |
|                                  |                                            |
//     wait 15 seconds             //                                           //
|                                  |                                            |
|--------------------------------->|                                            |
| 11.Send standard query           |                                            |
|  QNAME=example.org               |                                            |
|  QTYPE=NS                        |                                            |
```

```
|<--------------------------------|                                                    |
| 12.Standard query response      |                                                    |
|  QNAME=example.org              |                                                    |
|  QTYPE=NS                       |                                                    |
|  ANSWER Name=example.org        |                                                    |
|  ANSWER Nsdname =NS4.example.org |                                                    |
|  ANSWER TTL=more than 600       |                                                    |
|  ADDITIONAL Name =NS4.example.org|                                                    |
|  ADDITIONAL Address =192.168.1.40|                                                    |
v                                 v                                                    v

  1. TN send standard query QNAME=example.org, QTYPE=NS to NUT.
  2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
  3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
  4. NUT transmits standard query QNAME=example.org, QTYPE=NS to DNS Server3 (TN: NS3.example.org)
     (Judgment *4)
  5. TN send query response to ANSWER Name=example.org, ANSWER Nsdname=NS4.example.org.
  6. NUT transmits query response to DNS Client1 (TN). (Judgment *6)
  7. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
  8. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org)
     (Judgment *8)
  9. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
  10. NUT transmits query response to DNS Client1 (TN). (Judgment *10)
  11. TN send standard query QNAME=example.org, QTYPE=NS to NUT.
  12. NUT transmits query response to DNS Client1 (TN). (Judgment *12)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)

	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC014)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00C)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC019)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	0
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	600
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00C)
	RDLENGTH	6
DNS Additional section	NAME	NS4.example.org (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000

	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00C)
DNS Authority section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	2
	NSDNAME	NS4.example.org (Pointer 0xC029)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

7th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0

	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

8th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ

UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53

	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

11th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53

DNS Header	ID	0x1002
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

12th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1002
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)

	TTL	more than 600
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0x00C)
DNS Authority section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	6
	NSDNAME	NS4.example.org (Pointer 0xC0029)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=example.org, QTYPE=NS.
4. Received standard query including QNAME=example.org, QTYPE=NS.
6. Received standard query response.
8. Received standard query including QNAME=A.example.org, QTYPE=A.
10. Received standard query response.
12. Received standard query response.

References

RFC2181 Clarifications to the DNS Specification
5.4.1. Ranking data

5.149. Server makes a judgment by the reliability of data (Data from the authority section of an authoritative answer v.s. Data from the authority section of a non-authoritative answer)

Purpose

Verify that a NUT treats the reliability of the various data correctly.

When considering whether to accept an RRSet in a reply, or retain an RRSet already in its cache instead, a server should consider the relative likely trustworthiness of the various data. An authoritative answer from a reply should replace cached data that had been obtained from additional information in an earlier reply.

However additional information from a reply will be ignored if the cache contains data from an authoritative answer or a zone file.

The accuracy of data available is assumed from its source.

Trustworthiness shall be, in order from most to least:

+ Data from a primary zone file, other than glue data,
+ Data from a zone transfer, other than glue,
+ The authoritative data included in the answer section of an authoritative reply.
+ Data from the authority section of an authoritative answer,
+ Glue from a primary zone, or glue from a zone transfer,
+ Data from the answer section of a non-authoritative answer, and non-authoritative data from the answer section of authoritative answers,
+ Additional information from an authoritative answer, Data from the authority section of a non-authoritative answer, Additional information from non-authoritative answers.

Category

Caching Server

Initialization

- **Network Topology**

  Refer the topology "Fig. 15 Topology No.15".

- **Setup**

  Set the DNS Server1's (NUT) address as above mentioned Network Topology.

  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

.	3600000	IN	NS	A.ROOT.NET.
A.ROOT.NET.	3600000		A	192.168.1.20

For IPv6

.	3600000	IN	NS	A.ROOT.NET.

```
 A.ROOT.NET.              3600000          AAAA     3ffe:501:ffff:101::20
     Example of example.com zone file:
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                   <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)       DNS Server2 DNS Server3   DNS Server4
  |                         |                              |             |             |
  |-------------------------->|                              |             |             |
  | 1.Send standard query   |                              |             |             |
  |  QNAME=A.example.org    |                              |             |             |
  |  QTYPE=A                |                              |             |             |
  |                         |------------------------------>|             |             |
  |                         | 2.Recv standard query        |             |             |
  |                         |  QNAME=A.example.org         |             |             |
  |                         |  QTYPE=A                     |             |             |
  |                         |<------------------------------|             |             |
  |                         | 3.Send standard query response |             |             |
  |                         |  QNAME=A.example.org         |             |             |
  |                         |  QTYPE=A                     |             |             |
  |                         |  AUTHORITY Name=org          |             |             |
  |                         |  AUTHORITY Name Server= NS3.example.org|             |             |
  |                         |  ADDITIONAL Name =NS3.example.org |             |             |
  |                         |  ADDITIONAL Address =192.168.1.30 |             |             |
  |                         |                              v             |             |
  |                         |---------------------------------------------->|             |
  |                         |          4.Recv standard query               |             |
  |                         |           QNAME=A.example.org                |             |
  |                         |           QTYPE=A                            |             |
  |                         |<----------------------------------------------|             |
  |                         |          5.Send standard query response      |             |
  |                         |           AA=0                               |             |
  |                         |           QNAME=A.example.org                |             |
  |                         |           QTYPE=A                            |             |
  |                         |           ANSWER Name=A.example.org          |             |
  |                         |           ANSWER Address=192.168.1.10        |             |
  |                         |           AUTHORITY Name=example.org         |             |
  |                         |           AUTHORITY Name Server=NS4.example.org|             |
  |                         |           AUTHORITY TTL=600                  |             |
  |                         |           ADDITIONAL Name=NS4.example.org    |             |
  |                         |           ADDITIONAL Address=192.168.1.40    |             |
  |                         |                                            v             |
```

```
|<----------------------------|                                                        |
| 6.Standard query response   |                                                        |
|  QNAME= A.example.org       |                                                        |
|  QTYPE=A                    |                                                        |
|  ANSWER Name=A.example.org  |                                                        |
|  ANSWER Address=192.168.1.10|                                                        |
|  AUTHORITY Name=example.org |                                                        |
|  AUTHORITY Name Server      |                                                        |
|   = NS4.example.org         |                                                        |
|  AUTHORITY TTL=600          |                                                        |
|  ADDITIONAL Name            |                                                        |
|   = NS4.example.org         |                                                        |
|  ADDITIONAL Address         |                                                        |
|   = 192.168.1.40            |                                                        |
|---------------------------->|                                                        |
| 7. Send standard query      |                                                        |
|  QNAME=B.example.org        |                                                        |
|  QTYPE=A                    |                                                        |
|                             |-------------------------------------------------------->|
|                             |                        8.Send standard query            |
|                             |                         QNAME=B.example.org             |
|                             |                         QTYPE=A                         |
|                             |<--------------------------------------------------------|
|                             |                        9.Send standard query response   |
|                             |                         QNAME=B.example.org             |
|                             |                         QTYPE=A                         |
|                             |                         ANSWER Name=B.example.org       |
|                             |                         ANSWER Address=192.168.1.11     |
|                             |                         AUTHORITY Name=example.org      |
|                             |                         AUTHORITY Name Server           |
|                             |                             = NS4.example.org           |
|                             |                         AUTHORITY TTL=1 day             |
|                             |                         ADDITIONAL Name = NS4.example.org|
|                             |                         ADDITIONAL Address = 192.168.1.40|
|<----------------------------|                                                        |
|10.Standard query response   |                                                        |
|  QNAME= B.example.org       |                                                        |
|  QTYPE=A                    |                                                        |
|  ANSWER Name=B.example.org  |                                                        |
|  ANSWER Address=192.168.1.11|                                                        |
|  AUTHORITY Name=example.org |                                                        |
|  AUTHORITY Name Server      |                                                        |
|   = NS4.example.org         |                                                        |
|  AUTHORITY TTL=ANY          |                                                        |
|  ADDITIONAL Name            |                                                        |
|   = NS4.example.org         |                                                        |
|  ADDITIONAL Address         |                                                        |
|   = 192.168.1.40            |                                                        |
|                             |                                                        |
//     wait 15 seconds        //                                                       //
|                             |                                                        |
|---------------------------->|                                                        |
| 11. Send standard query     |                                                        |
|  QNAME=example.org          |                                                        |
|  QTYPE=NS                   |                                                        |
```

```
|<----------------------------|                                                        |
| 12.Standard query response  |                                                        |
|  QNAME=example.org          |                                                        |
|  QTYPE=NS                   |                                                        |
|  ANSWER Name=example.org    |                                                        |
|  ANSWER Nsdname             |                                                        |
|             =NS4.example.org|                                                        |
|  ANSWER TTL=more than 600   |                                                        |
|  ADDITIONAL Name            |                                                        |
|   = NS4.example.org         |                                                        |
|  ADDITIONAL Address         |                                                        |
|   = 192.168.1.40            |                                                        |
|                             |                                                        |
v                             v                                                        v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2(TN: root name server)(Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
6. NUT transmits query response to DNS Client1 (TN). (Judgment *6)
7. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
8. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *8)
9. TN send query response to ANSWER Name=B.example.org, ANSWER Address=192.168.1.11.
10. NUT transmits query response to DNS Client1 (TN). (Judgment *10)
11. TN send standard query QNAME=example.org, QTYPE=NS to NUT.
12. NUT transmits query response to DNS Client1 (TN). (Judgment *12)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)

	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	600
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	600
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

7th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

8th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY

DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	4
	ADDRESS	192.168.1.40

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4

	ADDRESS	192.168.1.40

11th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1002
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

12th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1002
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1

	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	more than 600
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0x00C)
DNS Authority section	NAME	example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	6
	NSDNAME	NS4.example.org (Pointer 0xC0029)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.40

- Termination
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query response.
8. Received standard query including QNAME=B.example.org, QTYPE=A.
10. Received standard query response.
12. Received standard query response.

References

RFC2181 Clarifications to the DNS Specification
5.4.1. Ranking data

5.150. Server makes a judgment by the reliability of data (Data from the answer section of a non-authoritative answer v.s. Data from the additional section of an authoritative answer)

Purpose

Verify that a NUT treats the reliability of the various data correctly.

When considering whether to accept an RRSet in a reply, or retain an RRSet already in its cache instead, a server should consider the relative likely trustworthiness of the various data. An authoritative answer from a reply should replace cached data that had been obtained from additional information in an earlier reply. However additional information from a reply will be ignored if the cache contains data from an authoritative answer or a zone file.

The accuracy of data available is assumed from its source.
Trustworthiness shall be, in order from most to least:

+ Data from a primary zone file, other than glue data,
+ Data from a zone transfer, other than glue,
+ The authoritative data included in the answer section of an authoritative reply.
+ Data from the authority section of an authoritative answer,
+ Glue from a primary zone, or glue from a zone transfer,
+ Data from the answer section of a non-authoritative answer, and non-authoritative data from the answer section of authoritative answers,
+ Additional information from an authoritative answer, Data from the authority section of a non-authoritative answer, Additional information from non-authoritative answers.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 15 Topology No.15".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

.	3600000	IN	NS	A.ROOT.NET.
A.ROOT.NET.	3600000		A	192.168.1.20

For IPv6

.	3600000	IN	NS	A.ROOT.NET.

```
 A.ROOT.NET.              3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS         NS1.example.com.
NS1      IN       A          192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                        <-------------- TN --------------->
DNS Client1 (TN)              DNS Server1 (NUT)         DNS Server2 DNS Server3 DNS Server4
  |                                |                          |           |             |
  |--------------------------------->|                          |           |             |
  | 1.Send standard query          |                          |           |             |
  |  QNAME=NS4.example.org         |                          |           |             |
  |  QTYPE=A                       |                          |           |             |
  |                                |--------------------------->|           |             |
  |                                | 2.Recv standard query    |           |             |
  |                                |  QNAME=NS4.example.org   |           |             |
  |                                |  QTYPE=A                 |           |             |
  |                                |<---------------------------|           |             |
  |                                | 3.Send standard query response |           |             |
  |                                |  QNAME=NS4.example.org   |           |             |
  |                                |  QTYPE=A                 |           |             |
  |                                |  AUTHORITY Name=org      |           |             |
  |                                |  AUTHORITY Name Server   |           |             |
  |                                |            =NS3.example.org |           |             |
  |                                |  ADDITIONAL Name=NS3.example.org|           |             |
  |                                |  ADDITIONAL Address=192.168.1.30|           |             |
  |                                |                          v           |             |
  |                                |------------------------------------------->|             |
  |                                |          4.Recv standard query             |             |
  |                                |           QNAME=NS4.example.org            |             |
  |                                |           QTYPE=A                          |             |
  |                                |<-------------------------------------------|             |
  |                                |          5.Send standard query response    |             |
  |                                |           AA=0                             |             |
  |                                |           QNAME=NS4.example.org            |             |
  |                                |           QTYPE=A                          |             |
  |                                |           ANSWER Name=NS4.example.org      |             |
  |                                |           ANSWER Address=192.168.1.40      |             |
  |                                |           ANSWER TTL=600                   |             |
  |                                |           AUTHORITY Name=example.org       |             |
  |                                |           AUTHORITY Name Server            |             |
  |                                |                  = NS4.example.org         |             |
  |                                |                                          v             |
```

```
|<---------------------------------|                                                        |
| 6.Standard query response        |                                                        |
|  QNAME=NS4.example.org           |                                                        |
|  QTYPE=A                         |                                                        |
|  ANSWER Name=NS4.example.org     |                                                        |
|  ANSWER Address=192.168.1.40     |                                                        |
|  ANSWER TTL=600                  |                                                        |
|  AUTHORITY Name=example.org      |                                                        |
|  AUTHORITY Name Server           |                                                        |
|          = NS4.example.org       |                                                        |
|--------------------------------->|                                                        |
| 7.Send standard query            |                                                        |
|  QNAME=A.example.org             |                                                        |
|  QTYPE=A                         |                                                        |
|                                  |-------------------------------------------------------->|
|                                  |                     8.Send standard query                |
|                                  |                      QNAME=A.example.org                 |
|                                  |                      QTYPE=A                             |
|                                  |<--------------------------------------------------------|
|                                  |                     9.Send standard query response       |
|                                  |                      QNAME=A.example.org                 |
|                                  |                      QTYPE=A                             |
|                                  |                      ANSWER Name=A.example.org           |
|                                  |                      ANSWER Address=192.168.1.10         |
|                                  |                      AUTHORITY Name=example.org          |
|                                  |                      AUTHORITY Name Server=NS4.example.org|
|                                  |                      ADDITIONAL Name= NS4.example.org    |
|                                  |                      ADDITIONAL Address= 192.168.1.40    |
|                                  |                      ADDITIONAL TTL=1 day                |
|<---------------------------------|                                                        |
|10.Standard query response        |                                                        |
|  QNAME=A.example.org             |                                                        |
|  QTYPE=A                         |                                                        |
|  ANSWER Name=A.example.org       |                                                        |
|  ANSWER Address=192.168.1.10     |                                                        |
|  AUTHORITY Name=example.org      |                                                        |
|  AUTHORITY Name Server           |                                                        |
|   = NS4.example.org              |                                                        |
|  ADDITIONAL Name= NS4.example.org|                                                        |
|  ADDITIONAL Address=192.168.1.40 |                                                        |
|  ADDITIONAL TTL=ANY              |                                                        |
|                                  |                                                        |
//     wait 15 seconds             //                                                        //
|                                  |                                                        |
|--------------------------------->|                                                        |
| 11.Send standard query           |                                                        |
|  QNAME=NS4.example.org           |                                                        |
|  QTYPE=A                         |                                                        |
|<---------------------------------|                                                        |
| 12.Standard query response       |                                                        |
|  QNAME=NS4.example.org           |                                                        |
|  QTYPE=A                         |                                                        |
|  ANSWER Name=NS4.example.org     |                                                        |
|  ANSWER Address = 192.168.1.40   |                                                        |
|  ANSWER TTL=less than 600        |                                                        |
|  AUTHORITY Name=example.org      |                                                        |
|  AUTHORITY Name Server           |                                                        |
|   = NS4.example.org              |                                                        |
|                                  |                                                        |
v                                  v                                                        v
```

1. TN send standard query QNAME=NS4.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=NS4.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to ANSWER Name=NS4.example.org, ANSWER Address=192.168.1.40.
6. NUT transmits query response to DNS Client1 (TN). (Judgment *6)
7. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
8. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *8)
9. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
10. NUT transmits query response to DNS Client1 (TN). (Judgment *10)
11. TN send standard query QNAME=NS4.example.org, QTYPE=A to NUT.
12. NUT transmits query response to DNS Client1 (TN). (Judgment *12)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53

DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC018)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC010)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC01D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0

	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	NS4.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	600
	RDLENGTH	4
	ADDRESS	192.168.1.40
DNS Authority section	NAME	example.org (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	2
	NSDNAME	NS4.example.org (Pointer 0xC00C)

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	NS4.example.org (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	600
	RDLENGTH	4
	ADDRESS	192.168.1.40
DNS Authority section	NAME	example.org (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	2
	NSDNAME	NS4.example.org (Pointer 0xC00C)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.40

7th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

8th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.40

11th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1002
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0

	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

12th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1002
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	NS4.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	less than 600
	RDLENGTH	4
	ADDRESS	192.168.1.40
DNS Authority section	NAME	example.org (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	2
	NSDNAME	NS4.example.org (Pointer 0xC00C)

DNS Additional section	NAME	NS4.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=NS4.example.org, QTYPE=A.
4. Received standard query including QNAME=NS4.example.org, QTYPE=A.
6. Received standard query response.
8. Received standard query including QNAME=A.example.org, QTYPE=A.
10. Received standard query response.
12. Received standard query response.

References

RFC2181 Clarifications to the DNS Specification
5.4.1. Ranking data

5.151. Least reliability data should not return as answer (Additional section from an authoritative answer)

Purpose

Verify that a NUT doesn't use the least reliability data as answer.

- Unauthenticated RRs received and cached from the least trustworthy of those groupings, that is data from the additional data section, and data from the authority section of a non-authoritative answer, should not be cached in such a way that they would ever be returned as answers to a received query. They may be returned as additional information where appropriate. Ignoring this would allow the trustworthiness of relatively untrustworthy data to be increased without cause or excuse.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.
  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20
For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
 )
 ;
         IN      NS     NS1.example.com.
 NS1     IN      A      192.168.0.10
 ;
```

Procedure

This test sequence is following.

```
                                                <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)    DNS Server2 DNS Server3 DNS Server4
  |                         |                    |           |           |
  |------------------------>|                    |           |           |
  | 1. Send standard query  |                    |           |           |
  |  QNAME=A.example.org    |                    |           |           |
  |  QTYPE=A                |                    |           |           |
  |                         |------------------->|           |           |
  |                         | 2.Recv standard query           |           |
  |                         |  QNAME=A.example.org            |           |
  |                         |  QTYPE=A                        |           |
  |                         |<-------------------|           |           |
  |                         | 3.Send standard query response  |           |
  |                         |  QNAME=A.example.org            |           |
  |                         |  QTYPE=A                        |           |
  |                         |  AUTHORITY Name=org             |           |
  |                         |  AUTHORITY Name Server          |           |
  |                         |            =NS3.example.org     |           |
  |                         |  ADDITIONAL Name=NS3.example.org|           |
  |                         |            =NS3.example.org     |           |
  |                         |  ADDITIONAL Address=192.168.1.30|           |
  |                         |                                 v           |
  |                         |------------------------------------------->|
  |                         |             4.Recv standard query           |
  |                         |              QNAME=A.example.org            |
  |                         |              QTYPE=A                        |
  |                         |<-------------------------------------------|
  |                         |             5.Send standard query response  |
  |                         |              QNAME=A.example.org            |
  |                         |              QTYPE=A                        |
  |                         |              AUTHORITY Name=example.org     |
  |                         |              AUTHORITY Name Server          |
  |                         |                     = NS4.example.org       |
  |                         |              ADDITIONAL Name=NS4.example.org|
  |                         |              ADDITIONAL Address=192.168.1.40|
  |                         |                                         v   |
  |                         |------------------------------------------------------>|
  |                         |                       6.Send standard query           |
  |                         |                        QNAME=A.example.org            |
  |                         |                        QTYPE=A                        |
  |                         |<------------------------------------------------------|
  |                         |                       7.Send standard query response  |
  |                         |                        QNAME=A.example.org            |
  |                         |                        QTYPE=A                        |
  |                         |                        ANSWER Name=A.example.org      |
  |                         |                        ANSWER Address=192.168.1.10    |
  |                         |                        ANSWER TTL=1 day               |
  |                         |                        AUTHORITY Name=example.org     |
  |                         |                        AUTHORITY Name Server          |
  |                         |                            = NS4.example.org          |
  |                         |                        ADDITIONAL Name                |
  |                         |                            = NS4.example.org          |
  |                         |                        ADDITIONAL Address             |
  |                         |                            = 192.168.1.40             |
```

```
|<----------------------------|                                                |
| 8.Standard query response   |                                                |
|  QNAME= A.example.org       |                                                |
|  QTYPE=A                    |                                                |
|  ANSWER Name=A.example.org  |                                                |
|  ANSWER Address=192.168.1.10|                                                |
|  ANSWER TTL=1 day           |                                                |
|  AUTHORITY Name=example.org |                                                |
|  AUTHORITY Name Server      |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Name            |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Address         |                                                |
|   = 192.168.1.40            |                                                |
|---------------------------->|                                                |
| 9.Send standard query       |                                                |
|  QNAME=NS4.example.org      |                                                |
|  QTYPE=A                    |                                                |
|                             |------------------------------------------------->|
|                             |                           10A.Send standard query |
|                             |                             QNAME=NS4.example.org |
|                             |                             QTYPE=A               |
| X <-------------------------|                                                |
|10B.Standard query response  |                                                |
|  QNAME=NS4.example.org      |                                                |
|  QTYPE=A                    |                                                |
|  ANSWER Name=NS4.example.org|                                                |
|  ANSWER Type=A              |                                                |
|  ANSWER Address=192.168.1.40|                                                |
|                             |                                                |
v                             v                                                v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
8. NUT transmits query response to DNS Client1 (TN). (Judgment *8)
9. TN send standard query QNAME=NS4.example.org, QTYPE=A to NUT.

10A. NUT transmits standard query QNAME=NS4.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *10A)

10B. TN send query response to ANSWER Name=NS4.example.org, ANSWER Address=192.168.1.40. (Judgment *10B)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53

DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY

	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1

	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0

	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet (10A).

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- Termination

  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response.
10A. Received standard query including QNAME=NS4.example.org, QTYPE=A.
or
10B. Not received standard query response.
*10A or 10B is judged.

References

RFC2181 Clarifications to the DNS Specification
5.4.1. Ranking data

5.152. Least reliability data should not return as answer (Authority section from a non-authoritative answer)

Purpose

Verify that a NUT doesn't use the least reliability data as answer.

- Unauthenticated RRs received and cached from the least trustworthy of those groupings, that is data from the additional data section, and data from the authority section of a non-authoritative answer, should not be cached in such a way that they would ever be returned as answers to a received query. They may be returned as additional information where appropriate. Ignoring this would allow the trustworthiness of relatively untrustworthy data to be increased without cause or excuse.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig.22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.
  Example of root server list:

```
For IPv4:
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                A       192.168.1.20
For IPv6
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000        AAAA    3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                  <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)      DNS Server2  DNS Server3  DNS Server4
  |                         |                            |           |           |
  |-------------------------->|                            |           |           |
  | 1. Send standard query  |                            |           |           |
  |  QNAME=A.example.org    |                            |           |           |
  |  QTYPE=A                |                            |           |           |
  |                         |----------------------------->|           |           |
  |                         | 2.Recv standard query      |           |           |
  |                         |  QNAME=A.example.org       |           |           |
  |                         |  QTYPE=A                   |           |           |
  |                         |<-----------------------------|           |           |
  |                         | 3.Send standard query response|           |           |
  |                         |  QNAME=A.example.org       |           |           |
  |                         |  QTYPE=A                   |           |           |
  |                         |  AUTHORITY Name=org        |           |           |
  |                         |  AUTHORITY Name Server     |           |           |
  |                         |            =NS3.example.org |           |           |
  |                         |  ADDITIONAL Name           |           |           |
  |                         |            =NS3.example.org |           |           |
  |                         |  ADDITIONAL Address        |           |           |
  |                         |            =192.168.1.30   |           |           |
  |                         |                            v           |           |
  |                         |------------------------------------------->|           |
  |                         |             4.Recv standard query         |           |
  |                         |              QNAME=A.example.org          |           |
  |                         |              QTYPE=A                      |           |
  |                         |<-------------------------------------------|           |
  |                         |             5.Send standard query response|           |
  |                         |              AA=0                         |           |
  |                         |              QNAME=A.example.org          |           |
  |                         |              QTYPE=A                      |           |
  |                         |              ANSWER Name=A.example.org    |           |
  |                         |              ANSWER Address=192.168.1.10  |           |
  |                         |              AUTHORITY Name=example.org   |           |
  |                         |              AUTHORITY Name Server        |           |
  |                         |                     = NS4.example.org     |           |
  |                         |              ADDITIONAL Name              |           |
  |                         |                     = NS4.example.org     |           |
  |                         |              ADDITIONAL Address           |           |
  |                         |                     = 192.168.1.40        |           |
  |                         |                                           v           |
  |<--------------------------|                                                       |
  | 6.Standard query response |                                                       |
  |  QNAME= A.example.org     |                                                       |
  |  QTYPE=A                  |                                                       |
  |  ANSWER Name=A.example.org |                                                       |
  |  ANSWER Address=192.168.1.10|                                                       |
  |  AUTHORITY Name=example.org |                                                       |
  |  AUTHORITY Name Server    |                                                       |
  |   = NS4.example.org       |                                                       |
  |  ADDITIONAL Name          |                                                       |
  |   = NS4.example.org       |                                                       |
  |  ADDITIONAL Address       |                                                       |
  |   = 192.168.1.40          |                                                       |
```

```
|---------------------------->|                                                |
| 7. Send standard query      |                                                |
|  QNAME=example.org          |                                                |
|  QTYPE=NS                   |                                                |
|                             |------------------------------------------->|   |
|                             |             8A.Send standard query         |   |
|                             |               QNAME=example.org            |   |
|                             |               QTYPE=NS                     |   |
| X <-------------------------|                                            |   |
| 8B.Standard query response  |                                            |   |
|  QNAME=example.org          |                                            |   |
|  QTYPE=NS                   |                                            |   |
|  ANSWER Name=example.org    |                                            |   |
|  ANSWER Nsdname             |                                            |   |
|             =NS4.example.org|                                            |   |
|                             |                                            |   |
v                             v                                            v   v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
6. NUT transmits query response to DNS Client1 (TN). (Judgment *6)
7. TN send standard query QNAME=example.org, QTYPE=NS to NUT.

8A. NUT transmits standard query QNAME=example.org, QTYPE=NS to DNS Server2 (TN: NS2.example.org) (Judgment *8A)

8B. TN send query response to ANSWER Name=example.org, ANSWER Nsdname=NS4.example.org. (Judgment *8B)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org

	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4

	ADDRESS	192.168.1.40

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

7th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

8th packet (8A).

Standard query from DNS Server1 (NUT) to DNS Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0

DNS Question section	QNAME	example.org
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

- Termination
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query response.
8A. Received standard query including QNAME=example.org, QTYPE=NS.
    or
8B. Not received standard query response.
*8A or 8B is judged.

References

RFC2181 Clarifications to the DNS Specification
  5.4.1. Ranking data

5.153. Least reliability data should not return as answer (Additional section from a non-authoritative answer)

Purpose

Verify that a NUT doesn't use the least reliability data as answer.

- Unauthenticated RRs received and cached from the least trustworthy of those groupings, that is data from the additional data section, and data from the authority section of a non-authoritative answer, should not be cached in such a way that they would ever be returned as answers to a received query. They may be returned as additional information where appropriate. Ignoring this would allow the trustworthiness of relatively untrustworthy data to be increased without cause or excuse.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig.22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.
  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20
For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                   <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)       DNS Server2 DNS Server3 DNS Server4
 |                           |                        |           |           |
 |---------------------------->|                      |           |           |
 | 1.Send standard query     |                        |           |           |
 |  QNAME=A.example.org      |                        |           |           |
 |  QTYPE=A                  |                        |           |           |
 |                           |------------------------>|           |           |
 |                           | 2.Recv standard query  |           |           |
 |                           |  QNAME=A.example.org   |           |           |
 |                           |  QTYPE=A               |           |           |
 |                           |<------------------------|           |           |
 |                           | 3.Send standard query response|    |           |
 |                           |  QNAME=A.example.org   |           |           |
 |                           |  QTYPE=A               |           |           |
 |                           |  AUTHORITY Name=org    |           |           |
 |                           |  AUTHORITY Name Server |           |           |
 |                           |            =NS3.example.org |      |           |
 |                           |  ADDITIONAL Name = NS3.example.org |  |           |
 |                           |  ADDITIONAL Address = 192.168.1.30 |  |           |
 |                           |                         v          |           |
 |                           |------------------------------------------>|           |
 |                           |             4.Recv standard query          |           |
 |                           |              QNAME=A.example.org           |           |
 |                           |              QTYPE=A                       |           |
 |                           |<------------------------------------------|           |
 |                           |             5.Send standard query response|           |
 |                           |              AA=0                          |           |
 |                           |              QNAME=A.example.org           |           |
 |                           |              QTYPE=A                       |           |
 |                           |              ANSWER Name=A.example.org     |           |
 |                           |              ANSWER Address=192.168.1.10   |           |
 |                           |              AUTHORITY Name=example.org    |           |
 |                           |              AUTHORITY Name Server         |           |
 |                           |                     = NS4.example.org      |           |
 |                           |              ADDITIONAL Name = NS4.example.org |       |
 |                           |              ADDITIONAL Address = 192.168.1.40 |       |
 |                           |                                         v  |           |
 |<----------------------------|                                                       |
 | 6.Standard query response |                                                       |
 |  QNAME= A.example.org     |                                                       |
 |  QTYPE=A                  |                                                       |
 |  ANSWER Name=A.example.org |                                                      |
 |  ANSWER Address=192.168.1.10|                                                      |
 |  AUTHORITY Name=example.org |                                                      |
 |  AUTHORITY Name Server    |                                                       |
 |   = NS4.example.org       |                                                       |
 |  ADDITIONAL Name = NS4.example.org |                                              |
 |  ADDITIONAL Address = 192.168.1.40 |                                              |
 |---------------------------->|                                                       |
 | 7.Send standard query     |                                                       |
 |  QNAME=NS4.example.org    |                                                       |
 |  QTYPE=A                  |                                                       |
```

```
|                            |------------------------------------------>|           |
|                            |             8A.Send standard query        |           |
|                            |               QNAME=NS4.example.org       |           |
|                            |               QTYPE=A                     |           |
| X <------------------------|                                           |           |
| 8B.Standard query response |                                           |           |
|  QNAME=NS4.example.org     |                                           |           |
|  QTYPE=A                   |                                           |           |
|  ANSWER Name=NS4.example.org|                                          |           |
|  ANSWER Type=A             |                                           |           |
|  ANSWER Address=192.168.1.40|                                          |           |
v                            v                                           v           v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2(TN:root name server)(Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to ANSWER Name=A.example.org, ANSWER Address = 192.168.1.10.
6. NUT transmits query response to DNS Client1 (TN). (Judgment *6)
7. TN send standard query QNAME=example.org, QTYPE=NS to NUT.

8A. NUT transmits standard query QNAME=NS4.example.org, QTYPE=A to DNS Server2 (TN: NS2.example.org) (Judgment *8A)

8B. TN send query response to ANSWER Name=NS4.example.org, ANSWER Address=192.168.1.40 (Judgment *8B)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)

	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

7th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

8th packet (8A).

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY

DNS Question section	QNAME	NS4.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query response.
8A. Received standard query including QNAME=NS4.example.org, QTYPE=A.
or
8B. Not received standard query response.
*8A or 8B is judged.

References

RFC2181 Clarifications to the DNS Specification
5.4.1. Ranking data

5.154. A Resource Record Set should only be included once in any DNS reply.

Purpose

Verify that a NUT includes only one RRset to response.

- A Resource Record Set should only be included once in any DNS reply. It may occur in any of the Answer, Authority, or Additional Information sections, as required. However it should not be repeated in the same, or any other, section, except where explicitly required by a specification.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1　Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
         IN        NS        NS2.example.com.
NS1      IN        A         192.168.0.10
NS2      IN        A         192.168.0.11
;
A        IN        A         192.168.1.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |---------------------------------------->|
    |   1. Send standard query              |
    |       QNAME=example.com               |
    |       QTYPE=NS                        |
    |<----------------------------------------|
    |   2. Standard query response          |
    |       QNAME Name=example.com          |
    |       OTYPE=NS                        |
    |       ANSWER Name=example.com         |
    |       ANSWER Nsdname=NS1.example.com  |
    |       ANSWER Name=example.com         |
    |       ANSWER Nsdname=NS2.example.com  |
    |       ADDITIONAL Name=NS1.example.com |
    |       ADDITIONAL Address=192.168.0.10 |
    |       ADDITIONAL Name=NS2.example.com |
    |       ADDITIONAL Address=192.168.0.11 |
    v                                       v

1. TN send standard query QNAME=example.com, QTYPE=NS to NUT.
2. NUT reply query response w/ NSDNAME=NS1.example.com, NS2.example.com to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.com

	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	any
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	0
	ARCOUNT	2
DNS Question section	QNAME	example.com
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00C)
DNS Answer section	NAME	example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS2.example.com (NS2 + Pointer 0xC00C)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC029)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4

	ADDRESS	192.168.0.10
DNS Additional section	NAME	NS1.example.com (Pointer 0xC035)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.11

- **Termination**
  None

Judgment

2. Received standard query response that include only one RRset in Answer section.

*Authority section must not include RRset same as Answer section's RRSet.
*Additional section is optional.

References

RFC2181 Clarifications to the DNS Specification
5.5. Sending RRSets (reprise)

5.155. A server for a zone should not return authoritative answer for queries related to names in another name

Purpose

Verify that a NUT does not set AA bit for subdomain.

- A server for a zone should not return authoritative answers for queries related to names in another zone, which includes the NS, and perhaps A, records at a zone cut, unless it also happens to be a server for the other zone.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 39 Topology No.39".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
         IN       NS       NS2.example.com.
NS1      IN       A        192.168.0.10
;
sub      IN       NS       NS6.sub.example.com.
NS6.sub  IN       A        192.168.0.30
;
A        IN       A        192.168.1.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                          DNS Server1 (NUT)
    |                                         |
    |----------------------------------------->|
    | 1. Send standard query                  |
    |       QNAME=sub.example.com             |
    |       QTYPE=NS                          |
    |<-----------------------------------------|
    | 2. Standard query response              |
    |   AA=0                                  |
    |   RD=0                                  |
    |   QNAME Name=sub.example.com            |
    |   QTYPE=NS                              |
    |   AUTHORITY Name=sub.example.com        |
    |   AUTHORITY Nsdname                     |
    |                 =NS6.sub.example.com    |
    |   ADDITIONAL Name=NS6.sub.example.com   |
    |   ADDITIONAL Address=192.168.0.30       |
    |----------------------------------------->|
    | 3. Send standard query                  |
    |       QNAME=NS6.sub.example.com         |
    |       QTYPE=A                           |
    |<-----------------------------------------|
    | 4. Standard query response              |
    |   AA=0                                  |
    |   RD=0                                  |
    |   QNAME Name=NS6.sub.example.com        |
    |   QTYPE=A                               |
    |   AUTHORITY Name=sub.example.com        |
    |   AUTHORITY Name Server                 |
    |                 =NS6.sub.example.com    |
    |   ADDITIONAL Name=NS6.sub.example.com   |
    |   ADDITIONAL Address=192.168.0.30       |
    v                                         v

     1. TN send standard query QNAME=sub.example.com, QTYPE=NS to NUT.
     2. NUT reply query response(non-authoritative answer) to TN (Judgment *2)
     3. TN send standard query QNAME=NS6.sub.example.com, QTYPE=A to NUT.
     4. NUT reply query response(non-authoritative answer) to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0

	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	sub.example.com
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	any
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	sub.example.com
	QTYPE	NS (0x0002)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sub.example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS6.sub.example.com (NS6 + Pointer 0xC00C)

DNS Additional section	NAME	NS6.sub.example.com (Pointer 0xC02D)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.30

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	NS6.sub.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0

	RA	any
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	NS6.sub.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	sub.example.com (Pointer 0xC010)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS6.sub.example.com (Pointer 0xC00C)
DNS Additional section	NAME	NS6.sub.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.30

- Termination
  None

Judgment

2. Received standard query response with AA bit=0.
4. Received standard query response with AA bit=0.

References

RFC2181 Clarifications to the DNS Specification
6.1. Zone authority

5.156. SOA records are to be placed in the authority section

Purpose

Verify that a NUT places SOA record into the authority section.

- RFC1034, in section 3.7, indicates that the authority section of an authoritative answer may contain the SOA record for the zone from which the answer was obtained. When discussing negative caching, RFC1034 section 4.3.4 refers to this technique but mentions the additional section of the response. The former is correct, as is implied by the example shown in section 6.2.5 of RFC1034. SOA records, if added, are to be placed in the authority section.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig.1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL      86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
          2005081600      ; serial
          3600            ; refresh every 1 hr
          900             ; retry every 15 min
          604800          ; expire after a week
          3600            ; Minimum TTL of a 1 hr
)
;
          IN      NS      NS1.example.com.
NS1       IN      A       192.168.0.10
;
A         IN      A       192.168.1.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |--------------------------------------->|
    |   1. Send standard query              |
    |       QNAME=invalid.example.com       |
    |       QTYPE=A                         |
    |<---------------------------------------|
    |   2. Standard query response          |
    |       NXDOMAIN                        |
    v                                       v

     1. TN send standard query QNAME=invalid.example.com, QTYPE=A to NUT.
     2. NUT reply query response w/ SOA record authority section to TN. (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	invalid.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	invalid.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

- **Termination**
  None

Judgment

2. Received standard query response w/ SOA record in Authority section.

References

RFC2181 Clarifications to the DNS Specification
7.1. Placement of SOA RRs in authoritative answers

5.157. Time to live

Purpose

Verify that a NUT uses a minimum value of 0, and a maximum value of 2147483647 as TTL value.

- It is hereby specified that a TTL value is an unsigned number, with a minimum value of 0, and a maximum value of 2147483647. That is, a maximum of 2^31 - 1. When transmitted, this value shall be encoded in the less significant 31 bits of the 32 bit TTL field, with the most significant, or sign, bit set to zero.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 40 Topology No.40".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN      NS        NS1.example.com.
NS1      IN      A         192.168.0.10
;
A        0       IN        A       192.168.1.10
B        2147483647        IN      A       192.168.1.11
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
    |                                     |
    |------------------------------------>|
    |   1. Send standard query            |
    |       QNAME=A.example.com           |
    |       QTYPE=A                       |
    |<------------------------------------|
    |   2. Standard query response        |
    |       TTL=0                         |
    |       A=192.168.1.10                |
    |------------------------------------>|
    |   3. Send standard query            |
    |       QNAME=B.example.com           |
    |       QTYPE=A                       |
    |<------------------------------------|
    |   4. Standard query response        |
    |       TTL=2147483647                |
    |       A=192.168.1.11                |
    v                                     v

1. TN send standard query QNAME=A.example.com, QTYPE=A to NUT.
2. NUT reply query response w/ TTL=0, A=192.168.1.10 to TN. (Judgment *2)
3. TN send standard query QNAME=B.example.com, QTYPE=A to NUT.
4. NUT reply query response w/ TTL=2147483647, A=192.168.1.11 to TN. (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0

DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	0
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	2147483647
	RDLENGTH	4
	ADDRESS	192.168.1.11
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response w/ TTL=0, A=192.168.1.10.
4. Received standard query response w/ TTL=2147483647, A=192.168.1.11.

References

RFC2181 Clarifications to the DNS Specification
8. Time to Live (TTL)

5.158. Received with the most significant bit is set

Purpose

Verify that a NUT treats TTL value with most significant bit is set as zero.

- Implementations should treat TTL values received with the most significant bit set as if the entire value received was zero.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20

For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                        <-------------- TN --------------->
DNS Client1 (TN)        DNS Server1 (NUT)               DNS Server2 DNS Server3 DNS Server4
 |                           |                                |           |           |
 |---------------------------->|                              |           |           |
 | 1.Send standard query     |                                |           |           |
 |  QNAME=A.example.org      |                                |           |           |
 |  QTYPE=A                  |                                |           |           |
 |                           |------------------------------->|           |           |
 |                           | 2.Recv standard query          |           |           |
 |                           |  QNAME=A.example.org           |           |           |
 |                           |  QTYPE=A                       |           |           |
 |                           |<-------------------------------|           |           |
 |                           | 3.Send standard query response |           |           |
 |                           |  QNAME=A.example.org           |           |           |
 |                           |  QTYPE=A                       |           |           |
 |                           |  AUTHORITY Name=org            |           |           |
 |                           |  AUTHORITY Name Server         |           |           |
 |                           |            =NS3.example.org    |           |           |
 |                           |  ADDITIONAL Name=NS3.example.org|          |           |
 |                           |            =NS3.example.org    |           |           |
 |                           |  ADDITIONAL Address=192.168.1.30|          |           |
 |                           |                                v           |           |
 |                           |---------------------------------------->|           |
 |                           |            4.Recv standard query           |           |
 |                           |             QNAME=A.example.org            |           |
 |                           |             QTYPE=A                        |           |
 |                           |<----------------------------------------|           |
 |                           |            5.Send standard query response  |           |
 |                           |             QNAME=A.example.org            |           |
 |                           |             QTYPE=A                        |           |
 |                           |             AUTHORITY Name=example.org     |           |
 |                           |             AUTHORITY Name Server          |           |
 |                           |                    = NS4.example.org       |           |
 |                           |             ADDITIONAL Name=NS4.example.org|           |
 |                           |             ADDITIONAL Address=192.168.1.40|           |
 |                           |                                        v           |
 |                           |------------------------------------------------------>|
 |                           |                       6.Send standard query           |
 |                           |                        QNAME=A.example.org            |
 |                           |                        QTYPE=A                        |
 |                           |<------------------------------------------------------|
 |                           |                       7.Send standard query response  |
 |                           |                        QNAME=A.example.org            |
 |                           |                        QTYPE=A                        |
 |                           |                        ANSWER Name=A.example.org      |
 |                           |                        ANSWER Address=192.168.1.10    |
 |                           |                        ANSWER TTL=TTL with most       |
 |                           |                               significant bit is set  |
 |                           |                        AUTHORITY Name=example.org     |
 |                           |                        AUTHORITY Name Server          |
 |                           |                            = NS4.example.org          |
 |                           |                        ADDITIONAL Name=NS4.example.org|
 |                           |                        ADDITIONAL Address=192.168.1.40|
```

```
|<----------------------------|                                                  |
| 8.Standard query response   |                                                  |
|  QNAME= A.example.org       |                                                  |
|  QTYPE=A                    |                                                  |
|  ANSWER Name=A.example.org  |                                                  |
|  ANSWER Address=192.168.1.10|                                                  |
|  AUTHORITY Name=example.org |                                                  |
|  AUTHORITY Name Server      |                                                  |
|        = NS4.example.org    |                                                  |
|  ADDITIONAL Name            |                                                  |
|        = NS4.example.org    |                                                  |
|  ADDITIONAL Address         |                                                  |
|        = 192.168.1.40       |                                                  |
|---------------------------->|                                                  |
| 9.Send standard query       |                                                  |
|  QNAME=A.example.org        |                                                  |
|  QTYPE=A                    |                                                  |
|                             |------------------------------------------------->|
|                             |                        10.Send standard query    |
|                             |                          QNAME=A.example.org     |
|                             |                          QTYPE=A                 |
|                             |                                                  |
v                             v                                                  v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)
9. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
10. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1

	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY

	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	0x80015180
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org

	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)

	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response.
10. Received standard query including QNAME=A.example.org, QTYPE=A.

References

RFC2181 Clarifications to the DNS Specification
8. Time to Live (TTL)

5.159. Case of the TC header bit is not set

Purpose

Verify that a NUT does not set TC bit for results of additional section processing.

- The TC bit should not be set merely because some extra information could have been included, but there was insufficient room. This includes the results of additional section processing. In such cases the entire RRSet that will not fit in the response should be omitted, and the reply sent as is, with the TC bit clear.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1　Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
B        IN      A        192.168.1.100
         IN      A        192.168.1.101
         IN      A        192.168.1.102
         IN      A        192.168.1.103
         IN      A        192.168.1.104
         IN      A        192.168.1.105
         IN      A        192.168.1.106
         IN      A        192.168.1.107
```

```
IN      A       192.168.1.108
IN      A       192.168.1.109
IN      A       192.168.1.110
IN      A       192.168.1.111
IN      A       192.168.1.112
IN      A       192.168.1.113
IN      A       192.168.1.114
IN      A       192.168.1.115
IN      A       192.168.1.116
IN      A       192.168.1.117
IN      A       192.168.1.118
IN      A       192.168.1.119
IN      A       192.168.1.120
IN      A       192.168.1.121
IN      A       192.168.1.122
IN      A       192.168.1.123
IN      A       192.168.1.124
IN      A       192.168.1.125
IN      A       192.168.1.126
IN      A       192.168.1.127
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
    |                                     |
    |------------------------------------>|
    |   1. Send standard query            |
    |       QNAME=B.example.com           |
    |       QTYPE=A                       |
    |<------------------------------------|
    |   2. Standard query response        |
    |       (TC bit is not set)           |
    |       QNAME=B.example.com           |
    |       QTYPE=A                       |
    |       ANSWER=192.168.1.100          |
    |          to  192.168.1.127          |
    |       AUTHORITY Name=example.org    |
    |       AUTHORITY Name Server         |
    |           = NS1.example.org         |
    v                                     v

     1. TN send standard query QNAME=B.example.com, QTYPE=A to NUT.
     2. NUT reply query response w/ A=192.168.1.100 - 192.168.1.127 to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ

	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	30
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

DNS Answer section	NAME	B.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.100
DNS Answer section X 28 ADDRESS 192.168.1.101 - 192.168.1.126	NAME	B.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	****
DNS Answer section	NAME	B.example.com (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.127
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)

- Termination
  None

Judgment

2. Received standard query response w/ A=192.168.1.100 - 192.168.1.127 that include Authority section (TC bit is not set).

References

RFC2181 Clarifications to the DNS Specification
9. The TC (truncated) header bit

5.160. RRSet for PTR record

Purpose

Verify that a NUT transmits response including RRSet for PTR resource record

- Confusion about canonical names has lead to a belief that a PTR record should have exactly one RR in its RRSet. This is incorrect, the relevant section of RFC1034 (section 3.6.2) indicates that the value of a PTR record should be a canonical name. That is, it should not be an alias. There is no implication in that section that only one PTR record is permitted for a name. No such restriction should be inferred.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1　Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
B        IN      A        192.168.1.10
```

  Example of 1.168.192.IN-ADDR.ARPA domain zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh after 1 hr
         900              ; retry after 15 min
```

```
        604800          ; expire after 1 week
        3600            ; Minimum TTL of 1 hr
)
;
        IN      NS      NS1.example.com.
;
10      IN      PTR     A.example.com.
10      IN      PTR     B.example.com.
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
    |                                     |
    |------------------------------------>|
    |   1. Send standard query            |
    |      QNAME=10.1.168.192.IN-ADDR.ARPA |
    |      QTYPE=PTR                      |
    |<------------------------------------|
    |   2. Standard query response        |
    v                                     v

1. TN send standard query QNAME=10.1.168.192.IN-ADDR.ARPA, QTYPE=PTR to NUT.
2. NUT reply query response w/ PTR=A.example.com, B.example.com to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0

DNS Question section	QNAME	10.1.168.192.IN-ADDR.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	10.1.168.192.IN-ADDR.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	10.1.168.192.IN-ADDR.ARPA (Pointer 0xC00C)
	TYPE	PTR (0x000C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	15
	PTRDNAME	A.example.com
DNS Answer section	NAME	10.1.168.192.IN-ADDR.ARPA (Pointer 0xC00C)
	TYPE	PTR (0x000C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	PTRDNAME	B.example.com (B + Pointer 0xC039)
DNS Authority section	NAME	1.168.192.IN-ADDR.ARPA (Pointer 0xC00F)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC039)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC062)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response including RRSet for PTR resource record.

References

RFC2181 Clarifications to the DNS Specification
10.2. PTR records

5.161. Name error (RCODE=NXDOMAIN)

Purpose

Verify that a NUT transmits the response with Name error (NXDOMAIN).

- Name errors (NXDOMAIN) are indicated by the presence of "Name Error" in the RCODE field. In this case the domain referred to by the QNAME does not exist. Note: the answer section may have SIG and CNAME RRs and the authority section may have SOA, NXT [RFC2065] and SIG RRsets
- Name servers authoritative for a zone MUST include the SOA record of the zone in the authority section of the response when reporting an NXDOMAIN or indicating that no data of the requested type exists. This is required so that the response may be cached. The TTL of this record is set from the minimum of the MINIMUM field of the SOA record and the TTL of the SOA itself, and indicates how long a resolver may cache the negative answer.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
B        IN      CNAME    invalid.example.com.
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
    |                                     |
    |------------------------------------->|
    |   1. Send standard query            |
    |       QNAME=B.example.com           |
    |       QTYPE=A                       |
    |<-------------------------------------|
    |   2. Standard query response        |
    |       NXDOMAIN                      |
    v                                     v

 1. TN send standard query QNAME=B.example.com, QTYPE=A to NUT.
 2. NUT reply query response w/ SOA record authority section to TN. (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	B.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.com (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	10
	CNAME	invalid.example.com (invalid + Pointer 0xC00E)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

- Termination

  None

Judgment

2. Received standard query response (NXDOMAIN) w/ SOA record in Authority section.

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
2.1 - Name Error
2.1.1 Special Handling of Name Error
3 - Negative Answers from Authoritative Servers

5.162. No Data

Purpose

Verify that a NUT transmits the response with No data (NODATA).

- NODATA is indicated by an answer with the RCODE set to NOERROR and no relevant answers in the answer section. The authority section will contain an SOA record, or there will be no NS records there.
- Name servers authoritative for a zone MUST include the SOA record of the zone in the authority section of the response when reporting an NXDOMAIN or indicating that no data of the requested type exists. This is required so that the response may be cached. The TTL of this record is set from the minimum of the MINIMUM field of the SOA record and the TTL of the SOA itself, and indicates how long a resolver may cache the negative answer.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL      86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
          2005081600       ; serial
          3600             ; refresh every 1 hr
          900              ; retry every 15 min
          604800           ; expire after a week
          3600             ; Minimum TTL of a 1 hr
)
;
          IN       NS        NS1.example.com.
NS1       IN       A         192.168.0.10
;
A         IN       A         192.168.1.10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
    |                                     |
    |------------------------------------>|
    |   1. Send standard query            |
    |       QNAME=A.example.com           |
    |       QTYPE=HINFO                   |
    |<------------------------------------|
    |   2. Standard query response        |
    |       NODATA                        |
    v                                     v

 1. TN send standard query QNAME=A.example.com, QTYPE=HINFO to NUT.
 2. NUT reply query response w/ SOA record authority section to TN. (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ

UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

- **Termination**
  None

Judgment

2. Received standard query response (NODATA) w/ SOA record in Authority section.

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
  2.2 - No Data
  2.2.1 - Special Handling of No Data
  3 - Negative Answers from Authoritative Servers

5.163. TTL expired negative cache MUST NOT be used (NXDOMAIN)

Purpose

Verify that a NUT does not use the TTL expired negative cache.

- This TTL decrements in a similar manner to a normal cached answer and upon reaching zero (0) indicates the cached negative answer MUST NOT be used again.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                <-------------- TN --------------->
DNS Client1 (TN)          DNS Server1 (NUT)     DNS Server2 DNS Server3 DNS Server4
  |                          |                        |           |           |
  |--------------------------->|                        |           |           |
  | 1.Send standard query    |                        |           |           |
  |  QNAME=B.example.org     |                        |           |           |
  |  QTYPE=A                 |                        |           |           |
  |                          |------------------------->|           |           |
  |                          | 2.Recv standard query  |           |           |
  |                          |  QNAME=B.example.org   |           |           |
  |                          |  QTYPE=A               |           |           |
  |                          |<-------------------------|           |           |
  |                          | 3.Send standard query response|           |           |
  |                          |  QNAME=B.example.org   |           |           |
  |                          |  QTYPE=A               |           |           |
  |                          |  AUTHORITY Name=org    |           |           |
  |                          |  AUTHORITY Name Server |           |           |
  |                          |            =NS3.example.org|           |           |
  |                          |  ADDITIONAL Name       |           |           |
  |                          |            =NS3.example.org|           |           |
  |                          |  ADDITIONAL Address    |           |           |
  |                          |            =192.168.1.30|           |           |
  |                          |                        v           |           |
  |                          |------------------------------------------->|           |
  |                          |             4.Recv standard query          |           |
  |                          |              QNAME=B.example.org           |           |
  |                          |              QTYPE=A                       |           |
  |                          |<-------------------------------------------|           |
  |                          |             5.Send standard query response|           |
  |                          |              QNAME=B.example.org           |           |
  |                          |              QTYPE=A                       |           |
  |                          |              AUTHORITY Name=example.org    |           |
  |                          |              AUTHORITY Name Server         |           |
  |                          |                     = NS4.example.org      |           |
  |                          |              ADDITIONAL Name               |           |
  |                          |                     = NS4.example.org      |           |
  |                          |              ADDITIONAL Address            |           |
  |                          |                     = 192.168.1.40         |           |
  |                          |                                            v           |
  |                          |------------------------------------------------------------>|
  |                          |                        6.Send standard query              |
  |                          |                         QNAME=B.example.org               |
  |                          |                         QTYPE=A                           |
  |                          |<------------------------------------------------------------|
  |                          |                        7.Send standard query response|
  |                          |                         RCODE=3(NXDOMIN)                  |
  |                          |                         QNAME=B.example.org               |
  |                          |                         QTYPE=A                           |
  |                          |                         AUTHORITY Name=example.org        |
  |                          |                         AUTHORITY Type=SOA                |
  |                          |                         AUTHORITY Minimum=15              |
```

```
|<---------------------------|                                                |
| 8.Standard query response  |                                                |
|  RCODE= 3(NXDOMIN)         |                                                |
|  QNAME= B.example.org      |                                                |
|  QTYPE=A                   |                                                |
|  AUTHORITY Name=example.org|                                                |
|  AUTHORITY Type=SOA        |                                                |
|  AUTHORITY Minimum=15      |                                                |
|                            |                                                |
//    wait 15 seconds        //                                              //
|                            |                                                |
|--------------------------->|                                                |
| 9.Send standard query      |                                                |
|  QNAME=B.example.org       |                                                |
|  QTYPE=A                   |                                                |
|                            |------------------------------------------------>|
|                            |                         10. Send standard query |
|                            |                           QNAME=B.example.org   |
|                            |                           QTYPE=A               |
v                            v                                                v
```

1. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response(NXDOMAIN) to AUTHORITY NAME=example.org, AUTHORITY Type=SOA.
8. NUT transmits query response(NXDOMAIN) to DNS Client1 (TN) (Judgment *8)
9. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
10. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0

	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0

	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0

DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	15
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	15

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	15

	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	15

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY

	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=B.example.org, QTYPE=A.
4. Received standard query including QNAME=B.example.org, QTYPE=A.
6. Received standard query including QNAME=B.example.org, QTYPE=A.
8. Received standard query response (NXDOMAIN).
10. Received standard query including QNAME=B.example.org, QTYPE=A.

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
5 - Caching Negative Answers

5.164. TTL expired negative cache MUST NOT be used (NODATA)

Purpose

Verify that a NUT does not use the TTL expired negative cache.

- This TTL decrements in a similar manner to a normal cached answer and upon reaching zero (0) indicates the cached negative answer MUST NOT be used again.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                <-------------- TN --------------->
DNS Client1 (TN)          DNS Server1 (NUT)     DNS Server2 DNS Server3 DNS Server4
 |                          |                          |           |           |
 |-------------------------->|                          |           |           |
 | 1.Send standard query    |                          |           |           |
 |  QNAME=A.example.org     |                          |           |           |
 |  QTYPE=HINFO             |                          |           |           |
 |                          |------------------------->|           |           |
 |                          | 2.Recv standard query    |           |           |
 |                          |  QNAME=A.example.org     |           |           |
 |                          |  QTYPE=HINFO             |           |           |
 |                          |<-------------------------|           |           |
 |                          | 3.Send standard query response|      |           |
 |                          |  QNAME=A.example.org     |           |           |
 |                          |  QTYPE=HINFO             |           |           |
 |                          |  AUTHORITY Name=org      |           |           |
 |                          |  AUTHORITY Name Server   |           |           |
 |                          |            =NS3.example.org|         |           |
 |                          |  ADDITIONAL Name         |           |           |
 |                          |            =NS3.example.org|         |           |
 |                          |  ADDITIONAL Address      |           |           |
 |                          |            =192.168.1.30 |           |           |
 |                          |                          v           |           |
 |                          |------------------------------------>|           |
 |                          |             4.Recv standard query    |           |
 |                          |              QNAME=A.example.org     |           |
 |                          |              QTYPE=HINFO             |           |
 |                          |<------------------------------------|           |
 |                          |             5.Send standard query response|      |
 |                          |              QNAME=A.example.org     |           |
 |                          |              QTYPE=HINF              |           |
 |                          |              AUTHORITY Name=example.org|         |
 |                          |              AUTHORITY Name Server   |           |
 |                          |                     = NS4.example.org|         |
 |                          |              ADDITIONAL Name         |           |
 |                          |                     = NS4.example.org|         |
 |                          |              ADDITIONAL Address      |           |
 |                          |                     = 192.168.1.40   |           |
 |                          |                                      v           |
 |                          |------------------------------------------------->|
 |                          |                        6.Send standard query     |
 |                          |                         QNAME=A.example.org      |
 |                          |                         QTYPE=HINFO              |
 |                          |<-------------------------------------------------|
 |                          |                        7.Send standard query response|
 |                          |                         (NODATA)                 |
 |                          |                         QNAME=A.example.org      |
 |                          |                         QTYPE=HINFO              |
 |                          |                         AUTHORITY Name=example.org|
 |                          |                         AUTHORITY Type=SOA       |
 |                          |                         AUTHORITY Minimum=15     |
```

```
|<---------------------------|                                                |
| 8.Standard query response  |                                                |
|  (NODATA)                  |                                                |
|  QNAME= A.example.org      |                                                |
|  QTYPE=HINFO               |                                                |
|  AUTHORITY Name=example.org|                                                |
|  AUTHORITY Type=SOA        |                                                |
|  AUTHORITY Minimum=15      |                                                |
|                            |                                                |
//    wait 15 seconds        //                                              //
|                            |                                                |
|--------------------------->|                                                |
| 9. Send standard query     |                                                |
|  QNAME=A.example.org       |                                                |
|  QTYPE=HINFO               |                                                |
|                            |------------------------------------------------->|
|                            |                         10. Send standard query |
|                            |                           QNAME=A.example.org   |
|                            |                           QTYPE=HINFO           |
v                            v                                                v
```

1. TN send standard query QNAME=A.example.org, QTYPE=HINFO to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=HINFO to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=HINFO to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response(NXDOMAIN) to AUTHORITY NAME=example.org, AUTHORITY Type=SOA.
8. NUT transmits query response(NXDOMAIN) to DNS Client1 (TN) (Judgment *8)
9. TN send standard query QNAME=A.example.org, QTYPE=HINFO to NUT.
10. NUT transmits standard query QNAME=A.example.org, QTYPE=HINFO to DNS Server4 (TN: NS4.example.org) (Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0

	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0

	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0

DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	15
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	15

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	15
	RDLENGTH	33

	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	15

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0

	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=HINFO.
4. Received standard query including QNAME=A.example.org, QTYPE=HINFO.
6. Received standard query including QNAME=A.example.org, QTYPE=HINFO.
8. Received standard query response (NODATA).
10. Received standard query including QNAME=A.example.org, QTYPE=HINFO.

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
5 - Caching Negative Answers

5.165. Caching of name error (NXDOMAIN)

Purpose

Verify that a NUT caches negative answer that resulted from a name error (NXDOMAIN).

- A negative answer that resulted from a name error (NXDOMAIN) should be cached such that it can be retrieved and returned in response to another query for the same "QNAME, QCLASS" that resulted in the cached negative response.
- When a server, in answering a query, encounters a cached negative response it MUST add the cached SOA record to the authority section of the response with the TTL decremented by the amount of time it was stored in the cache. This allows the NXDOMAIN / NODATA response to time out correctly.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                A       192.168.1.20

For IPv6
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000        AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
```

```
NS1      IN       A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                   <-------------- TN --------------->
DNS Client1 (TN)          DNS Server1 (NUT)        DNS Server2 DNS Server3 DNS Server4
  |                         |                          |           |           |
  |-------------------------->|                          |           |           |
  | 1.Send standard query     |                          |           |           |
  |  QNAME=B.example.org      |                          |           |           |
  |  QTYPE=A                  |                          |           |           |
  |                           |------------------------->|           |           |
  |                           | 2.Recv standard query    |           |           |
  |                           |  QNAME=B.example.org     |           |           |
  |                           |  QTYPE=A                 |           |           |
  |                           |<-------------------------|           |           |
  |                           | 3.Send standard query response|      |           |
  |                           |  QNAME=B.example.org     |           |           |
  |                           |  QTYPE=A                 |           |           |
  |                           |  AUTHORITY Name=org      |           |           |
  |                           |  AUTHORITY Name Server   |           |           |
  |                           |            =NS3.example.org|         |           |
  |                           |  ADDITIONAL Name         |           |           |
  |                           |            =NS3.example.org|         |           |
  |                           |  ADDITIONAL Address      |           |           |
  |                           |            =192.168.1.30 |           |           |
  |                           |                          v           |           |
  |                           |------------------------------------------>|           |
  |                           |            4.Recv standard query     |           |
  |                           |             QNAME=B.example.org      |           |
  |                           |             QTYPE=A                  |           |
  |                           |<-----------------------------------------|           |
  |                           |            5.Send standard query response|           |
  |                           |             QNAME=B.example.org      |           |
  |                           |             QTYPE=A                  |           |
  |                           |             AUTHORITY Name=example.org|           |
  |                           |             AUTHORITY Name Server    |           |
  |                           |                    = NS4.example.org |           |
  |                           |             ADDITIONAL Name          |           |
  |                           |                    = NS4.example.org |           |
  |                           |             ADDITIONAL Address       |           |
  |                           |                    = 192.168.1.40    |           |
  |                           |                                      v           |
  |                           |------------------------------------------------------>|
  |                           |                       6.Send standard query         |
  |                           |                        QNAME=B.example.org          |
  |                           |                        QTYPE=A                      |
  |                           |<------------------------------------------------------|
  |                           |                       7.Send standard query response|
  |                           |                        RCODE=3(NXDOMIN)             |
  |                           |                        QNAME=B.example.org          |
  |                           |                        QTYPE=A                      |
  |                           |                        AUTHORITY Name=example.org   |
  |                           |                        AUTHORITY Type=SOA           |
  |                           |                        AUTHORITY Minimum=1 hour     |
```

```
|<---------------------------|                                                |
| 8.Standard query response  |                                                |
|  RCODE= 3(NXDOMIN)         |                                                |
|  QNAME= B.example.org      |                                                |
|  QTYPE=A                   |                                                |
|  AUTHORITY Name=example.org|                                                |
|  AUTHORITY Type=SOA        |                                                |
|  AUTHORITY Minimum=1 hour  |                                                |
|                            |                                                |
//   wait 15 seconds         //                                               //
|                            |                                                |
|--------------------------->|                                                |
| 9.Send standard query      |                                                |
|  QNAME=B.example.org       |                                                |
|  QTYPE=A                   |                                                |
|<---------------------------|                                                |
|10.Standard query response  |                                                |
|  RCODE= 3(NXDOMIN)         |                                                |
|  QNAME= B.example.org      |                                                |
|  QTYPE=A                   |                                                |
|  AUTHORITY Name=example.org|                                                |
|  AUTHORITY Type=SOA        |                                                |
|  AUTHORITY TTL=less than 1 hour |                                          |
|  AUTHORITY Minimum=1 hour  |                                                |
v                            v                                                v
```

1. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN:root name server)(Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response(NXDOMAIN) to AUTHORITY NAME=example.org, AUTHORITY Type=SOA.
8. NUT transmits query response(NXDOMAIN) to DNS Client1(TN)(Judgment *8)
9. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
10. NUT transmits query response(NXDOMAIN) to DNS Client1(TN)(Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1

	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY

	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0

DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)

	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0

	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	less than 1 hour
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=B.example.org, QTYPE=A.
4. Received standard query including QNAME=B.example.org, QTYPE=A.
6. Received standard query including QNAME=B.example.org, QTYPE=A.
8. Received standard query response (NXDOMAIN).
10. Received standard query response (NXDOMAIN).

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
  5 - Caching Negative Answers
  6 - Negative answers from the cache

5.166. Caching of name error (NXDOMAIN) for query tuple

Purpose

Verify that a NUT caches negative answer that resulted from a name error (NXDOMAIN) for query tuple.

- A negative answer that resulted from a name error (NXDOMAIN) should be cached such that it can be retrieved and returned in response to another query for the same "QNAME, QCLASS" that resulted in the cached negative response.
- When a server, in answering a query, encounters a cached negative response it MUST add the cached SOA record to the authority section of the response with the TTL decremented by the amount of time it was stored in the cache. This allows the NXDOMAIN / NODATA response to time out correctly.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig.22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL  86400             ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600        ; serial
      3600              ; refresh every 1 hr
      900               ; retry every 15 min
      604800            ; expire after a week
      3600              ; Minimum TTL of a 1 hr
)
;
```

```
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                  <-------------- TN --------------->
DNS Client1 (TN)          DNS Server1 (NUT)       DNS Server2 DNS Server3 DNS Server4
  |                          |                        |           |           |
  |--------------------------->|                      |           |           |
  | 1.Send standard query    |                        |           |           |
  |  QNAME=B.example.org     |                        |           |           |
  |  QTYPE=A                 |                        |           |           |
  |                          |------------------------>|          |           |
  |                          | 2.Recv standard query  |           |           |
  |                          |  QNAME=B.example.org   |           |           |
  |                          |  QTYPE=A               |           |           |
  |                          |<------------------------|          |           |
  |                          | 3.Send standard query response|    |           |
  |                          |  QNAME=B.example.org   |           |           |
  |                          |  QTYPE=A               |           |           |
  |                          |  AUTHORITY Name=org    |           |           |
  |                          |  AUTHORITY Name Server |           |           |
  |                          |            =NS3.example.org|       |           |
  |                          |  ADDITIONAL Name       |           |           |
  |                          |            =NS3.example.org|       |           |
  |                          |  ADDITIONAL Address    |           |           |
  |                          |            =192.168.1.30|          |           |
  |                          |                        v           |           |
  |                          |------------------------------------>|          |
  |                          |            4.Recv standard query   |           |
  |                          |             QNAME=B.example.org    |           |
  |                          |             QTYPE=A                |           |
  |                          |<------------------------------------|          |
  |                          |            5.Send standard query response|     |
  |                          |             QNAME=B.example.org    |           |
  |                          |             QTYPE=A                |           |
  |                          |             AUTHORITY Name=example.org|        |
  |                          |             AUTHORITY Name Server  |           |
  |                          |                    = NS4.example.org|        |
  |                          |             ADDITIONAL Name        |           |
  |                          |                    = NS4.example.org|        |
  |                          |             ADDITIONAL Address     |           |
  |                          |                    = 192.168.1.40  |           |
  |                          |                                   v           |
  |                          |------------------------------------------------>|
  |                          |                       6.Send standard query     |
  |                          |                        QNAME=B.example.org      |
  |                          |                        QTYPE=A                  |
  |                          |<------------------------------------------------|
  |                          |                       7.Send standard query response|
  |                          |                        RCODE=3(NXDOMIN)         |
  |                          |                        QNAME=B.example.org      |
  |                          |                        QTYPE=A                  |
  |                          |                        AUTHORITY Name=example.org|
  |                          |                        AUTHORITY Type=SOA       |
  |                          |                        AUTHORITY Minimum=1 hour |
```

```
|<---------------------------|                                                |
| 8.Standard query response  |                                                |
|  RCODE= 3(NXDOMIN)         |                                                |
|  QNAME= B.example.org      |                                                |
|  QTYPE=A                   |                                                |
|  AUTHORITY Name=example.org|                                                |
|  AUTHORITY Type=SOA        |                                                |
|  AUTHORITY Minimum=1 hour  |                                                |
|--------------------------->|                                                |
| 9. Send standard query     |                                                |
|  QNAME=A.example.org       |                                                |
|  QTYPE=A                   |                                                |
|                            |------------------------------------------------->|
|                            |                         10. Send standard query |
|                            |                           QNAME=A.example.org   |
|                            |                           QTYPE=A               |
|                            |                                                 |
v                            v                                                 v
```

1. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response(NXDOMAIN) to AUTHORITY NAME=example.org, AUTHORITY Type=SOA.
8. NUT transmits query response(NXDOMAIN) to DNS Client1(TN)(Judgment *8)
9. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
10. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY

DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)

	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY

	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=B.example.org, QTYPE=A.
4. Received standard query including QNAME=B.example.org, QTYPE=A.
6. Received standard query including QNAME=B.example.org, QTYPE=A.
8. Received standard query response (NXDOMAIN).
10. Received standard query including QNAME=A.example.org, QTYPE=A.

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
5 - Caching Negative Answers

5.167. Caching of name error (NODATA)

Purpose

Verify that a NUT caches negative answer that resulted from a name error(NODATA).

- A negative answer that resulted from a no data error (NODATA) should be cached such that it can be retrieved and returned in response to another query for the same "QNAME, QTYPE, QCLASS" that resulted in the cached negative response.
- When a server, in answering a query, encounters a cached negative response it MUST add the cached SOA record to the authority section of the response with the TTL decremented by the amount of time it was stored in the cache. This allows the NXDOMAIN / NODATA response to time out correctly.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig.22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                A       192.168.1.20

For IPv6
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000        AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL  86400             ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600        ; serial
      3600              ; refresh every 1 hr
      900               ; retry every 15 min
      604800            ; expire after a week
      3600              ; Minimum TTL of a 1 hr
)
;
          IN      NS    NS1.example.com.
```

```
NS1        IN      A      192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                  <-------------- TN --------------->
DNS Client1 (TN)          DNS Server1 (NUT)       DNS Server2 DNS Server3 DNS Server4
  |                          |                          |           |           |
  |--------------------------->|                          |           |           |
  | 1.Send standard query    |                          |           |           |
  |  QNAME=A.example.org     |                          |           |           |
  |  QTYPE=HINFO             |                          |           |           |
  |                          |------------------------->|           |           |
  |                          | 2.Recv standard query    |           |           |
  |                          |  QNAME=A.example.org     |           |           |
  |                          |  QTYPE=HINFO             |           |           |
  |                          |<-------------------------|           |           |
  |                          | 3.Send standard query response|      |           |
  |                          |  QNAME=A.example.org     |           |           |
  |                          |  QTYPE=HINFO             |           |           |
  |                          |  AUTHORITY Name=org      |           |           |
  |                          |  AUTHORITY Name Server   |           |           |
  |                          |            =NS3.example.org|         |           |
  |                          |  ADDITIONAL Name         |           |           |
  |                          |            =NS3.example.org|         |           |
  |                          |  ADDITIONAL Address      |           |           |
  |                          |            =192.168.1.30 |           |           |
  |                          |                          v           |           |
  |                          |------------------------------------>|           |
  |                          |             4.Recv standard query    |           |
  |                          |              QNAME=A.example.org     |           |
  |                          |              QTYPE=HINFO             |           |
  |                          |<-------------------------------------|           |
  |                          |             5.Send standard query response|      |
  |                          |              QNAME=A.example.org     |           |
  |                          |              QTYPE=HINFO             |           |
  |                          |              AUTHORITY Name=example.org|         |
  |                          |              AUTHORITY Name Server   |           |
  |                          |                     = NS4.example.org|         |
  |                          |              ADDITIONAL Name         |           |
  |                          |                     = NS4.example.org|         |
  |                          |              ADDITIONAL Address      |           |
  |                          |                     = 192.168.1.40   |           |
  |                          |                                      v           |
  |                          |------------------------------------------------>|
  |                          |                        6.Send standard query     |
  |                          |                         QNAME=A.example.org      |
  |                          |                         QTYPE=HINFO              |
  |                          |<-------------------------------------------------|
  |                          |                        7.Send standard query response|
  |                          |                         (NODATA)                 |
  |                          |                         QNAME=A.example.org      |
  |                          |                         QTYPE=HINFO              |
  |                          |                         AUTHORITY Name=example.org|
  |                          |                         AUTHORITY Type=SOA       |
  |                          |                         AUTHORITY Minimum=1 hour |
```

```
|<---------------------------|                                                |
| 8.Standard query response  |                                                |
|  (NODATA)                  |                                                |
|  QNAME= A.example.org      |                                                |
|  QTYPE=HINFO               |                                                |
|  AUTHORITY Name=example.org|                                                |
|  AUTHORITY Type=SOA        |                                                |
|  AUTHORITY Minimum=1 hour  |                                                |
|                            |                                                |
//   wait 15 seconds         //                                               //
|                            |                                                |
|--------------------------->|                                                |
| 9.Send standard query      |                                                |
|  QNAME=A.example.org       |                                                |
|  QTYPE=HINFO               |                                                |
|<---------------------------|                                                |
|10.Standard query response  |                                                |
|  (NODATA)                  |                                                |
|  QNAME= A.example.org      |                                                |
|  QTYPE=HINFO               |                                                |
|  AUTHORITY Name=example.org|                                                |
|  AUTHORITY Type=SOA        |                                                |
|  AUTHORITY TTL=less than   |                                                |
|                1 hour      |                                                |
|  AUTHORITY Minimum=1 hour  |                                                |
|                            |                                                |
v                            v                                                v
```

1. TN send standard query QNAME=A.example.org, QTYPE=HINFO to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=HINFO to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=HINFO to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response(NODATA) to AUTHORITY NAME=example.org, AUTHORITY Type=SOA.
8. NUT transmits query response(NODATA) to DNS Client1 (TN) (Judgment *8)
9. TN send standard query QNAME=A.example.org, QTYPE=HINFO to NUT.
10. NUT transmits query response(NODATA) to DNS Client1(TN) (Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0

	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses

DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY

	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority	NAME	example.com (Pointer 0xC00E)

section	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001

	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	less than 1 hour
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

- Termination
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=HINFO.
4. Received standard query including QNAME=A.example.org, QTYPE=HINFO.
6. Received standard query including QNAME=A.example.org, QTYPE=HINFO.
8. Received standard query response (NODATA).
9. Received standard query response (NODATA).

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
5 - Caching Negative Answers

5.168. Caching of no data (NODATA) for query tuple

Purpose

Verify that a NUT caches negative answer that resulted from a name error (NODATA) for query tuple.

- A negative answer that resulted from a no data error (NODATA) should be cached such that it can be retrieved and returned in response to another query for the same "QNAME, QTYPE, QCLASS" that resulted in the cached negative response.
- When a server, in answering a query, encounters a cached negative response it MUST add the cached SOA record to the authority section of the response with the TTL decremented by the amount of time it was stored in the cache. This allows the NXDOMAIN / NODATA response to time out correctly.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig.22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
```

```
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                   <-------------- TN --------------->
DNS Client1 (TN)          DNS Server1 (NUT)         DNS Server2 DNS Server3 DNS Server4
  |                          |                          |           |           |
  |------------------------->|                          |           |           |
  | 1.Send standard query    |                          |           |           |
  |  QNAME=A.example.org     |                          |           |           |
  |  QTYPE=HINFO             |                          |           |           |
  |                          |------------------------->|           |           |
  |                          | 2.Recv standard query    |           |           |
  |                          |  QNAME=A.example.org     |           |           |
  |                          |  QTYPE=HINFO             |           |           |
  |                          |<-------------------------|           |           |
  |                          | 3.Send standard query response|      |           |
  |                          |  QNAME=A.example.org     |           |           |
  |                          |  QTYPE=HINFO             |           |           |
  |                          |  AUTHORITY Name=org      |           |           |
  |                          |  AUTHORITY Name Server   |           |           |
  |                          |            =NS3.example.org|         |           |
  |                          |  ADDITIONAL Name         |           |           |
  |                          |            =NS3.example.org|         |           |
  |                          |  ADDITIONAL Address      |           |           |
  |                          |            =192.168.1.30 |           |           |
  |                          |                          v           |           |
  |                          |------------------------------------>|           |
  |                          |           4.Recv standard query      |           |
  |                          |            QNAME=A.example.org       |           |
  |                          |            QTYPE=HINFO               |           |
  |                          |<-------------------------------------|           |
  |                          |           5.Send standard query response|        |
  |                          |            QNAME=A.example.org       |           |
  |                          |            QTYPE=HINF                |           |
  |                          |            AUTHORITY Name=example.org|           |
  |                          |            AUTHORITY Name Server     |           |
  |                          |                     = NS4.example.org|           |
  |                          |            ADDITIONAL Name=NS4.example.org|      |
  |                          |            ADDITIONAL Address=192.168.1.40|      |
  |                          |                                      v           |
  |                          |------------------------------------------------->|
  |                          |                        6.Send standard query     |
  |                          |                         QNAME=A.example.org      |
  |                          |                         QTYPE=HINFO              |
  |                          |<-------------------------------------------------|
  |                          |                        7.Send standard query response|
  |                          |                         (NODATA)                 |
  |                          |                         QNAME=A.example.org      |
  |                          |                         QTYPE=HINFO              |
  |                          |                         AUTHORITY Name=example.org|
  |                          |                         AUTHORITY Type=SOA       |
  |                          |                         AUTHORITY Minimum=1 hour |
```

```
|<---------------------------|                                                |
| 8. Standard query response |                                                |
|  (NODATA)                  |                                                |
|  QNAME= A.example.org      |                                                |
|  QTYPE=HINFO               |                                                |
|  AUTHORITY Name=example.org|                                                |
|  AUTHORITY Type=SOA        |                                                |
|  AUTHORITY Minimum=1 hour  |                                                |
|--------------------------->|                                                |
| 9. Send standard query     |                                                |
|  QNAME=B.example.org       |                                                |
|  QTYPE=HINFO               |                                                |
|                            |------------------------------------------------>|
|                            |                          10.Send standard query |
|                            |                           QNAME=B.example.org   |
|                            |                           QTYPE=HINFO           |
|                            |                                                 |
v                            v                                                 v
```

1. TN send standard query QNAME=A.example.org, QTYPE=HINFO to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=HINFO to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=HINFO to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response(NXDOMAIN) to AUTHORITY NAME=example.org, AUTHORITY Type=SOA.
8. NUT transmits query response(NXDOMAIN) to DNS Client1 (TN) (Judgment *8)
9. TN send standard query QNAME=B.example.org, QTYPE=HINFO to NUT.
10. NUT transmits standard query QNAME=B.example.org, QTYPE=HINFO to DNS Server4 (TN: NS4.example.org) (Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY

DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)

	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY

	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=HINFO.
4. Received standard query including QNAME=A.example.org, QTYPE=HINFO.
6. Received standard query including QNAME=A.example.org, QTYPE=HINFO.
8. Received standard query response (NODATA).
10. Received standard query including QNAME=B.example.org, QTYPE=HINFO.

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
5 - Caching Negative Answers

5.169. Negative responses without SOA records

Purpose

Verify that a NUT doesn't cache negative responses without SOA records.

- Negative responses without SOA records SHOULD NOT be cached as there is no way to prevent the negative responses looping forever between a pair of servers even with a short TTL.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600      ; serial
         3600            ; refresh every 1 hr
         900             ; retry every 15 min
         604800          ; expire after a week
         3600            ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                <-------------- TN --------------->
DNS Client1 (TN)          DNS Server1 (NUT)     DNS Server2 DNS Server3 DNS Server4
  |                          |                        |           |           |
  |--------------------------->|                        |           |           |
  | 1.Send standard query    |                        |           |           |
  |  QNAME=A.example.org     |                        |           |           |
  |  QTYPE=A                 |                        |           |           |
  |                          |------------------------->|           |           |
  |                          | 2.Recv standard query  |           |           |
  |                          |  QNAME=A.example.org   |           |           |
  |                          |  QTYPE=A               |           |           |
  |                          |<-------------------------|           |           |
  |                          | 3.Send standard query response|           |           |
  |                          |  QNAME=A.example.org   |           |           |
  |                          |  QTYPE=A               |           |           |
  |                          |  AUTHORITY Name=org    |           |           |
  |                          |  AUTHORITY Name Server |           |           |
  |                          |            =NS3.example.org|           |           |
  |                          |  ADDITIONAL Name       |           |           |
  |                          |            =NS3.example.org|           |           |
  |                          |  ADDITIONAL Address    |           |           |
  |                          |            =192.168.1.30|           |           |
  |                          |                        v           |           |
  |                          |------------------------------------------->|           |
  |                          |           4. Recv standard query           |           |
  |                          |            QNAME=A.example.org             |           |
  |                          |            QTYPE=A                         |           |
  |                          |<-------------------------------------------|           |
  |                          |           5.Send standard query response   |           |
  |                          |            QNAME=A.example.org             |           |
  |                          |            QTYPE=A                         |           |
  |                          |            AUTHORITY Name=example.org      |           |
  |                          |            AUTHORITY Name Server           |           |
  |                          |                     = NS4.example.org      |           |
  |                          |            ADDITIONAL Name=NS4.example.org|           |
  |                          |            ADDITIONAL Address=192.168.1.40|           |
  |                          |                                        v           |
  |                          |------------------------------------------------------>|
  |                          |                        6.Send standard query          |
  |                          |                         QNAME=A.example.org           |
  |                          |                         QTYPE=A                       |
  |                          |<------------------------------------------------------|
  |                          |                        7.Send standard query response|
  |                          |                         RCODE=3(NXDOMIN)              |
  |                          |                         QNAME=A.example.org           |
  |                          |                         QTYPE=A                       |
  |                          |                         ANSWER Name=A.example.org     |
  |                          |                         ANSWER Type=CNAME             |
  |<---------------------------|                                                      |
  | 8.Standard query response |                                                      |
  |  RCODE= 3(NXDOMIN)       |                                                      |
  |  QNAME= A.example.org    |                                                      |
  |  QTYPE=A                 |                                                      |
  |  ANSWER Name=A.example.org |                                                    |
  |  ANSWER Type=CNAME       |                                                      |
```

```
|--------------------------->|                                                    |
| 9.Send standard query      |                                                    |
|  QNAME=A.example.org       |                                                    |
|  QTYPE=A                   |                                                    |
|                            |----------------------------------------------------->|
|                            |                          10.Send standard query    |
|                            |                            QNAME=A.example.org     |
|                            |                            QTYPE=A                 |
|                            |                                                    |
v                            v                                                    v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response(NXDOMAIN) to AUTHORITY NAME=example.org, AUTHORITY Type=SOA.
8. NUT transmits query response(NXDOMAIN) to DNS Client1 (TN) (Judgment *8)
9. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
10. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)

	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY

	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	10
	CNAME	invalid.example.com (invalid + Pointer 0xC00E)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	10
	CNAME	invalid.example.com (invalid + Pointer 0xC00E)

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0

	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**

  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response (NXDOMAIN).
10. Received standard query including QNAME=A.example.org, QTYPE=A.

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
5 - Caching Negative Answers

5.170. Negative answer should have an implicit referral built into the answer (NXDOMAIN)

Purpose

Verify that a NUT has an implicit referral in the negative answer (NXDOMAIN).

- As with all answers coming from the cache, negative answers SHOULD have an implicit referral built into the answer. This enables the resolver to locate an authoritative source. An implicit referral is characterized by NS records in the authority section referring the resolver towards a authoritative source.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig.22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.            3600000               A      192.168.1.20

For IPv6
 .                      3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.            3600000        AAAA   3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN     NS     NS1.example.com.
NS1      IN     A      192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                        <-------------- TN --------------->
DNS Client1 (TN)        DNS Server1 (NUT)               DNS Server2 DNS Server3 DNS Server4
  |                          |                                |           |           |
  |--------------------------->|                              |           |           |
  | 1.Send standard query    |                                |           |           |
  |  QNAME=B.example.org     |                                |           |           |
  |  QTYPE=A                 |                                |           |           |
  |                          |--------------------------------->|         |           |
  |                          | 2.Recv standard query          |           |           |
  |                          |  QNAME=B.example.org           |           |           |
  |                          |  QTYPE=A                       |           |           |
  |                          |<---------------------------------|         |           |
  |                          | 3.Send standard query response |           |           |
  |                          |  QNAME=B.example.org           |           |           |
  |                          |  QTYPE=A                       |           |           |
  |                          |  AUTHORITY Name=org            |           |           |
  |                          |  AUTHORITY Name Server         |           |           |
  |                          |            =NS3.example.org    |           |           |
  |                          |  ADDITIONAL Name=NS3.example.org|          |           |
  |                          |  ADDITIONAL Address=192.168.1.30|          |           |
  |                          |                                v           |           |
  |                          |---------------------------------------------->|        |
  |                          |            4.Recv standard query           |           |
  |                          |             QNAME=B.example.org            |           |
  |                          |             QTYPE=A                        |           |
  |                          |<----------------------------------------------|        |
  |                          |            5.Send standard query response  |           |
  |                          |             QNAME=B.example.org            |           |
  |                          |             QTYPE=A                        |           |
  |                          |             AUTHORITY Name=example.org     |           |
  |                          |             AUTHORITY Name Server          |           |
  |                          |                    = NS4.example.org       |           |
  |                          |             ADDITIONAL Name=NS4.example.org|           |
  |                          |             ADDITIONAL Address=192.168.1.40|           |
  |                          |                                        v           |
  |                          |------------------------------------------------------>|
  |                          |                        6.Send standard query          |
  |                          |                         QNAME=B.example.org           |
  |                          |                         QTYPE=A                       |
  |                          |<------------------------------------------------------|
  |                          |                       7.Send standard query response  |
  |                          |                        RCODE=3(NXDOMIN)               |
  |                          |                        QNAME=B.example.org            |
  |                          |                        QTYPE=A                        |
  |                          |                        AUTHORITY Name=example.org     |
  |                          |                        AUTHORITY Type=SOA             |
  |                          |                        AUTHORITY Minimum=1 hour       |
  |                          |                        AUTHORITY Name=example.org     |
  |                          |                        AUTHORITY Type=NS              |
  |                          |                        AUTHORITY Name Server          |
  |                          |                            = NS4.example.org          |
  |                          |                        ADDITIONAL Name=NS4.example.org|
  |                          |                        ADDITIONAL Address=192.168.1.40|
```

```
|<---------------------------|                                                  |
| 8.Standard query response  |                                                |
|  RCODE= 3(NXDOMIN)         |                                                |
|  QNAME= B.example.org      |                                                |
|  QTYPE=A                   |                                                |
|  AUTHORITY Name=example.org|                                                |
|  AUTHORITY Type=SOA        |                                                |
|  AUTHORITY Minimum=1 hour  |                                                |
|  AUTHORITY Name=example.org|                                                |
|  AUTHORITY Type=NS         |                                                |
|  ADDITIONAL Name           |                                                |
|   = NS4.example.org        |                                                |
|  ADDITIONAL Address        |                                                |
|   = 192.168.1.40           |                                                |
|                            |                                                |
v                            v                                                v
```

1. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response(NXDOMAIN) to AUTHORITY NAME=example.org, AUTHORITY Type=SOA, and AUTHORITY NAME=example.org, AUTHORITY Type=NS .
8. NUT transmits query response(NXDOMAIN) to DNS Client1(TN)(Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0

DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0

	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY

	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	2
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)

	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	2
	NSDNAME	NS4.example.org (Pointer 0xC02B)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	2
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)

	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	2
	NSDNAME	NS4.example.org (Pointer 0xC02B)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=B.example.org, QTYPE=A.
4. Received standard query including QNAME=B.example.org, QTYPE=A.
6. Received standard query including QNAME=B.example.org, QTYPE=A.
8. Received standard query response (NXDOMAIN) including referral (NS record of Authority section and A record of additional section).

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
6 - Negative answers from the cache

5.171. Negative answer should have an implicit referral built into the answer (NODATA)

Purpose

Verify that a NUT has an implicit referral in the negative answer (NODATA).

- As with all answers coming from the cache, negative answers SHOULD have an implicit referral built into the answer. This enables the resolver to locate an authoritative source. An implicit referral is characterized by NS records in the authority section referring the resolver towards a authoritative source.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20
For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                <-------------- TN --------------->
DNS Client1 (TN)        DNS Server1 (NUT)       DNS Server2 DNS Server3 DNS Server4
 |                       |                              |           |           |
 |------------------------>|                              |           |           |
 | 1.Send standard query  |                              |           |           |
 |  QNAME=A.example.org   |                              |           |           |
 |  QTYPE=HINFO           |                              |           |           |
 |                        |------------------------------>|           |           |
 |                        | 2.Recv standard query        |           |           |
 |                        |  QNAME=A.example.org         |           |           |
 |                        |  QTYPE=HINFO                 |           |           |
 |                        |<------------------------------|           |           |
 |                        | 3.Send standard query response |           |           |
 |                        |  QNAME=A.example.org         |           |           |
 |                        |  QTYPE=HINFO                 |           |           |
 |                        |  AUTHORITY Name=org          |           |           |
 |                        |  AUTHORITY Name Server       |           |           |
 |                        |            =NS3.example.org  |           |           |
 |                        |  ADDITIONAL Name=NS3.example.org|           |           |
 |                        |  ADDITIONAL Address=192.168.1.30|           |           |
 |                        |                              v           |           |
 |                        |---------------------------------------------->|           |
 |                        |            4.Recv standard query           |           |
 |                        |             QNAME=A.example.org            |           |
 |                        |             QTYPE=HINFO                    |           |
 |                        |<----------------------------------------------|           |
 |                        |            5.Send standard query response  |           |
 |                        |             QNAME=A.example.org            |           |
 |                        |             QTYPE=HINFO                    |           |
 |                        |             AUTHORITY Name=example.org     |           |
 |                        |             AUTHORITY Name Server          |           |
 |                        |                    = NS4.example.org       |           |
 |                        |             ADDITIONAL Name=NS4.example.org|           |
 |                        |             ADDITIONAL Address=192.168.1.40|           |
 |                        |                                        v           |
 |                        |------------------------------------------------------------>|
 |                        |                       6.Send standard query           |
 |                        |                       QNAME=A.example.org             |
 |                        |                       QTYPE=HINFO                     |
 |                        |<------------------------------------------------------------|
 |                        |                       7.Send standard query response  |
 |                        |                        (NODATA)                       |
 |                        |                        QNAME=A.example.org            |
 |                        |                        QTYPE=HINFO                    |
 |                        |                        AUTHORITY Name=example.org     |
 |                        |                        AUTHORITY Type=SOA             |
 |                        |                        AUTHORITY Minimum=1 hour       |
 |                        |                        AUTHORITY Name=example.org     |
 |                        |                        AUTHORITY Type=NS              |
 |                        |                        AUTHORITY Name Server          |
 |                        |                            = NS4.example.org          |
 |                        |                        ADDITIONAL Name=NS4.example.org|
 |                        |                        ADDITIONAL Address=192.168.1.40|
```

```
|<---------------------------|                                                |
| 8 Standard query response  |                                                |
|  (NODATA)                  |                                                |
|  QNAME= A.example.org      |                                                |
|  QTYPE=HINFO               |                                                |
|  AUTHORITY Name=example.org|                                                |
|  AUTHORITY Type=SOA        |                                                |
|  AUTHORITY Minimum=1 hour  |                                                |
|  AUTHORITY Name=example.org|                                                |
|  AUTHORITY Type=NS         |                                                |
|  ADDITIONAL Name           |                                                |
|   = NS4.example.org        |                                                |
|  ADDITIONAL Name           |                                                |
|   = NS4.example.org        |                                                |
|  ADDITIONAL Address        |                                                |
|   = 192.168.1.40           |                                                |
|                            |                                                |
v                            v                                                v
```

1. TN send standard query QNAME=A.example.org, QTYPE=HINFO to NUT.
2. NUT transmits standard query to DNS Server2(TN:root name server)(Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=HINFO to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=HINFO to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response(NODATA) to AUTHORITY NAME=example.org, AUTHORITY Type=SOA, and AUTHORITY NAME=example.org, AUTHORITY Type=NS.
8. NUT transmits query response(NODATA) to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org

	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY

UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	2
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)

	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	2
	NSDNAME	NS4.example.org (Pointer 0xC02B)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	2

	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	HINFO (0x000D)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	2
	NSDNAME	NS4.example.org (Pointer 0xC02B)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=HINFO.
4. Received standard query including QNAME=A.example.org, QTYPE=HINFO.
6. Received standard query including QNAME=A.example.org, QTYPE=HINFO.
8. Received standard query response (NODATA) including referral
(NS record of Authority section and A record of additional section).

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
6 - Negative answers from the cache

5.172. Resolver cache a server failure response

Purpose

Verify that a NUT caches a server failure response.

- Server failures fall into two major classes. The first is where a server can determine that it has been misconfigured for a zone. This may be where it has been listed as a server, but not configured to be a server for the zone, or where it has been configured to be a server for the zone, but cannot obtain the zone data for some reason. This can occur either because the zone file does not exist or contains errors, or because another server from which the zone should have been available either did not respond or was unable or unwilling to supply the zone.
- The second class is where the server needs to obtain an answer from elsewhere, but is unable to do so, due to network failures, other servers that don't reply, or return server failure errors, or similar.
- In either case a resolver MAY cache a server failure response. If it does so it MUST NOT cache it for longer than five (5) minutes, and it MUST be cached against the specific query tuple "query name, type, class, server IP address".

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                    3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.          3600000               A      192.168.1.20

For IPv6
 .                    3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.          3600000        AAAA   3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
```

```
        3600            ; refresh every 1 hr
        900             ; retry every 15 min
        604800          ; expire after a week
        3600            ; Minimum TTL of a 1 hr
)
;
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                    <------------------ TN ---------------->
DNS Client1 (TN)          DNS Server1 (NUT)         DNS Server2     DNS Server3 DNS Server4
  |                       |                              |               |           |
  |-------------------------->|                          |               |           |
  | 1.Send standard query     |                          |               |           |
  |  QNAME=A.example.org      |                          |               |           |
  |  QTYPE=A                  |                          |               |           |
  |                           |--------------------------->|             |           |
  |                           | 2.Recv standard query    |               |           |
  |                           |  QNAME=A.example.org     |               |           |
  |                           |  QTYPE=A                 |               |           |
  |                           |<---------------------------|             |           |
  |                           | 3.Send standard query response |         |           |
  |                           |  QNAME=A.example.org     |               |           |
  |                           |  QTYPE=A                 |               |           |
  |                           |  AUTHORITY Name=org      |               |           |
  |                           |  AUTHORITY Name Server   |               |           |
  |                           |                = NS3.example.org |       |           |
  |                           |  ADDITIONAL Name=NS3.example.org |       |           |
  |                           |  ADDITIONAL Address =192.168.1.30|       |           |
  |                           |                          v               |           |
  |                           |------------------------------------------------>|   |
  |                           |            4.Recv standard query                |   |
  |                           |             QNAME=A.example.org                  |   |
  |                           |             QTYPE=A                             |   |
  |                           |<------------------------------------------------|   |
  |                           |            5.Send standard query response       |   |
  |                           |             QNAME=A.example.org                 |   |
  |                           |             QTYPE=A                             |   |
  |                           |             AUTHORITY Name=example.org          |   |
  |                           |             AUTHORITY Name Server               |   |
  |                           |                            = NS4.example.org    |   |
  |                           |             ADDITIONAL Name = NS4.example.org   |   |
  |                           |             ADDITIONAL Address = 192.168.1.40   |   |
  |                           |                                             v       |
  |                           |-------------------------------------------------------->|
  |                           |                        6.Send standard query            |
  |                           |                         QNAME=A.example.org             |
  |                           |                         QTYPE=A                         |
```

```
   |                            |<-------------------------------------------------------------|
   |                            |                          7.Send standard query response      |
   |                            |                           RCODE=2(Server failure)            |
   |                            |                           QNAME=A.example.org                |
   |                            |                           QTYPE=A                            |
   |<---------------------------|                                                              |
   | 8.Standard query response  |                                                              |
   |  RCODE= 2(Server failure)  |                                                              |
   |  QNAME= A.example.org      |                                                              |
   |  QTYPE=A                   |                                                              |
   |--------------------------->|                                                              |
   | 9.Send standard query      |                                                              |
   |  QNAME=A.example.org       |                                                              |
   |  QTYPE=A                   |                                                              |
   |<---------------------------|                                                              |
   | 10.Standard query response |                                                              |
   |  RCODE= 2(Server failure)  |                                                              |
   |  QNAME= A.example.org      |                                                              |
   |  QTYPE=A                   |                                                              |
   v                            v                                                              v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response(server failure) to NUT.
8. NUT transmits query response(server failure) to DNS Client1 (TN) (Judgment *8)
9. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
10. NUT transmits query response(server failure) to DNS Client1 (TN) (Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	2
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	2
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	2
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response (Server failure).
10. Received standard query response (Server failure).

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
7.1 Server Failure (OPTIONAL)

5.173. Resolver cache a server failure response for query tuple

Purpose

Verify that a NUT caches a server failure response for the specific query tuple.

- Server failures fall into two major classes. The first is where a server can determine that it has been misconfigured for a zone. This may be where it has been listed as a server, but not configured to be a server for the zone, or where it has been configured to be a server for the zone, but cannot obtain the zone data for some reason. This can occur either because the zone file does not exist or contains errors, or because another server from which the zone should have been available either did not respond or was unable or unwilling to supply the zone.
- The second class is where the server needs to obtain an answer from elsewhere, but is unable to do so, due to network failures, other servers that don't reply, or return server failure errors, or similar.
- In either case a resolver MAY cache a server failure response. If it does so it MUST NOT cache it for longer than five (5) minutes, and it MUST be cached against the specific query tuple "query name, type, class, server IP address".

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                A       192.168.1.20
For IPv6
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000        AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
```

```
        604800          ; expire after a week
        3600            ; Minimum TTL of a 1 hr
)
;
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                  <-------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)      DNS Server2 DNS Server3 DNS Server4
  |                         |                            |           |           |
  |-------------------------->|                            |           |           |
  | 1.Send standard query   |                            |           |           |
  |  QNAME=A.example.org    |                            |           |           |
  |  QTYPE=A                |                            |           |           |
  |                         |----------------------------->|           |           |
  |                         | 2.Recv standard query      |           |           |
  |                         |  QNAME=A.example.org       |           |           |
  |                         |  QTYPE=A                   |           |           |
  |                         |<-----------------------------|           |           |
  |                         | 3.Send standard query response|           |           |
  |                         |  QNAME=A.example.org       |           |           |
  |                         |  QTYPE=A                   |           |           |
  |                         |  AUTHORITY Name=org        |           |           |
  |                         |  AUTHORITY Name Server     |           |           |
  |                         |            =NS3.example.org |           |           |
  |                         |  ADDITIONAL Name           |           |           |
  |                         |            =NS3.example.org |           |           |
  |                         |  ADDITIONAL Address        |           |           |
  |                         |            =192.168.1.30   |           |           |
  |                         |                            v           |           |
  |                         |------------------------------------------->|           |
  |                         |            4.Recv standard query         |           |
  |                         |             QNAME=A.example.org          |           |
  |                         |             QTYPE=A                      |           |
  |                         |<-------------------------------------------|           |
  |                         |            5.Send standard query response|           |
  |                         |             QNAME=A.example.org          |           |
  |                         |             QTYPE=A                      |           |
  |                         |             AUTHORITY Name=example.org   |           |
  |                         |             AUTHORITY Name Server        |           |
  |                         |                    = NS4.example.org     |           |
  |                         |             ADDITIONAL Name              |           |
  |                         |                    = NS4.example.org     |           |
  |                         |             ADDITIONAL Address           |           |
  |                         |                    = 192.168.1.40        |           |
  |                         |                                         v           |
  |                         |------------------------------------------------------>|
  |                         |                        6.Send standard query         |
  |                         |                         QNAME=A.example.org          |
  |                         |                         QTYPE=A                      |
```

```
|                              |<-----------------------------------------------------|
|                              |                        7.Send standard query response|
|                              |                         RCODE=2(Server failure)      |
|                              |                         QNAME=A.example.org          |
|                              |                         QTYPE=A                      |
|<-----------------------------|                                                      |
| 8.Standard query response    |                                                      |
|  RCODE= 2(Server failure)    |                                                      |
|  QNAME= A.example.org        |                                                      |
|  QTYPE=A                     |                                                      |
|----------------------------->|                                                      |
| 9.Send standard query        |                                                      |
|  QNAME=B.example.org         |                                                      |
|  QTYPE=A                     |                                                      |
|                              |----------------------------------------------------->|
|                              |                        10.  Send standard query      |
|                              |                          QNAME=B.example.org         |
|                              |                          QTYPE=A                     |
|                              |                                                      |
v                              v                                                      v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response(server failure) to NUT.
8. NUT transmits query response(server failure) to DNS Client1 (TN) (Judgment *8)
9. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
10. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	2
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	2
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0

DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response (Server failure).
10. Received standard query including QNAME=B.example.org, QTYPE=A.

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
7.1 Server Failure (OPTIONAL)

5.174. Limit of time(5 minutes) for caching (Server Failure)

Purpose

Verify that a NUT must not cache a server failure response for longer than 5 minutes.

- Server failures fall into two major classes. The first is where a server can determine that it has been misconfigured for a zone. This may be where it has been listed as a server, but not configured to be a server for the zone, or where it has been configured to be a server for the zone, but cannot obtain the zone data for some reason. This can occur either because the zone file does not exist or contains errors, or because another server from which the zone should have been available either did not respond or was unable or unwilling to supply the zone.
- The second class is where the server needs to obtain an answer from elsewhere, but is unable to do so, due to network failures, other servers that don't reply, or return server failure errors, or similar.
- In either case a resolver MAY cache a server failure response. If it does so it MUST NOT cache it for longer than five (5) minutes, and it MUST be cached against the specific query tuple "query name, type, class, server IP address".

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig.22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.
  Example of root server list:

```
For IPv4:
 .                    3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.          3600000               A      192.168.1.20
For IPv6
 .                    3600000        IN     NS     A.ROOT.NET.
 A.ROOT.NET.          3600000        AAAA   3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
```

```
        900             ; retry every 15 min
        604800          ; expire after a week
        3600            ; Minimum TTL of a 1 hr
)
;
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                <-------------- TN --------------->
DNS Client1 (TN)          DNS Server1 (NUT)          DNS Server2 DNS Server3 DNS Server4
  |                          |                              |           |           |
  |--------------------------->|                              |           |           |
  | 1.Send standard query      |                              |           |           |
  |  QNAME=A.example.org       |                              |           |           |
  |  QTYPE=A                   |                              |           |           |
  |                            |------------------------------>|           |           |
  |                            | 2.Recv standard query         |           |           |
  |                            |  QNAME=A.example.org          |           |           |
  |                            |  QTYPE=A                      |           |           |
  |                            |<------------------------------|           |           |
  |                            | 3.Send standard query response|           |           |
  |                            |  QNAME=A.example.org          |           |           |
  |                            |  QTYPE=A                      |           |           |
  |                            |  AUTHORITY Name=org           |           |           |
  |                            |  AUTHORITY Name Server        |           |           |
  |                            |            =NS3.example.org   |           |           |
  |                            |  ADDITIONAL Name=NS3.example.org|         |           |
  |                            |  ADDITIONAL Address=192.168.1.30 |        |           |
  |                            |                               v           |           |
  |                            |------------------------------------------>|           |
  |                            |             4.Recv standard query         |           |
  |                            |              QNAME=A.example.org          |           |
  |                            |              QTYPE=A                      |           |
  |                            |<------------------------------------------|           |
  |                            |             5.Send standard query response|           |
  |                            |              QNAME=A.example.org          |           |
  |                            |              QTYPE=A                      |           |
  |                            |              AUTHORITY Name=example.org   |           |
  |                            |              AUTHORITY Name Server        |           |
  |                            |                     = NS4.example.org     |           |
  |                            |              ADDITIONAL Name              |           |
  |                            |                     = NS4.example.org     |           |
  |                            |              ADDITIONAL Address=192.168.1.40 |        |
  |                            |                                        v            |
  |                            |------------------------------------------------------>|
  |                            |                        6.Send standard query          |
  |                            |                         QNAME=A.example.org           |
  |                            |                         QTYPE=A                       |
  |                            |<------------------------------------------------------|
  |                            |                        7.Send standard query response|
  |                            |                         RCODE=2(Server failure)       |
  |                            |                         QNAME=A.example.org           |
  |                            |                         QTYPE=A                       |
```

```
|<---------------------------|                                                |
| 8.Standard query response  |                                                |
|  RCODE= 2(Server failure)  |                                                |
|  QNAME= A.example.org      |                                                |
|  QTYPE=A                   |                                                |
|                            |                                                |
//       wait 5 minutes      //                                              //
|                            |                                                |
|--------------------------->|                                                |
| 9.Send standard query      |                                                |
|  QNAME=A.example.org       |                                                |
|  QTYPE=A                   |                                                |
|                            |------------------------------------------------->|
|                            |                         10.  Send standard query |
|                            |                           QNAME=A.example.org    |
|                            |                           QTYPE=A                |
|                            |                                                |
v                            v                                                v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2(TN: root name server)(Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response(server failure) to NUT.
8. NUT transmits query response(server failure) to DNS Client1 (TN) (Judgment *8)
9. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
10. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1

	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0

	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	2
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	2
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response(Server failure).
10. Received standard query including QNAME=A.example.org, QTYPE=A.

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
7.1 Server Failure (OPTIONAL)

5.175. Caching of dead server indication

Purpose

Verify that a NUT caches a dead server indication.

- Dead / Unreachable servers are servers that fail to respond in any way to a query or where the transport layer has provided an indication that the server does not exist or is unreachable. A server may be deemed to be dead or unreachable if it has not responded to an outstanding query within 120 seconds.
- A server MAY cache a dead server indication. If it does so it MUST NOT be deemed dead for longer than five (5) minutes. The indication MUST be stored against query tuple "query name, type, class, server IP address" unless there was a transport layer indication that the server does not exist, in which case it applies to all queries to that specific IP address.

Category

Caching Server

Initialization

- **Network Topology**

  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".

- **Setup**

  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000                  A       192.168.1.20
For IPv6
 .                        3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                   <-------------- TN --------------->
DNS Client1 (TN)          DNS Server1 (NUT)         DNS Server2 DNS Server3 DNS Server4
  |                          |                            |           |           |
  |--------------------------->|                            |           |           |
  | 1.Send standard query    |                            |           |           |
  |  QNAME=A.example.org     |                            |           |           |
  |  QTYPE=A                 |                            |           |           |
  |                          |------------------------------>|           |           |
  |                          | 2.Recv standard query      |           |           |
  |                          |  QNAME=A.example.org       |           |           |
  |                          |  QTYPE=A                   |           |           |
  |                          |<------------------------------|           |           |
  |                          | 3.Send standard query response |           |           |
  |                          |  QNAME=A.example.org       |           |           |
  |                          |  QTYPE=A                   |           |           |
  |                          |  AUTHORITY Name=org        |           |           |
  |                          |  AUTHORITY Name Server=NS3.example.org|           |           |
  |                          |  ADDITIONAL Name=NS3.example.org|           |           |
  |                          |  ADDITIONAL Address=192.168.1.30|           |           |
  |                          |                            v           |           |
  |                          |------------------------------------------->|           |
  |                          |            4.Recv standard query           |           |
  |                          |             QNAME=A.example.org            |           |
  |                          |             QTYPE=A                        |           |
  |                          |<-------------------------------------------|           |
  |                          |            5.Send standard query response  |           |
  |                          |             QNAME=A.example.org            |           |
  |                          |             QTYPE=A                        |           |
  |                          |             AUTHORITY Name=example.org     |           |
  |                          |             AUTHORITY Name Server          |           |
  |                          |                    = NS4.example.org       |           |
  |                          |             ADDITIONAL Name=NS4.example.org|           |
  |                          |             ADDITIONAL Address=192.168.1.40|           |
  |                          |                                        v           |
  |                          |------------------------------------------------------>|
  |                          |                        6.Send standard query          |
  |                          |                         QNAME=A.example.org           |
  |                          |                         QTYPE=A                       |
  |                          | X <-------------------------------------------------------|
  |                          |                        7.Send standard query response |
  //   wait 120 seconds      //                                                       //
  |                          |                                                       |
  |<---------------------------|                                                       |
  | 8.Standard query response |                                                       |
  |  RCODE= 2(Server failure) |                                                       |
  |  QNAME= A.example.org    |                                                       |
  |  QTYPE=A                 |                                                       |
  |--------------------------->|                                                       |
  | 9.Send standard query    |                                                       |
  |  QNAME=A.example.org     |                                                       |
  |  QTYPE=A                 |                                                       |
  |<---------------------------|                                                       |
  | 10.Standard query response |                                                       |
  |  RCODE= 2(Server failure) |                                                       |
  |  QNAME= A.example.org    |                                                       |
  |  QTYPE=A                 |                                                       |
  v                          v                                                       v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server)(Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to NUT.
8. NUT transmits query response(server failure) to DNS Client1(TN)(Judgment *8)
9. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
10. NUT transmits query response(server failure) to DNS Client1(TN)(Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0

	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)

DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org

	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	2
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	2
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response (Server failure).
10. Received standard query response (Server failure).

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
7.2 Dead / Unreachable Server (OPTIONAL)

5.176. Caching of dead server indication for query tuple

Purpose

Verify that a NUT caches a dead server indication for the specific query tuple.

- Dead / Unreachable servers are servers that fail to respond in any way to a query or where the transport layer has provided an indication that the server does not exist or is unreachable. A server may be deemed to be dead or unreachable if it has not responded to an outstanding query within 120 seconds.
- A server MAY cache a dead server indication. If it does so it MUST NOT be deemed dead for longer than five (5) minutes. The indication MUST be stored against query tuple "query name, type, class, server IP address" unless there was a transport layer indication that the server does not exist, in which case it applies to all queries to that specific IP address.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                A       192.168.1.20

For IPv6
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000        AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
```

```
;
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                <-------------- TN --------------->
DNS Client1 (TN)          DNS Server1 (NUT)     DNS Server2 DNS Server3 DNS Server4
  |                          |                          |           |           |
  |------------------------->|                          |           |           |
  | 1.Send standard query    |                          |           |           |
  |  QNAME=A.example.org     |                          |           |           |
  |  QTYPE=A                 |                          |           |           |
  |                          |------------------------->|           |           |
  |                          | 2.Recv standard query    |           |           |
  |                          |  QNAME=A.example.org     |           |           |
  |                          |  QTYPE=A                 |           |           |
  |                          |<-------------------------|           |           |
  |                          | 3.Send standard query response|      |           |
  |                          |  QNAME=A.example.org     |           |           |
  |                          |  QTYPE=A                 |           |           |
  |                          |  AUTHORITY Name=org      |           |           |
  |                          |  AUTHORITY Name Server   |           |           |
  |                          |            =NS3.example.org|         |           |
  |                          |  ADDITIONAL Name = NS3.example.org |  |           |
  |                          |  ADDITIONAL Address = 192.168.1.30 |  |           |
  |                          |                          v           |           |
  |                          |------------------------------------------>|     |
  |                          |            4.Recv standard query     |           |
  |                          |             QNAME=A.example.org      |           |
  |                          |             QTYPE=A                  |           |
  |                          |<-----------------------------------------|      |
  |                          |            5.Send standard query response|      |
  |                          |             QNAME=A.example.org      |           |
  |                          |             QTYPE=A                  |           |
  |                          |             AUTHORITY Name=example.org |         |
  |                          |             AUTHORITY Name Server    |           |
  |                          |                    = NS4.example.org |         |
  |                          |             ADDITIONAL Name          |           |
  |                          |                    = NS4.example.org |         |
  |                          |             ADDITIONAL Address       |           |
  |                          |                    = 192.168.1.40    |         |
  |                          |                                     v           |
  |                          |------------------------------------------------>|
  |                          |                       6.Send standard query     |
  |                          |                        QNAME=A.example.org      |
  |                          |                        QTYPE=A                  |
  |                          | X <-------------------------------------------------|
  |                          |                       7.Send standard query response|
  |                          |                                                 |
  //   wait 120 seconds      //                                                //
  |                          |                                                 |
```

```
|<---------------------------|                                                |
| 8.Standard query response  |                                                |
|  RCODE= 2(Server failure)  |                                                |
|  QNAME= A.example.org      |                                                |
|  QTYPE=A                   |                                                |
|--------------------------->|                                                |
| 9.Send standard query      |                                                |
|  QNAME=A.example.org       |                                                |
|  QTYPE=A                   |                                                |
|<---------------------------|                                                |
| 10.Standard query response |                                                |
|  RCODE= 2(Server failure)  |                                                |
|  QNAME= A.example.org      |                                                |
|  QTYPE=A                   |                                                |
|                            |                                                |
v                            v                                                v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2(TN: root name server)(Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to NUT.
8. NUT transmits query response(server failure) to DNS Client1(TN)(Judgment *8)
9. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
10. NUT transmits query response(server failure) to DNS Client1 (TN)(Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)

	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY

	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	2
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	2
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- Termination
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response (Server failure).
10. Received standard query response (Server failure).

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
7.2 Dead / Unreachable Server (OPTIONAL)

5.177. Limit of time (5 minutes) for caching (Dead/Unreachable Server)

Purpose

Verify that a NUT must not cache a dead server indication for longer than 5 minutes.

- Dead / Unreachable servers are servers that fail to respond in any way to a query or where the transport layer has provided an indication that the server does not exist or is unreachable. A server may be deemed to be dead or unreachable if it has not responded to an outstanding query within 120 seconds.
- A server MAY cache a dead server indication. If it does so it MUST NOT be deemed dead for longer than five (5) minutes. The indication MUST be stored against query tuple "query name, type, class, server IP address" unless there was a transport layer indication that the server does not exist, in which case it applies to all queries to that specific IP address.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                A       192.168.1.20

For IPv6
 .                      3600000        IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000        AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
```

```
;
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                   <------------- TN --------------->
DNS Client1 (TN)        DNS Server1 (NUT)          DNS Server2 DNS Server3 DNS Server4
 |                      |                              |           |           |
 |----------------------->|                              |           |           |
 | 1.Send standard query |                              |           |           |
 |  QNAME=A.example.org  |                              |           |           |
 |  QTYPE=A              |                              |           |           |
 |                       |------------------------------>|           |           |
 |                       | 2. Recv standard query       |           |           |
 |                       |  QNAME=A.example.org         |           |           |
 |                       |  QTYPE=A                     |           |           |
 |                       |<------------------------------|           |           |
 |                       | 3.Send standard query response |           |           |
 |                       |  QNAME=A.example.org         |           |           |
 |                       |  QTYPE=A                     |           |           |
 |                       |  AUTHORITY Name=org          |           |           |
 |                       |  AUTHORITY Name Server       |           |           |
 |                       |            =NS3.example.org  |           |           |
 |                       |  ADDITIONAL Name=NS3.example.org|           |           |
 |                       |  ADDITIONAL Address=192.168.1.30|           |           |
 |                       |                              v           |           |
 |                       |--------------------------------------------->|           |
 |                       |          4.Recv standard query             |           |
 |                       |           QNAME=A.example.org              |           |
 |                       |           QTYPE=A                          |           |
 |                       |<---------------------------------------------|           |
 |                       |          5.Send standard query response    |           |
 |                       |           QNAME=A.example.org              |           |
 |                       |           QTYPE=A                          |           |
 |                       |           AUTHORITY Name=example.org       |           |
 |                       |           AUTHORITY Name Server            |           |
 |                       |                  = NS4.example.org         |           |
 |                       |           ADDITIONAL Name = NS4.example.org|           |
 |                       |           ADDITIONAL Address = 192.168.1.40|           |
 |                       |                                        v           |
 |                       |------------------------------------------------------------>|
 |                       |                    6.Send standard query                    |
 |                       |                     QNAME=A.example.org                     |
 |                       |                     QTYPE=A                                 |
 |                       | X <------------------------------------------------------------|
 |                       |                    7.Send standard query response           |
 |                       |                                                            |
//   wait 120 seconds    //                                                           //
 |                       |                                                            |
```

```
|<-------------------------|                                                |
| 8.Standard query response|                                                |
|  RCODE= 2(Server failure)|                                                |
|  QNAME= A.example.org    |                                                |
|  QTYPE=A                 |                                                |
|                          |                                                |
//       wait 5 minutes    //                                              //
|                          |                                                |
|------------------------->|                                                |
| 9.Send standard query    |                                                |
|  QNAME=A.example.org     |                                                |
|  QTYPE=A                 |                                                |
|                          |------------------------------------------------->|
|                          |                      10.Send standard query    |
|                          |                        QNAME=A.example.org     |
|                          |                        QTYPE=A                 |
v                          v                                                v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2(TN: root name server)(Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to NUT.
8. NUT transmits query response(server failure) to DNS Client1(TN)(Judgment *8)
9. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
10. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *10)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org

	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY

UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	2
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY

DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

- Termination
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response (Server failure).
10. Received standard query including QNAME=A.example.org, QTYPE=A.

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
7.2 Dead / Unreachable Server (OPTIONAL)

5.178. Caching of SOA record

Purpose

Verify that a NUT caches SOA record from the authority section for query tuple.

- The SOA record from the authority section MUST be cached. Name error indications must be cached against the tuple "query name, QCLASS". No data indications must be cached against "query name, QTYPE, QCLASS" tuple.

  A cached SOA record must be added to the response. This was explicitly not allowed because previously the distinction between a normal cached SOA record, and the SOA cached as a result of a negative response was not made, and simply extracting a normal cached SOA and adding that to a cached negative response causes problems.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
```

```
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                    <-------------- TN --------------->
DNS Client1 (TN)          DNS Server1 (NUT)         DNS Server2 DNS Server3 DNS Server4
  |                           |                          |           |           |
  |-------------------------->|                          |           |           |
  | 1.Send standard query     |                          |           |           |
  |  QNAME=B.example.org      |                          |           |           |
  |  QTYPE=A                  |                          |           |           |
  |                           |------------------------->|           |           |
  |                           | 2.Recv standard query    |           |           |
  |                           |  QNAME=B.example.org     |           |           |
  |                           |  QTYPE=A                 |           |           |
  |                           |<-------------------------|           |           |
  |                           | 3.Send standard query response|      |           |
  |                           |  QNAME=B.example.org     |           |           |
  |                           |  QTYPE=A                 |           |           |
  |                           |  AUTHORITY Name=org      |           |           |
  |                           |  AUTHORITY Name Server   |           |           |
  |                           |            =NS3.example.org |        |           |
  |                           |  ADDITIONAL Name = NS3.example.org |  |           |
  |                           |  ADDITIONAL Address =192.168.1.30 |   |           |
  |                           |                          v           |           |
  |                           |------------------------------------->|           |
  |                           |          4.Recv standard query       |           |
  |                           |           QNAME=B.example.org        |           |
  |                           |           QTYPE=A                    |           |
  |                           |<-------------------------------------|           |
  |                           |          5.Send standard query response |        |
  |                           |           QNAME=B.example.org        |           |
  |                           |           QTYPE=A                    |           |
  |                           |           AUTHORITY Name=example.org |           |
  |                           |           AUTHORITY Name Server      |           |
  |                           |                  = NS4.example.org   |           |
  |                           |           ADDITIONAL Name=NS4.example.org|       |
  |                           |           ADDITIONAL Address=192.168.1.40|       |
  |                           |                                  v               |
  |                           |------------------------------------------------->|
  |                           |                       6.Send standard query      |
  |                           |                        QNAME=B.example.org       |
  |                           |                        QTYPE=A                   |
  |                           |<-------------------------------------------------|
  |                           |                       7.Send standard query response|
  |                           |                        RCODE=3(NXDOMIN)          |
  |                           |                        QNAME=B.example.org       |
  |                           |                        QTYPE=A                   |
  |                           |                        AUTHORITY Name=example.org |
  |                           |                        AUTHORITY Type=SOA        |
  |                           |                        AUTHORITY Minimum=1 hour  |
```

```
|<---------------------------|                                                  |
| 8.Standard query response  |                                                  |
|  RCODE= 3(NXDOMIN)         |                                                  |
|  QNAME= B.example.org      |                                                  |
|  QTYPE=A                   |                                                  |
|  AUTHORITY Name=example.org|                                                  |
|  AUTHORITY Type=SOA        |                                                  |
|  AUTHORITY Minimum=1 hour  |                                                  |
|--------------------------->|                                                  |
| 9.Send standard query      |                                                  |
|  QNAME=B.example.org       |                                                  |
|  QTYPE=A                   |                                                  |
|<---------------------------|                                                  |
|10.Standard query response  |                                                  |
|  RCODE= 3(NXDOMIN)         |                                                  |
|  QNAME= B.example.org      |                                                  |
|  QTYPE=A                   |                                                  |
|  AUTHORITY Name=example.org|                                                  |
|  AUTHORITY Type=SOA        |                                                  |
|  AUTHORITY TTL             |                                                  |
|          = less than 1 hour|                                                  |
|  AUTHORITY Minimum=1 hour  |                                                  |
|--------------------------->|                                                  |
|11.Send standard query      |                                                  |
|  QNAME=example.org         |                                                  |
|  QTYPE=SOA                 |                                                  |
|                            |------------------------------------------------->|
|                            |                        12.Send standard query    |
|                            |                          QNAME=example.org       |
|                            |                          QTYPE=SOA               |
v                            v                                                  v
```

1. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response(NXDOMAIN) to AUTHORITY NAME=example.org, AUTHORITY Type=SOA.
8. NUT transmits query response(NXDOMAIN)to DNS Client1(TN)(Judgment *8)
9. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
10. NUT transmits query response(NXDOMAIN) to DNS Client1 (TN) (Judgment *10)
11. TN send standard query QNAME=example.org, QTYPE=SOA to NUT.
12. NUT transmits standard query QNAME=example.org, QTYPE=SOA to DNS Server4 (TN: NS4.example.org) (Judgment *12)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000

	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY

	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1

	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	1 hour (3600)
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	3
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	SOA (0x0006)
	CLASS	IN (0x0001)
	TTL	less than 1 hour
	RDLENGTH	33
	NSDNAME	NS4.example.com (NS4 + Pointer 0xC00E)
	RNAME	root.example.com (root + Pointer 0xC00E)
	SERIAL	2005081600
	REFRESH	1 hour
	RETRY	15 minutes
	EXPIRE	1 week
	MINIMUM	1 hour (3600)

11th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000

	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.org
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

12th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	example.org
	QTYPE	SOA (0x0006)
	QCLASS	IN (0x0001)

- **Termination**

  None

Judgment

2. Received standard query including QNAME=B.example.org, QTYPE=A.
4. Received standard query including QNAME=B.example.org, QTYPE=A.
6. Received standard query including QNAME=B.example.org, QTYPE=A.
8. Received standard query response (NXDOMAIN).
10. Received standard query response (NXDOMAIN).
12. Received standard query including QNAME=example.org, QTYPE=SOA.

References

RFC2308 Negative Caching of DNS Queries (DNS NCACHE)
8. Changes from RFC1034

5.179. OPT pseudo-RR

Purpose

Verify that a NUT transmits correct message including OPT pseudo-RR

- OPT pseudo-RR format

```
+-+-+-+-+-+-+-+-+
| NAME          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| TYPE                          | CLASS                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|EXTENDED-RCODE | VERSION       | Z                             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| RDLENGTH                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+ -+-
| OPTION-CODE                   | OPTION-LENGTH                 |  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+  | {attribute,value} pair
| OPTION-DATA ...                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+ -+-
| OPTION-CODE                   | OPTION-LENGTH                 |  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+  | {attribute,value} pair
| OPTION-DATA ...                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+ -+-
| OPTION-CODE                   | OPTION-LENGTH                 |  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+  | {attribute,value} pair
| OPTION-DATA ...                                               |
+-+-+-+-+                                                      -+-
                                                                | ...
```

NAME	empty (root domain)
TYPE	OPT (= 41)
CLASS	sender's UDP payload size
EXTENDED-RCODE	Forms upper 8 bits of extended 12-bit RCODE.
VERSION	Indicates the implementation level of whoever sets it.
Z	0
OPTION-CODE	(Assigned by IANA.)
OPTION-LENGTH	Size (in octets) of OPTION-DATA.
OPTION-DATA	Varies per OPTION-CODE.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 41　Topology No.41".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.

Set the DNS Server1's (NUT) EDNS UDP size to 1024.
Configure the Server1's (NUT) zone file to response query from TN.

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
NS1      IN        A         192.168.0.10
;
A        IN        AAAA      3ffe:501:ffff:101::10
                   AAAA      3ffe:501:ffff:101::11
                   AAAA      3ffe:501:ffff:101::12
                   AAAA      3ffe:501:ffff:101::13
                   AAAA      3ffe:501:ffff:101::14
                   AAAA      3ffe:501:ffff:101::15
                   AAAA      3ffe:501:ffff:101::16
                   AAAA      3ffe:501:ffff:101::17
                   AAAA      3ffe:501:ffff:101::18
                   AAAA      3ffe:501:ffff:101::19
                   AAAA      3ffe:501:ffff:101::20
                   AAAA      3ffe:501:ffff:101::21
                   AAAA      3ffe:501:ffff:101::22
                   AAAA      3ffe:501:ffff:101::23
                   AAAA      3ffe:501:ffff:101::24
                   AAAA      3ffe:501:ffff:101::25
                   AAAA      3ffe:501:ffff:101::26
                   AAAA      3ffe:501:ffff:101::27
                   AAAA      3ffe:501:ffff:101::28
                   AAAA      3ffe:501:ffff:101::29
                   AAAA      3ffe:501:ffff:101::30
                   AAAA      3ffe:501:ffff:101::31
                   AAAA      3ffe:501:ffff:101::32
                   AAAA      3ffe:501:ffff:101::33
                   AAAA      3ffe:501:ffff:101::34
                   AAAA      3ffe:501:ffff:101::35
                   AAAA      3ffe:501:ffff:101::36
                   AAAA      3ffe:501:ffff:101::37
```

AAAA	3ffe:501:ffff:101::38
AAAA	3ffe:501:ffff:101::39
AAAA	3ffe:501:ffff:101::40
AAAA	3ffe:501:ffff:101::41

Procedure

This test sequence is following.

```
     DNS Client1 (TN)                        DNS Server1 (NUT)
         |                                        |
         |---------------------------------------->|
         | 1. Send standard query                 |
         |    QNAME=A.example.com                 |
         |    QTYPE=AAAA                          |
         |    ADDITIONAL UDP payload size = 1024|
         |<----------------------------------------|
         | 2. Standard query response             |
         |    AAAA=3ffe:501:ffff:101::10          |
         |     ...                                |
         |    AAAA=3ffe:501:ffff:101::41          |
         |    ADDITIONAL UDP payload size = 1024|
         v                                        v

     1. TN send standard query QNAME=A.example.com, QTYPE=AAAA w/ EDNS0 to NUT.
     2. NUT reply query response
     w/ AAAA=3ffe:501:ffff:101::10-3ffe:501:ffff:101::41
        w/ EDNS0 to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0

DNS Question section	QNAME	A.example.com
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)
	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0
	Z	0
	RDLENGTH	0

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	32
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	A.example.com
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::10
...	...	...
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	AAAA (0x001C)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::41
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC3AB)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)
	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0
	Z	0
	RDLENGTH	0

- **Termination**
  None

Judgment

2. Received standard query response including OPT pseudo-RR.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
RFC 2671 EDNS0
  4. OPT pseudo-RR

5.180. OPT pseudo-RR (recursive)

Purpose

Verify that a NUT transmits correct message including OPT pseudo-RR

- Query type AAAA.
  Header section field has the following value.

QR	**0**
QDCOUNT	**1**
ANCOUNT	**0**
NSCOUNT	**0**
ARCOUNT	***ANY***

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	**A.example.org**
QTYPE	**AAAA (0x001C)**
QCLASS	**IN (0x0001)**

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 42　Topology No.42".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Set the DNS Server1's (NUT) EDNS UDP size to 1024.
  Configure the Server1's (NUT) zone file to response query from TN.
  Example of root server list:

For IPv4:

```
.                       3600000          IN       NS       A.ROOT.NET.
```

```
 A.ROOT.NET.              3600000                    A        192.168.1.20
For IPv6
 .                        3600000          IN        NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA      3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL  86400               ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600          ; serial
      3600                ; refresh every 1 hr
      900                 ; retry every 15 min
      604800              ; expire after a week
      3600                ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                      <--------------- TN ---------------->
DNS Client1 (TN)           DNS Server1 (NUT)           DNS Server2 DNS Server3 DNS Server4
  |                                |                                |         |         |
  |-------------------------------->|                                |         |         |
  | 1.Send standard query          |                                |         |         |
  |  QNAME=A.example.org           |                                |         |         |
  |  QTYPE=AAAA                    |                                |         |         |
  |  ADDITIONAL UDP payload size=1024|                              |         |         |
  |                                |---------------------------------->|      |         |
  |                                | 2.Send standard query          |         |         |
  |                                |  QNAME=A.example.org           |         |         |
  |                                |  QTYPE=AAAA                    |         |         |
  |                                |  ADDITIONAL UDP payload size = 1024|     |         |
  |                                |<----------------------------------|      |         |
  |                                | 3.Send standard response       |         |         |
  |                                |  QNAME=A.example.org           |         |         |
  |                                |  QTYPE=AAAA                    |         |         |
  |                                |  AUTHORITY Name=org            |         |         |
  |                                |  AUTHORITY Name Server         |         |         |
  |                                |            =NS3.example.org    |         |         |
  |                                |  ADDITIONAL Name=NS3.example.org|        |         |
  |                                |  ADDITIONAL Address=192.168.1.30|        |         |
  |                                |  ADDITIONAL UDP payload size = 1024|     |         |
  |                                |                                v         |         |
  |                                |------------------------------------------>|         |
  |                                |             4.Send standard query         |         |
  |                                |              QNAME=A.example.org          |         |
  |                                |              QTYPE=AAAA                   |         |
  |                                |              ADDITIONAL UDP payload size=1024|        |
  |                                |                                          |         |
```

```
|                                |<-----------------------------------------|         |
|                                |            5.Send standard response      |         |
|                                |             QNAME=A.example.org          |         |
|                                |             QTYPE=AAAA                   |         |
|                                |             AUTHORITY Name=example.org   |         |
|                                |             AUTHORITY Name Server        |         |
|                                |                    = NS4.example.org     |         |
|                                |             ADDITIONAL Name =NS4.example.org|      |
|                                |             ADDITIONAL Address =192.168.1.40|      |
|                                |             ADDITIONAL UDP payload size=1024|      |
|                                |                                     v    |
|                                |------------------------------------------------->|
|                                |                 6.Send standard query                |
|                                |                  QNAME=A.example.org                 |
|                                |                  QTYPE=AAAA                          |
|                                |                  ADDITIONAL UDP payload size= 1024   |
|                                |<-------------------------------------------------|
|                                |                 7.Send standard response             |
|                                |                  QNAME=A.example.org                 |
|                                |                   QTYPE=AAAA                         |
|                                |                  ANSWER Name=A.example.org           |
|                                |                  ANSWER Address=3ffe:501:ffff:101::10 |
|                                |                   ...                                |
|                                |                  ANSWER Address=3ffe:501:ffff:101::41 |
|                                |                  AUTHORITY Name=example.org          |
|                                |                  AUTHORITY Name Serve=NS4.example.org |
|                                |                  ADDITIONAL Name= NS4.example.org    |
|                                |                  ADDITIONAL Address = 192.168.1.40   |
|                                |                  ADDITIONAL UDP payload size= 1024   |
|                                |                                                   v
|<-------------------------------|
| 8.Standard query response      |
|  QNAME=A.example.org           |
|  QTYPE=AAAA                    |
|  ANSWER Name=A.example.org     |
|  ANSWER Address                |
|      = 3ffe:501:ffff:101::10   |
|   ...                          |
|  ANSWER Address                |
|      = 3ffe:501:ffff:101::42   |
|  AUTHORITY Name=example.org    |
|  AUTHORITY Name Server         |
|            =NS4.example.org    |
|  ADDITIONAL UDP payload size=1024
|                                |
v                                v
```

1. TN send standard query QNAME=A.example.org, QTYPE=AAAA to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=AAAA DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=AAAA DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER NAME=A.example.org, ANSWER Address=3ffe:501:ffff:101::10-3ffe:501:ffff:101::10 to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)
	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0
	Z	0
	RDLENGTH	0

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0

	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)
	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0
	Z	0
	RDLENGTH	0

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)

	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)
	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0
	Z	0
	RDLENGTH	0

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY

DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)
	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0
	Z	0
	RDLENGTH	0

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)
	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0
	Z	0
	RDLENGTH	0

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)
	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0
	Z	0
	RDLENGTH	0

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	32
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::10
...	...	...
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::41
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC3AB)

	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)
	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0
	Z	0
	RDLENGTH	0

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	32
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::10
...	...	...

DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::41
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC3AB)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)
	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0
	Z	0
	RDLENGTH	0

- Termination
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=AAAA w/ OPT pseudo-RR.
4. Received standard query including QNAME=A.example.org, QTYPE=AAAA w/ OPT pseudo-RR.
6. Received standard query including QNAME=A.example.org, QTYPE=AAAA w/ OPT pseudo-RR.
8. Received standard query response including correct address in the ADDRESS field w/ OPT pseudo-RR.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
RFC2671 EDNS0
  4. OPT pseudo-RR

5.181. The presence of an OPT pseudo-RR

Purpose

Verify that a NUT takes the presence of an OPT pseudo-RR in a request as an indication that the requestor fully implements the given version of EDNS.

- The presence of an OPT pseudo-RR in a request should be taken as an indication that the requestor fully implements the given version of EDNS, and can correctly understand any response that conforms to that feature's specification.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1　Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Set the DNS Server1's (NUT) EDNS UDP size to 1024.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
A        IN      AAAA    3ffe:501:ffff:101::10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |--------------------------------------->|
    |   1. Send standard query              |
    |       QNAME=A.example.com             |
    |       QTYPE=AAAA                      |
    |       ADDITIONAL UDP payload size     |
    |        = 1024                         |
    |<---------------------------------------|
    |   2. Standard query response          |
    |       AAAA=3ffe:501:ffff:101::10      |
    |       ADDITIONAL UDP payload size     |
    |        = 1024                         |
    v                                       v

     1. TN send standard query QNAME=A.example.com, QTYPE=AAAA w/ EDNS0 to NUT.
     2. NUT reply query response w/ AAAA=3ffe:501:ffff:101::10 w/ EDNS0 to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)

	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0
	Z	0
	RDLENGTH	0

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	A.example.com
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC047)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)
	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0
	Z	0
	RDLENGTH	0

- **Termination**
  None

Judgment

2. Received standard query response including OPT pseudo-RR.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
RFC2671 EDNS0
  5. Transport Considerations

5.182. The presence of an OPT pseuduo-RR

Purpose

Verify that a NUT takes the lack of an OPT pseudo-RR in a request as an indication that the requestor does not implement any part of EDNS0 specification

- Lack of use of these features in a request must be taken as an indication that the requestor does not implement any part of EDNS0 specification and that the responder may make no use of any protocol extension described here in its response.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1　Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Set the DNS Server1's (NUT) EDNS UDP size to 1024.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
A        IN      AAAA    3ffe:501:ffff:101::10
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |-------------------------------------->|
    |   1. Send standard query              |
    |       QNAME=A.example.com             |
    |       QTYPE=AAAA                      |
    |<--------------------------------------|
    |   2. Standard query response          |
    |       AAAA=3ffe:501:ffff:101::10      |
    v                                       v

     1. TN send standard query QNAME=A.example.com, QTYPE=AAAA w/o EDNS0 to NUT.
     2. NUT reply query response w/ AAAA=3ffe:501:ffff:101::10 w/o EDNS0 to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ

UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC047)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response excluding OPT pseudo-RR.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
3.2.1 Format
RFC2671 EDNS0
5. Transport Considerations

5.183. responders don't understand OPT RR

Purpose

Verify that a NUT retransmits query when responders don't understand OPT RR

- Responders who do not understand these protocol extensions are expected to send a response with RCODE NOTIMPL, FORMERR, or SERVFAIL. Therefore use of extensions should be "probed" such that a responder who isn't known to support them be allowed a retry with no extensions if it responds with such an RCODE.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig.22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Set the DNS Server1's (NUT) EDNS UDP size to 1024.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN       NS       NS1.example.com.
NS1      IN       A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                        <--------------- TN ------------->
DNS Client1 (TN)            DNS Server1 (NUT)           DNS Server2 DNS Server3 DNS Server4
  |                          |                                |          |          |
  |--------------------------->|                               |          |          |
  | 1.Send standard query      |                               |          |          |
  |  QNAME=A.example.org       |                               |          |          |
  |  QTYPE=AAAA                |                               |          |          |
  |  ADDITIONAL UDP payload size|                              |          |          |
  |   = 1024                   |--------------------------------->|      |          |
  |                            | 2.Send standard query          |          |          |
  |                            |  QNAME=A.example.org           |          |          |
  |                            |  QTYPE=AAAA                    |          |          |
  |                            |  ADDITIONAL UDP payload size = 1024 |     |          |
  |                            |<---------------------------------|       |          |
  |                            | 3.Send standard response       |          |          |
  |                            |  RCODE=4(Not Implemented)      |          |          |
  |                            |  QNAME=A.example.org           |          |          |
  |                            |  QTYPE=AAAA                    |          |          |
  |                            |  AUTHORITY Name=org            |          |          |
  |                            |  AUTHORITY Name Server         |          |          |
  |                            |            =NS3.example.org    |          |          |
  |                            |  ADDITIONAL Name=NS3.example.org|         |          |
  |                            |  ADDITIONAL Address=192.168.1.30|         |          |
  |                            |--------------------------------->|       |          |
  |                            | 4.Send standard query          |          |          |
  |                            |  QNAME=A.example.org           |          |          |
  |                            |  QTYPE=AAAA                    |          |          |
  |                            |<---------------------------------|       |          |
  |                            | 5.Send standard response       |          |          |
  |                            |  QNAME=A.example.org           |          |          |
  |                            |  QTYPE=AAAA                    |          |          |
  |                            |  AUTHORITY Name=org            |          |          |
  |                            |  AUTHORITY Name Server         |          |          |
  |                            |            =NS3.example.org    |          |          |
  |                            |  ADDITIONAL Name=NS3.example.org|         |          |
  |                            |  ADDITIONAL Address=192.168.1.30|         |          |
  |                            |                                v          |          |
  |                            |------------------------------------------>|          |
  |                            |             6.Send standard query         |          |
  |                            |              QNAME=A.example.org          |          |
  |                            |              QTYPE=AAAA                   |          |
  |                            |              ADDITIONAL UDP payload size = 1024 |    |
  |                            |<------------------------------------------|          |
  |                            |             7.Send standard response      |          |
  |                            |              RCODE=4(Not Implemented)     |          |
  |                            |              QNAME=A.example.org          |          |
  |                            |              QTYPE=AAAA                   |          |
  |                            |              AUTHORITY Name=example.org   |          |
  |                            |              AUTHORITY Name Server        |          |
  |                            |                     = NS4.example.org     |          |
  |                            |              ADDITIONAL Name              |          |
  |                            |                     = NS4.example.org     |          |
  |                            |             ADDITIONAL Address = 192.168.1.40 |      |
```

```
|                            |------------------------------------------>|         |
|                            |             8.Send standard query         |         |
|                            |              QNAME=A.example.org          |         |
|                            |              QTYPE=AAAA                   |         |
|                            |<------------------------------------------|         |
|                            |             9.Send standard response      |         |
|                            |              QNAME=A.example.org          |         |
|                            |              QTYPE=AAAA                   |         |
|                            |              AUTHORITY Name=example.org   |         |
|                            |              AUTHORITY Name Server        |         |
|                            |                     = NS4.example.org     |         |
|                            |              ADDITIONAL Name = NS4.example.org |         |
|                            |              ADDITIONAL Address = 192.168.1.40 |         |
|                            |                                       v         |
|                            |--------------------------------------------------->|
|                            |                   10.Send standard query          |
|                            |                     QNAME=A.example.org           |
|                            |                     QTYPE=AAAA                    |
|                            |                     ADDITIONAL UDP payload size=1024|
|                            |                                                   |
|                            |<---------------------------------------------------|
|                            |                   11.Send standard response       |
|                            |                     RCODE=4(Not Implemented)      |
|                            |                     QNAME=A.example.org           |
|                            |                     QTYPE=AAAA                    |
|                            |                     AUTHORITY Name=example.org    |
|                            |                     AUTHORITY Name Server         |
|                            |                         = NS4.example.org         |
|                            |                     ADDITIONAL Name=NS4.example.org |
|                            |                     ADDITIONAL Address=192.168.1.40 |
|                            |--------------------------------------------------->|
|                            |                   12.Send standard query          |
|                            |                     QNAME=A.example.org           |
|                            |                     QTYPE=AAAA                    |
|                            |<---------------------------------------------------|
|                            |                   13.Send standard response       |
|                            |                     QNAME=A.example.org           |
|                            |                     QTYPE=AAAA                    |
|                            |                     ANSWER Name=A.example.org     |
|                            |                     ANSWER Address                |
|                            |                            = 3ffe:501:ffff:101::10  |
|                            |                     AUTHORITY Name=example.org    |
|                            |                     AUTHORITY Name Server         |
|                            |                           = NS4.example.org       |
|                            |                     ADDITIONAL Name =NS4.example.org|
|                            |                     ADDITIONAL Address =192.168.1.40|
|<---------------------------|                                                   v
| 14.Standard query response |
|  QNAME=A.example.org       |
|  QTYPE=AAAA                |
|  ANSWER Name=A.example.org |
|  ANSWER Address            |
|      = 3ffe:501:ffff:101::10|
|  AUTHORITY Name=example.org |
|  AUTHORITY Name Server     |
|            =NS4.example.org |
v                            v
```

1. TN send standard query QNAME=A.example.org, QTYPE=AAAA to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send standard query response to NUT w/ RCODE=4(Not Implemented).
4. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
5. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=AAAA DNS Server3 (TN: NS3.example.org) (Judgment *4)
7. TN send standard query response to NUT w/ RCODE=4(Not Implemented).
8. NUT transmits standard query QNAME=A.example.org, QTYPE=AAAA DNS Server3 (TN: NS3.example.org) (Judgment *4)
9. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
10. NUT transmits standard query QNAME=A.example.org, QTYPE=AAAA DNS Server4 (TN: NS4.example.org) (Judgment *6)
11. TN send standard query response to NUT w/ RCODE=4(Not Implemented).
12. NUT transmits standard query QNAME=A.example.org, QTYPE=AAAA DNS Server4 (TN: NS4.example.org) (Judgment *6)
13. TN send query response to ANSWER NAME=A.example.org, ANSWER Address =3ffe:501:ffff:101::10-3ffe:501:ffff:101::10 to NUT.
14. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)
	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0

	Z	0
	RDLENGTH	0

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)
	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0
	Z	0
	RDLENGTH	0

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1

	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	4
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0

	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	4
	ADDRESS	192.168.1.30

6th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)
	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0
	Z	0
	RDLENGTH	0

7th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1

	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	4
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0

	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)

9th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	4
	ADDRESS	192.168.1.40

10th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)
	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0
	Z	0
	RDLENGTH	0

11th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1

	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	4
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC047)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

12th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0

	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)

13th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC047)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

14th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6

	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC047)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40
DNS Additional section	NAME	empty (root domain)
	TYPE	OPT (0x0029)
	CLASS	1024
	EXTENDED-RCODE	0
	VERSION	0
	Z	0
	RDLENGTH	0

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=AAAA w/ OPT pseudo-RR.
4. Received standard query including QNAME=A.example.org, QTYPE=AAAA w/o OPT pseudo-RR.
6. Received standard query including QNAME=A.example.org, QTYPE=AAAA w/ OPT pseudo-RR.
8. Received standard query including QNAME=A.example.org, QTYPE=AAAA w/o OPT pseudo-RR.
10. Received standard query including QNAME=A.example.org, QTYPE=AAAA w/ OPT pseudo-RR.
12. Received standard query including QNAME=A.example.org, QTYPE=AAAA w/o OPT pseudo-RR.
14. Received standard query response including correct address in the ADDRESS field w/ OPT pseudo-RR.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
3.2.1 Format
RFC2671 EDNS0
5 Transport Considerations

5.184. Resource record SRV type

Purpose

Verify that a NUT transmits correct message including SRV type in the QTYPE field.

- Query type SRV.
  Header section field has the following value.

QR	**0**
QDCOUNT	**1**
ANCOUNT	**0**
NSCOUNT	**0**
ARCOUNT	***ANY***

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	**A.example.org**
QTYPE	**SRV (0x0021)**
QCLASS	**IN (0x0001)**

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.
  Example of root server list:

```
For IPv4:
 .                        3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.              3600000                   A        192.168.1.20

For IPv6
 .                        3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                   <------------- TN ---------------->
DNS Client1 (TN)              DNS Server1 (NUT)    DNS Server2 DNS Server3 DNS Server4
  |                                |                          |          |           |
  |------------------------------->|                          |          |           |
  | 1. Send standard query         |                          |          |           |
  |    QNAME=_http._tcp.example.org.|                         |          |           |
  |    QTYPE=SRV                   |                          |          |           |
  |                                |--------------------------->|        |           |
  |                                | 2. Send standard query   |          |           |
  |                                |  QNAME=_http._tcp.example.org.      |           |
  |                                |  QTYPE=SRV               |          |           |
  |                                |<---------------------------|        |           |
  |                                | 3. Send standard response|          |           |
  |                                |  QNAME=_http._tcp.example.org.      |           |
  |                                |  QTYPE=SRV               |          |           |
  |                                |  AUTHORITY Name=org.     |          |           |
  |                                |  AUTHORITY Name Server   |          |           |
  |                                |            =NS3.example.org.        |           |
  |                                |  ADDITIONAL Name=NS3.example.org.   |           |
  |                                |  ADDITIONAL Addres=192.168.1.30     |           |
  |                                |                          v          |           |
  |                                |------------------------------------------>|    |
  |                                |          4. Send standard query     |           |
  |                                |           QNAME=_http._tcp.example.org.           |
  |                                |           QTYPE=SRV                 |           |
  |                                |                                     |           |
```

```
|                                |<-----------------------------------------|          |
|                                |          5. Send standard response       |          |
|                                |           QNAME=_http._tcp.example.org.  |          |
|                                |           QTYPE=SRV                      |          |
|                                |           AUTHORITY Name=example.org.    |          |
|                                |           AUTHORITY Name Server          |          |
|                                |                  = NS4.example.org.      |          |
|                                |           ADDITIONAL Name=NS4.example.org. |        |
|                                |           ADDITIONAL Address=192.168.1.40 |         |
|                                |                                       v          |
|                                |------------------------------------------------->|
|                                |                   6. Send standard query           |
|                                |                    QNAME=_http._tcp.example.org.   |
|                                |                    QTYPE=SRV                       |
|                                |<-------------------------------------------------|
|                                |                   7. Send standard response        |
|                                |                    QNAME=_http._tcp.example.org.   |
|                                |                    QTYPE=SRV                       |
|                                |                    ANSWER                          |
|                                |                        Priority = 10               |
|                                |                        Weight = 20                 |
|                                |                        Port = 80                   |
|                                |                        Target = A.example.org.     |
|                                |                    AUTHORITY Name=example.org.     |
|                                |                    AUTHORITY Name Server           |
|                                |                                 = NS4.example.org. |
|                                |                    ADDITIONAL Name = A.example.org. |
|                                |                    ADDITIONAL Address = 192.168.1.10 |
|                                |                    ADDITIONAL Name = NS4.example.org. |
|                                |                    ADDITIONAL Address = 192.168.1.40 |
|<-------------------------------|                                                   v
| 8. Standard query response     |
|  QNAME=_http._tcp.example.org. |
|  QTYPE=SRV                     |
|  ANSWER                        |
|      Priority = 10             |
|      Weight = 20               |
|      Port = 80                 |
|      Target =A.example.org.    |
|  AUTHORITY Name=example.org.   |
|  AUTHORITY Name Server         |
|      = NS4.example.org.        |
|  ADDITIONAL Name =A.example.org.|
|  ADDITIONAL Address=192.168.1.10|
|  ADDITIONAL Name=NS4.example.org.|
|  ADDITIONAL Address=192.168.1.40|
v                                v
```

1. TN send standard query QNAME=_http._tcp.example.org., QTYPE=SRV to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org., AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=_http._tcp.example.org., QTYPE=SRV DNS Server3 (TN: NS3.example.org.) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org., AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=_http._tcp.example.org., QTYPE=SRV DNS Server4 (TN: NS4.example.org.) (Judgment *6)
7. TN send query response to ANSWER Target = A.example.org. to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	_http._tcp.example.org.
	QTYPE	SRV (0x0021)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1

	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	_http._tcp.example.org.
	QTYPE	SRV (0x0021)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	_http._tcp.example.org.
	QTYPE	SRV (0x0021)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org. (Pointer 0xC01F)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	17
	NSDNAME	NS3.example.org.
DNS Additional section	NAME	NS3.example.org. (Pointer 0xC034)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	_http._tcp.example.org.
	QTYPE	SRV (0x0021)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	_http._tcp.example.org.
	QTYPE	SRV (0x0021)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org. (Pointer 0xC017)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org.
DNS Additional section	NAME	NS4.example.org. (Pointer 0xC034)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	_http._tcp.example.org.
	QTYPE	SRV (0x0021)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	_http._tcp.example.org.
	QTYPE	SRV (0x0021)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	_http._tcp.example.org. (Pointer 0xC00C)
	TYPE	SRV (0x0021)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	21
	Priority	10
	Weight	20
	Port	80
	Target	A.example.org.
DNS Authority section	NAME	example.org. (Pointer 0xC03C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org. (NS4 + Pointer 0xC03C)
DNS Additional section	NAME	A.example.org. (Pointer 0xC03A)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4

	ADDRESS	192.168.1.10
DNS Additional section	NAME	NS4.example.org (Pointer 0xC055)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	_http._tcp.example.org.
	QTYPE	SRV (0x0021)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	_http._tcp.example.org. (Pointer 0xC00C)
	TYPE	SRV (0x0021)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	21
	Priority	10
	Weight	20
	Port	80
	Target	A.example.org.
DNS Authority section	NAME	example.org (Pointer 0xC03C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC03C)
DNS Additional section	NAME	A.example.org. (Pointer 0xC03A)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Additional section	NAME	NS4.example.org (Pointer 0xC055)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- Termination
  None

Judgment

2. Received standard query including QNAME=_http._tcp.example.org., QTYPE=SRV.
4. Received standard query including QNAME=_http._tcp.example.org., QTYPE=SRV.
6. Received standard query including QNAME=_http._tcp.example.org., QTYPE=SRV.
8. Received standard query response including correct domain name in the Target field.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
RFC2782 DNS SRV RR

5.185. Resource record of SRV type

Purpose

Verify that a NUT transmits correct message including SRV resource record

- Single host address case.
  Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	1

- SRV RDATA format

```
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Priority                      | Weight                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Port                          | Target ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
```

Priority	The priority of this target host. A client MUST attempt to contact the target host with the lowest-numbered priority it can reach. This is a 16 bit unsigned integer in network byte order.
Weight	The weight field specifies a relative weight for entries with the same priority. Larger weights SHOULD be given a proportionately higher probability of being selected. This is a 16 bit unsigned integer in network byte order.
Port	The port on this target host of this service. This is a 16 bit unsigned integer in network byte order.
Target	The domain name of the target host. A Target of "." means that the service is decidedly not available at this domain.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 43 Topology No.43".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN     NS     NS1.example.com.
NS1      IN     A      192.168.0.10
;
_http._tcp       IN     SRV      10      20     80     www1.example.com.
                 IN     SRV      11      21     81     www2.example.com.
www1     IN     A      192.168.1.10
www2     IN     A      192.168.1.20
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                          DNS Server1 (NUT)
    |                                          |
    |------------------------------------------>|
    | 1. Send standard query                   |
    |   QNAME = _http._tcp.example.com.        |
    |   QTYPE = SRV                            |
    |<------------------------------------------|
    | 2. Standard query response               |
    |   QNAME = _http._tcp.example.com.        |
    |   QTYPE = SRV                            |
    |   ANSWER                                 |
    |    Priority = 10                         |
    |    Weight = 20                           |
    |    Port = 80                             |
    |    Target = www1.example.com.            |
    |   ANSWER                                 |
    |    Priority = 11                         |
    |    Weight = 21                           |
    |    Port = 81                             |
    |    Target = www2.example.com.            |
    |   AUTHORITY Name = example.com.          |
    |   AUTHORITY Name Server = NS1.example.com.|
    |   ADDITIONAL Name = www1.example.com.    |
    |   ADDITIONAL Address = 192.168.1.10      |
    |   ADDITIONAL Name = www2.example.com.    |
    |   ADDITIONAL Address = 192.168.1.20      |
    |   ADDITIONAL Name = NS1.example.com.     |
    |   ADDITIONAL Address = 192.168.0.10      |
    v                                          v

  1. TN send standard query QNAME=_http._tcp.example.com., QTYPE=SRV to NUT.
  2. NUT reply query response w/ SRV=10 20 80 www1.example.com.
     and SRV=11 21 81 www2.example.com. to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	_http._tcp.example.com.
	QTYPE	SRV (0x0021)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1

	ARCOUNT	3
DNS Question section	QNAME	_http._tcp.example.com.
	QTYPE	SRV (0x0021)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	_http._tcp.example.com. (Pointer 0xC00C)
	TYPE	SRV (0x0021)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	24
	Priority	10
	Weight	20
	Port	80
	Target	www1.example.com.
DNS Answer section	NAME	_http._tcp.example.com. (Pointer 0xC00C)
	TYPE	SRV (0x0021)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	24
	Priority	11
	Weight	21
	Port	81
	Target	www2.example.com.
DNS Authority section	NAME	example.com. (Pointer 0xC063)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com. (NS1 + Pointer 0xC063)
DNS Additional section	NAME	www1.example.com. (Pointer 0xC03A)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Additional section	NAME	www2.example.com. (Pointer 0xC05E)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.20
DNS Additional section	NAME	NS1.example.com. (Pointer 0xC07C)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response including SRV type record.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
RFC2782 DNS SRV RR

5.186. NAPTR type

Purpose

Verify that a NUT transmits correct message including NAPTR type in the QTYPE field.

- Query type NAPTR.
  Header section field has the following value.

QR	0
QDCOUNT	1
ANCOUNT	0
NSCOUNT	0

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
QTYPE	NAPTR (0x0023)
QCLASS	IN (0x0001)

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig.45 Topology No.45".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
.                    3600000        IN    NS    A.ROOT.NET.
A.ROOT.NET.          3600000              A     192.168.1.20
```

```
For IPv6
 .                        3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                          <--------------- TN --------------->
DNS Client1 (TN)            DNS Server1 (NUT)             DNS Server2 DNS Server3 DNS Server4
    |                                |                                |         |         |
    |------------------------------->|                                |         |         |
    | 1. Send standard query         |                                |         |         |
    |  QNAME                         |                                |         |         |
    |   =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.                           |         |         |
    |  QTYPE=NAPTR                   |                                |         |         |
    |                                |--------------------------------->|         |         |
    |                                | 2. Recv standard query         |         |         |
    |                                |  QNAME                         |         |         |
    |                                |   =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.     |         |
    |                                |  QTYPE=NAPTR                   |         |         |
    |                                |<---------------------------------|         |         |
    |                                | 3. Send standard query response |         |         |
    |                                |  QNAME                         |         |         |
    |                                |   =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.     |         |
    |                                |  QTYPE=NAPTR                   |         |         |
    |                                |  AUTHORITY Name= 1.8.e164.arpa.|         |         |
    |                                |  AUTHORITY Nsdname=NS3.example.org|      |         |
    |                                |  ADDITIONAL Name = NS3.example.org|      |         |
    |                                |  ADDITIONAL Address = 192.168.1.30|      |         |
    |                                |                              v         |         |
    |                                |---------------------------------------------->|         |
    |                                |          4. Recv standard query        |         |
    |                                |           QNAME                        |         |
    |                                |              =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.  |
    |                                |           QTYPE=NAPTR                  |         |
    |                                |                                        |         |
```

```
|                                |<-------------------------------------------|         |
|                                |          5. Send standard query response   |         |
|                                |           QNAME                            |         |
|                                |            =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.        |
|                                |           QTYPE=NAPTR                      |         |
|                                |           AUTHORITY Name                   |         |
|                                |                  = 0.9.1.8.e164.arpa.      |         |
|                                |           AUTHORITY Nsdname=NS4.example.org|         |
|                                |           ADDITIONAL Name = NS4.example.org|         |
|                                |           ADDITIONAL Address = 192.168.1.40|         |
|                                |                                        v          |
|                                |--------------------------------------------------->|
|                                |                 6. Send standard query               |
|                                |                   QNAME                              |
|                                |                    =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
|                                |                   QTYPE=NAPTR                        |
|                                |                                                      |
|                                |<-----------------------------------------------------|
|                                |                 7. Send standard query response      |
|                                |                   QNAME                              |
|                                |                    =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
|                                |                   QTYPE=NAPTR                        |
|                                |                   ANSWER Name                        |
|                                |                    =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
|                                |                   ANSWER Type=NAPTR                  |
|                                |                   AUTHORITY Name = 0.9.1.8.e164.arpa.|
|                                |                   AUTHORITY Nsdname = NS4.example.org|
|                                |                   ADDITIONAL Name = NS4.example.org  |
|                                |                   ADDITIONAL Address = 192.168.1.40    |
|<-------------------------------|                                                      |
|8.Recv Standard query response  |                                                      |
|  QNAME                         |                                                      |
|   = 1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.                                                |
|  QTYPE=NAPTR                   |                                                      |
|  ANSWER Name                   |                                                      |
|   = 1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.                                                |
|  ANSWER Type = NAPTR           |                                                      |
|  AUTHORITY Name                |                                                      |
|   = 0.9.1.8.e164.arpa          |                                                      |
|  AUTHORITY Nsdname             |                                                      |
|   = NS4.example.org            |                                                      |
|  ADDITIONAL Name=NS4.example.org|                                                     |
|  ADDITIONAL Address=192.168.1.40|                                                     |
|                                |                                                      |
v                                v                                                      v
```

1. TN send standard query QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, QTYPE=NAPTR to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=1.8.e164.arpa, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, QTYPE=NAPTR to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=0.9.1.8.e164.arpa, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, QTYPE=NAPTR to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to NUT w/ ANSWER Name = 1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, ANSWER Type=NAPTR to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	Any
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	ANY
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	1.8.e164.arpa (Pointer 0xC020)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS3.example.org
DNS Additional section	NAME	NS3.example.org (Pointer 0xC03F)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	0.9.1.8.e164.arpa (Pointer 0xC01C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS4.example.org
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03F)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	45
	ORDER	100
	PREFERENCE	10
	FLAGS	U
	SERVICES	sip+E2U
	REGEXP	!^.*$!sip:info1@example.org!i
	REPLACEMENT	.
DNS Authority section	NAME	0.9.1.8.e164.arpa. (Pointer 0xC01C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS4.example.org
DNS Additional section	NAME	NS4.example.org (Pointer 0xC078)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	45
	ORDER	100
	PREFERENCE	10
	FLAGS	U
	SERVICES	sip+E2U
	REGEXP	!^.*$!sip:info1@example.org!i
	REPLACEMENT	.
DNS Authority section	NAME	0.9.1.8.e164.arpa. (Pointer 0xC01C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS4.example.org
DNS Additional section	NAME	NS4.example.org (Pointer 0xC078)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- Termination
  None

Judgment

2. Received standard query including QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, QTYPE=NAPTR.
4. Received standard query including QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, QTYPE=NAPTR.
6. Received standard query including QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, QTYPE=NAPTR.
8. Received standard query response including correct NAPTR record in Answer section.

References

RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Three: The Domain Name System (DNS) Database
4. NAPTR RR Format

5.187. Caching NAPTR resource record

Purpose

Verify that a NUT uses the cached data and does not use the TTL expired cache.

- All DNS resource records have a Time To Live (TTL) associated with them. When the number of seconds has passed since the record was retrieved the record is no longer valid and a new query must be used to retrieve the new records.

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 45 Topology No.45".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

```
For IPv4:
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000                  A       192.168.1.20

For IPv6
 .                      3600000          IN      NS      A.ROOT.NET.
 A.ROOT.NET.            3600000          AAAA    3ffe:501:ffff:101::20
```

  Example of example.com zone file:

```
$TTL     86400           ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600      ; serial
         3600            ; refresh every 1 hr
         900             ; retry every 15 min
         604800          ; expire after a week
         3600            ; Minimum TTL of a 1 hr
)
;
         IN      NS      NS1.example.com.
NS1      IN      A       192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                        <--------------- TN -------------->
DNS Client1 (TN)            DNS Server1 (NUT)           DNS Server2 DNS Server3 DNS Server4
  |                         |                                |          |          |
  |------------------------>|                                |          |          |
  | 1. Send standard query  |                                |          |          |
  |  QNAME                  |                                |          |          |
  |   =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.                    |          |          |
  |  QTYPE=NAPTR            |                                |          |          |
  |                         |------------------------------->|          |          |
  |                         | 2. Recv standard query         |          |          |
  |                         |  QNAME                         |          |          |
  |                         |   =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.     |          |
  |                         |  QTYPE=NAPTR                   |          |          |
  |                         |<-------------------------------|          |          |
  |                         | 3. Send standard query response|          |          |
  |                         |  QNAME                         |          |          |
  |                         |   =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.     |          |
  |                         |  QTYPE=NAPTR                   |          |          |
  |                         |  AUTHORITY Name=1.8.e164.arpa. |          |          |
  |                         |  AUTHORITY Nsdname=NS3.example.org|       |          |
  |                         |  ADDITIONAL Name = NS3.example.org|       |          |
  |                         |  ADDITIONAL Address = 192.168.1.30|       |          |
  |                         |                                v          |          |
  |                         |------------------------------------------>|          |
  |                         |           4. Recv standard query          |          |
  |                         |            QNAME                          |          |
  |                         |             =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.      |
  |                         |            QTYPE=NAPTR                    |          |
  |                         |<------------------------------------------|          |
  |                         |           5. Send standard query response |          |
  |                         |            QNAME                          |          |
  |                         |             =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.      |
  |                         |            QTYPE=NAPTR                    |          |
  |                         |            AUTHORITY Name= 0.9.1.8.e164.arpa.|       |
  |                         |            AUTHORITY Nsdname =NS4.example.org|       |
  |                         |            ADDITIONAL Name = NS4.example.org |       |
  |                         |            ADDITIONAL Address = 192.168.1.40 |       |
  |                         |                                        v          |
  |                         |------------------------------------------------------>|
  |                         |                   6. Send standard query              |
  |                         |                    QNAME                              |
  |                         |                     =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.|
  |                         |                    QTYPE=NAPTR                         |
  |                         |<------------------------------------------------------|
  |                         |                   7. Send standard query response     |
  |                         |                    QNAME                              |
  |                         |                     =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.|
  |                         |                    QTYPE=NAPTR                         |
  |                         |                    ANSWER Name                         |
  |                         |                     =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.|
  |                         |                    ANSWER Type=NAPTR                   |
  |                         |                    ANSWER TTL= 15 seconds              |
  |                         |                    AUTHORITY Name = 0.9.1.8.e164.arpa. |
  |                         |                    AUTHORITY Nsdname = NS4.example.org |
  |                         |                    ADDITIONAL Name = NS4.example.org   |
  |                         |                    ADDITIONAL Address = 192.168.1.40   |
```

```
|<-----------------------------|                                          |
|8.Recv Standard query response |                                          |
|  QNAME                       |                                          |
|   = 1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.                                  |
|  QTYPE=NAPTR                 |                                          |
|  ANSWER Name                 |                                          |
|   = 1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.                                  |
|  ANSWER Type = NAPTR         |                                          |
|  AUTHORITY Name              |                                          |
|   = 0.9.1.8.e164.arpa        |                                          |
|  AUTHORITY Nsdname           |                                          |
|   = NS4.example.org          |                                          |
|  ADDITIONAL Name             |                                          |
|   = NS4.example.org          |                                          |
|  ADDITIONAL Address          |                                          |
|   = 192.168.1.40             |                                          |
|                              |                                          |
|      wait 5 seconds          |                                          |
|----------------------------->|                                          |
| 9. Send standard query       |                                          |
|  QNAME                       |                                          |
|   =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.                                   |
|  QTYPE=NAPTR                 |                                          |
|<-----------------------------|                                          |
|10.Recv Standard query response|                                          |
|  QNAME                       |                                          |
|   = 1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.                                  |
|  QTYPE=NAPTR                 |                                          |
|  ANSWER Name                 |                                          |
|   = 1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.                                  |
|  ANSWER Type = NAPTR         |                                          |
|  AUTHORITY Name              |                                          |
|   = 0.9.1.8.e164.arpa        |                                          |
|  AUTHORITY Nsdname           |                                          |
|   = NS4.example.org          |                                          |
|  ADDITIONAL Name             |                                          |
|   = NS4.example.org          |                                          |
|  ADDITIONAL Address          |                                          |
|   = 192.168.1.40             |                                          |
|                              |                                          |
|      wait 15 seconds         |                                          |
|----------------------------->|                                          |
|11. Send standard query       |                                          |
|  QNAME                       |                                          |
|   =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.                                   |
|  QTYPE=NAPTR                 |                                          |
|                              |------------------------------------------>|
|                              |                 12. Send standard query  |
|                              |                   QNAME                  |
|                              |                    =1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
|                              |                   QTYPE=NAPTR            |
|                              |                                          |
v                              v                                          v
```

```
1. TN send standard query QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, QTYPE=NAPTR to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=1.8.e164.arpa, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, QTYPE=NAPTR to DNS Server3 (TN:
   NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=0.9.1.8.e164.arpa,
   AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, QTYPE=NAPTR to DNS Server4 (TN:
   NS4.example.org) (Judgment *6)
7. TN send query response to NUT w/ ANSWER Name =
1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, ANSWER Type=NAPTR to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

wait 5 seconds

9. TN send standard query QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, QTYPE=NAPTR to NUT.
10. NUT transmits query response to DNS Client1 (TN) form cache. (Judgment *10)

wait 15 seconds

11. TN send standard query QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, QTYPE=NAPTR to NUT.
12. NUT transmits standard query QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, QTYPE=NAPTR to DNS Server4 (TN:
   NS4.example.org) (Judgment *12)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	Any
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1

DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	1.8.e164.arpa (Pointer 0xC020)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS3.example.org
DNS Additional section	NAME	NS3.example.org (Pointer 0xC03F)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY

	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	0.9.1.8.e164.arpa (Pointer 0xC01C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS4.example.org
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03F)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY

	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	15 sec
	RDLENGTH	45
	ORDER	100
	PREFERENCE	10

	FLAGS	U
	SERVICES	sip+E2U
	REGEXP	!^.*$!sip:info1@example.org!i
	REPLACEMENT	.
DNS Authority section	NAME	0.9.1.8.e164.arpa. (Pointer 0xC01C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS4.example.org
DNS Additional section	NAME	NS4.example.org (Pointer 0xC078)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)

	TTL	15 sec
	RDLENGTH	45
	ORDER	100
	PREFERENCE	10
	FLAGS	U
	SERVICES	sip+E2U
	REGEXP	!^.*$!sip:info1@example.org!i
	REPLACEMENT	.
DNS Authority section	NAME	0.9.1.8.e164.arpa. (Pointer 0xC01C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS4.example.org
DNS Additional section	NAME	NS4.example.org (Pointer 0xC078)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
	QTYPE	NAPTR (0x0023)

	QCLASS	IN (0x0001)

10th packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	less than 15 sec
	RDLENGTH	45
	ORDER	100
	PREFERENCE	10
	FLAGS	U
	SERVICES	sip+E2U
	REGEXP	!^.*$!sip:info1@example.org!i
	REPLACEMENT	.
DNS Authority section	NAME	0.9.1.8.e164.arpa. (Pointer 0xC01C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	less than 1 day (86400)
	RDLENGTH	16
	NSDNAME	NS4.example.org
DNS Additional section	NAME	NS4.example.org (Pointer 0xC078)

	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	less than 1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

11th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1002
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

12th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY

	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query including QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, QTYPE=NAPTR.
4. Received standard query including QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, QTYPE=NAPTR.
6. Received standard query including QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, QTYPE=NAPTR.
8. Received standard query response including correct NAPTR record in Answer section.
10. Received standard query response including correct NAPTR record in Answer section from cache.
12. Received standard query including QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa, QTYPE=NAPTR.

References

RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Three: The Domain Name System (DNS) Database
3. DDDS Database Specification
4. NAPTR RR Format

5.188. Resource record of NAPTR type

Purpose

Verify that a NUT transmits correct message including NAPTR resource record

- A <domain-name> have single NAPTR resource record case.
  Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	1

- NAPTR RDATA format

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     ORDER                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                  PREFERENCE                   |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
/                     FLAGS                     /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
/                   SERVICES                    /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
/                    REGEXP                     /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
/                  REPLACEMENT                  /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

ORDER	A 16-bit unsigned integer specifying the order in which the NAPTR records MUST be processed in order to accurately represent the ordered list of Rules.
PREFERENCE	Although it is called "preference" in deference to DNS terminology, this field is equivalent to the Priority value in the DDDS Algorithm. It is a 16-bit unsigned integer that specifies the order in which NAPTR records with equal Order values SHOULD be processed, low numbers being processed before high numbers.
FLAGS	A <character-string> containing flags to control aspects of the rewriting and interpretation of the fields in the record. Flags are single characters from the set A-Z and 0-9. The case of the alphabetic characters is not significant. The field can be empty
SERVICES	A <character-string> that specifies the Service Parameters applicable to this delegation path. It is up to the Application Specification to specify the values found in this field.
REGEXP	A containing a substitution expression that is applied to the original string held by the client in order to construct the next domain name to lookup.

REPLACEMENT	A <domain-name> which is the next domain-name to query for depending on the potential values found in the flags field. This field is used when the regular expression is a simple replacement operation. Any value in this field MUST be a fully qualified domain-name. Name compression is not to be used for this field.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 44 Topology No.44".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
```

  Example of 1.1.1.1.0.9.1.8.e164.arpa. domain zone file:

```
$TTL   86400              ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
        2005081600        ; serial
        3600              ; refresh after 1 hr
        900               ; retry after 15 min
        604800            ; expire after 1 week
        3600              ; Minimum TTL of 1 hr
)
;
        IN      NS      NS1.example.com.
;
1.0.0.0  IN      NAPTR    100        10    "u"   "sip+E2U""!^.*$!sip:info1@example.com!i"  .
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |-------------------------------------->|
    |   1. Send standard query              |
    |      QNAME = 1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
    |      QTYPE= NAPTR                     |
    |<--------------------------------------|
    |   2. Standard query response          |
    |                                       |
    v                                       v

 1. TN send standard query
    QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa., QTYPE=NAPTR to NUT.
 2. NUT reply query response w/ NAPTR resource record to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	45
	ORDER	100
	PREFERENCE	10
	FLAGS	U
	SERVICES	sip+E2U
	REGEXP	!^.*$!sip:info1@example.com!i
	REPLACEMENT	.
DNS Authority section	NAME	1.1.1.1.0.9.1.8.e164.arpa. (Pointer 0xC014)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	17
	NSDNAME	NS1.example.com
DNS Additional section	NAME	NS1.example.com (Pointer 0xC078)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**

  None

Judgment

2. Received standard query response including NAPTR resource record.

References

RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Three: The Domain Name System (DNS) Database
4. NAPTR RR Format
4.1 Packet Format

5.189. Multiple NAPTR resource records with several ORDER and PREFERENCE

Purpose

Verify that a NUT transmits correct message including multiple NAPTR resource records with several ORDER and PREFERENCE

- NAPTR RDATA field

ORDER	A 16-bit unsigned integer specifying the order in which the NAPTR records MUST be processed in order to accurately represent the ordered list of Rules. The ordering is from lowest to highest. If two records have the same order value then they are considered to be the same rule and should be selected based on the combination of the Preference values and Services offered.
PREFERENCE	Although it is called "preference" in deference to DNS terminology, this field is equivalent to the Priority value in the DDDS Algorithm. It is a 16-bit unsigned integer that specifies the order in which NAPTR records with equal Order values SHOULD be processed, low numbers being processed before high numbers. This is similar to the preference field in an MX record, and is used so domain administrators can direct clients towards more capable hosts or lighter weight protocols. A client MAY look at records with higher preference values if it has a good reason to do so such as not supporting some protocol or service very well.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 44 Topology No.44".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
```

```
        3600            ; Minimum TTL of a 1 hr
)
;
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
A       IN      A       192.168.1.10
```

Example of 1.1.1.1.0.9.1.8.e164.arpa. domain zone file:

```
$TTL    86400           ; TTL of 1 day
@ IN SOA NS1.example.com. root.example.com. (
        2005081600      ; serial
        3600            ; refresh after 1 hr
        900             ; retry after 15 min
        604800          ; expire after 1 week
        3600            ; Minimum TTL of 1 hr
)
;
        IN NS     NS1.example.com.
;
1.0.0.0 IN NAPTR  100  10   "U"  "sip+E2U" "!^.*$!sip:info1@example.com!i" .
;
1.0.0.0 IN NAPTR  100  11   "U"  "sip+E2U" "!^.*$!sip:info2@example.com!i" .
;
1.0.0.0 IN NAPTR  101  10   "U"  "sip+E2U" "!^.*$!sip:info3@example.com!i" .
;
1.0.0.0 IN NAPTR  101  10   "U"  "sip+E2U" "!^.*$!sip:info4@example.com!i" .
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
    |                                     |
    |------------------------------------>|
    |   1. Send standard query            |
    |      QNAME = 1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
    |      QTYPE= NAPTR                   |
    |<------------------------------------|
    |   2. Standard query response        |
    |                                     |
    v                                     v

 1. TN send standard query
    QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.,
    QTYPE=NAPTR to NUT.
 2. NUT reply query response w/ NAPTR resource records to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	4
	NSCOUNT	1

	ARCOUNT	1
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	45
	ORDER	100
	PREFERENCE	10
	FLAGS	U
	SERVICES	sip+E2U
	REGEXP	!^.*$!sip:info1@example.com!i
	REPLACEMENT	.
DNS Answer section	NAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	45
	ORDER	100
	PREFERENCE	11
	FLAGS	U
	SERVICES	sip+E2U
	REGEXP	!^.*$!sip:info2@example.com!i
	REPLACEMENT	.
DNS Answer section	NAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	45
	ORDER	101
	PREFERENCE	10
	FLAGS	U
	SERVICES	sip+E2U
	REGEXP	!^.*$!sip:info3@example.com!i
	REPLACEMENT	.
DNS Answer section	NAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	45

	ORDER	101
	PREFERENCE	10
	FLAGS	U
	SERVICES	sip+E2U
	REGEXP	!^.*$!sip:info4@example.com!i
	REPLACEMENT	.
DNS Authority section	NAME	1.1.1.1.0.9.1.8.e164.arpa. (Pointer 0xC014)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	17
	NSDNAME	NS1.example.com
DNS Additional section	NAME	NS1.example.com (Pointer 0xC123)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response including NAPTR resource records.

References

RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Three: The Domain Name System (DNS) Database
4. NAPTR RR Format
4.1 Packet Format

5.190. Invalid NAPTR resource record format

Purpose

Verify that a NUT transmits an error for invalid NAPTR resource record format.

- NAPTR RDATA field

REPLACEMENT	A <domain-name> which is the next domain-name to query for depending on the potential values found in the flags field. This field is used when the regular expression is a simple replacement operation. Any value in this field MUST be a fully qualified domain-name. Name compression is not to be used for this field. This field and the REGEXP field together make up the Substitution Expression in the DDDS Algorithm. It is simply a historical optimization specifically for DNS compression that this field exists. The fields are also mutually exclusive. If a record is returned that has values for both fields then it is considered to be in error and SHOULD be either ignored or an error returned.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 44 Topology No.44".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL        86400                ; TTL of 1 day
@ IN SOA NS1.example.com. root.example.com. (
            2005081600     ; serial
            3600                 ; refresh every 1 hr
            900                  ; retry every 15 min
            604800               ; expire after a week
            3600                 ; Minimum TTL of a 1 hr
)
;
            IN        NS        NS1.example.com.
NS1         IN        A         192.168.0.10
;
A           IN        A         192.168.1.10
```

  Example of 1.1.1.1.0.9.1.8.e164.arpa. domain zone file:

```
$TTL        86400                ; TTL of 1 day
@ IN SOA NS1.example.com. root.example.com. (
```

```
            2005081600 ; serial
            3600                ; refresh after 1 hr
            900                 ; retry after 15 min
            604800              ; expire after 1 week
            3600                ; Minimum TTL of 1 hr
)
;
          IN    NS     NS1.example.com.
;
1.0.0.0   IN    NAPTR  100  10   "u"  "sip+E2U"  "!^.*$!sip:info1@example.com!i" A.example.com.
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
    |                                     |
    |------------------------------------>|
    |   1. Send standard query            |
    |      QNAME = 1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
    |      QTYPE= NAPTR                   |
    |<------------------------------------|
    |   2. Standard query response        |
    |      RCODE=2 (Server failure)       |
    |                                     |
    v                                     v

 1. TN send standard query
    QNAME=1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.,
    QTYPE=NAPTR to NUT.
 2. NUT reply query response w/ RCODE=2 (Server failure) to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	0
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	2
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	1.0.0.0.1.1.1.1.0.9.1.8.e164.arpa
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

- **Termination**
  None

Judgment

2. Received standard query response including RCODE=2.

References

RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Three: The Domain Name System (DNS) Database
4. NAPTR RR Format
4.1 Packet Format

5.191. Flag in NAPTR resource record (empty)

Purpose

Verify that a NUT transmits correct message including NAPTR resource record without flag

- NAPTR RDATA field

FLAGS	A <character-string> containing flags to control aspects of the rewriting and interpretation of the fields in the record. Flags are single characters from the set A-Z and 0-9. The case of the alphabetic characters is not significant. The field can be empty

- Flags

At this time only four flags, "S", "A", "U", and "P", are defined. The "S", "A" and "U" flags are for a terminal lookup. This means that the Rule is the last one and that the flag determines what the next stage should be.

Category

Authoritative Server

Initialization

- **Network Topology**

  Refer the topology "Fig. 44 Topology No.44".

- **Setup**

  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
;
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
```

  Example of cid.urn.arpa. domain zone file:

```
$TTL     86400            ; TTL of 1 day
```

```
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh after 1 hr
         900              ; retry after 15 min
         604800           ; expire after 1 week
         3600             ; Minimum TTL of 1 hr
)
;
         IN      NS       NS1.example.com.
;
cid.urn.arpa.  IN NAPTR 100 10 ""  ""  "!^urn:cid:.+@([^¥¥.]+¥¥.)(.*)$!¥¥2!i" .
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |-------------------------------------->|
    |   1. Send standard query              |
    |      QNAME = cid.urn.arpa.            |
    |      QTYPE= NAPTR                     |
    |<--------------------------------------|
    |   2. Standard query response          |
    |                                       |
    v                                       v

 1. TN send standard query
    QNAME=cid.urn.arpa.,
    QTYPE=NAPTR to NUT.
 2. NUT reply query response w/ NAPTR resource record to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	cid.urn.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	cid.urn.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	cid.urn.arpa. (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	41
	ORDER	100
	PREFERENCE	10
	FLAGS	
	SERVICES	
	REGEXP	!^urn:cid:.+@([^¥.]+¥.)(.*)$!¥2!i
	REPLACEMENT	.

DNS Authority section	NAME	cid.urn.arpa. (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	17
	NSDNAME	NS1.example.com
DNS Additional section	NAME	NS1.example.com (Pointer 0xC05F)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response including NAPTR resource record.

References

RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Three: The Domain Name System (DNS) Database
4.1 Packet Format
RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Four: The Uniform Resource Identifiers (URI)
Resolution Application
4.3 Flags

5.192. Flag in NAPTR resource record (P flag)

Purpose

Verify that a NUT transmits correct message including NAPTR resource record with P flag

- NAPTR RDATA field

FLAGS	A <character-string> containing flags to control aspects of the rewriting and interpretation of the fields in the record. Flags are single characters from the set A-Z and 0-9. The case of the alphabetic characters is not significant. The field can be empty

- Flags

At this time only four flags, "S", "A", "U", and "P", are defined. The "S", "A" and "U" flags are for a terminal lookup. This means that the Rule is the last one and that the flag determines what the next stage should be.

Category

Authoritative Server

Initialization

- **Network Topology**

  Refer the topology "Fig. 44 Topology No.44".

- **Setup**

  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
;
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
```

  Example of cid.urn.arpa. domain zone file:

```
$TTL     86400            ; TTL of 1 day
```

```
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh after 1 hr
         900              ; retry after 15 min
         604800           ; expire after 1 week
         3600             ; Minimum TTL of 1 hr
)
;
         IN      NS       NS1.example.com.
;
cid.urn.arpa. IN NAPTR 100 10 "P" ""  "!^urn:cid:.+@([^¥¥.]+¥¥.)(.*)$!¥¥2!i" .
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |-------------------------------------->|
    |   1. Send standard query              |
    |      QNAME = cid.urn.arpa.            |
    |      QTYPE= NAPTR                     |
    |<--------------------------------------|
    |   2. Standard query response          |
    |                                       |
    v                                       v

 1. TN send standard query
    QNAME=cid.urn.arpa.,
    QTYPE=NAPTR to NUT.
 2. NUT reply query response w/ NAPTR resource record to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	cid.urn.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	cid.urn.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	cid.urn.arpa. (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	42
	ORDER	100
	PREFERENCE	10
	FLAGS	P
	SERVICES	
	REGEXP	!^urn:cid:.+@([^¥.]+¥.)(.*)$!¥2!i

	REPLACEMENT	.
DNS Authority section	NAME	cid.urn.arpa. (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	17
	NSDNAME	NS1.example.com
DNS Additional section	NAME	NS1.example.com (Pointer 0xC060)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response including NAPTR resource record.

References

RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Three: The Domain Name System (DNS) Database
4.1 Packet Format
RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Four: The Uniform Resource Identifiers (URI)
Resolution Application
4.3 Flags

5.193. Flag in NAPTR resource record (A flag)

Purpose

Verify that a NUT transmits correct message including NAPTR resource record with A flag

- NAPTR RDATA field

FLAGS	A <character-string> containing flags to control aspects of the rewriting and interpretation of the fields in the record. Flags are single characters from the set A-Z and 0-9. The case of the alphabetic characters is not significant. The field can be empty

- Flags

At this time only four flags, "S", "A", "U", and "P", are defined. The "S", "A" and "U" flags are for a terminal lookup. This means that the Rule is the last one and that the flag determines what the next stage should be.

Category

Authoritative Server

Initialization

- **Network Topology**

  Refer the topology "Fig. 44 Topology No.44".

- **Setup**

  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
;
         IN NAPTR 100  50  "a"    "rcds+N2C"          ""   A.example.com.
;
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
```

Example of cid.urn.arpa. domain zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com. root.example.com. (
         2005081600       ; serial
         3600             ; refresh after 1 hr
         900              ; retry after 15 min
         604800           ; expire after 1 week
         3600             ; Minimum TTL of 1 hr
)
;
         IN      NS       NS1.example.com.
;
cid.urn.arpa. IN NAPTR 100 10 "" ""  "!^urn:cid:.+@([^¥¥.]+¥¥.)(.*)$!¥¥2!i" .
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                      DNS Server1 (NUT)
    |                                     |
    |------------------------------------>|
    |   1. Send standard query            |
    |      QNAME = cid.urn.arpa.          |
    |      QTYPE= NAPTR                   |
    |<------------------------------------|
    |   2. Standard query response        |
    |                                     |
    |------------------------------------>|
    |   3. Send standard query            |
    |      QNAME = example.com.           |
    |      QTYPE= NAPTR                   |
    |<------------------------------------|
    |   4. Standard query response        |
    |                                     |
    |------------------------------------>|
    |   5. Send standard query            |
    |      QNAME = A.example.com.         |
    |      QTYPE= A                       |
    |<------------------------------------|
    |   6. Standard query response        |
    |                                     |
    v                                     v

  1. TN send standard query
     QNAME=cid.urn.arpa.,
     QTYPE=NAPTR to NUT.
  2. NUT reply query response w/ NAPTR resource record to TN (Judgment *2)
  3. TN send standard query
     QNAME=example.com.,
     QTYPE=NAPTR to NUT.
  4. NUT reply query response w/ NAPTR resource record to TN (Judgment *4)
  5. TN send standard query
     QNAME=A.example.com.,
     QTYPE=A to NUT.
  6. NUT reply query response w/ A resource record to TN (Judgment *6)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	cid.urn.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1

	ARCOUNT	1
DNS Question section	QNAME	cid.urn.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	cid.urn.arpa. (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	41
	ORDER	100
	PREFERENCE	10
	FLAGS	
	SERVICES	
	REGEXP	!^urn:cid:.+@([^¥.]+¥.)(.*)$!¥2!i
	REPLACEMENT	.
DNS Authority section	NAME	cid.urn.arpa. (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	17
	NSDNAME	NS1.example.com
DNS Additional section	NAME	NS1.example.com (Pointer 0xC05F)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0

	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.com.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	example.com
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.com. (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	31
	ORDER	100
	PREFERENCE	50
	FLAGS	A
	SERVICES	rcds+N2C
	REGEXP	
	REPLACEMENT	A.example.com.

DNS Authority section	NAME	example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00C)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC054)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

5th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1002
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com.
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

6th packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000

DNS Header	ID	0x1002
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com. (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response including NAPTR resource record.
4. Received standard query response including NAPTR resource record.
6. Received standard query response including A resource record.

References

RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Three: The Domain Name System (DNS) Database
4.1 Packet Format
RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Four: The Uniform Resource Identifiers (URI)
Resolution Application
4.3 Flags

5.194. Flag in NAPTR resource record (S flag)

Purpose

Verify that a NUT transmits correct message including NAPTR resource record with S flag

- NAPTR RDATA field

FLAGS	A <character-string> containing flags to control aspects of the rewriting and interpretation of the fields in the record. Flags are single characters from the set A-Z and 0-9. The case of the alphabetic characters is not significant. The field can be empty

- Flags

At this time only four flags, "S", "A", "U", and "P", are defined. The "S", "A" and "U" flags are for a terminal lookup. This means that the Rule is the last one and that the flag determines what the next stage should be.

Category

Authoritative Server

Initialization

- **Network Topology**

  Refer the topology "Fig. 44 Topology No.44".

- **Setup**

  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
;
  IN   NAPTR  100  50  "S"  "http+N2L+N2C+N2R"  ""   _http._tcp.example.com.
;
_http._tcp    IN    SRV    10     20       80       www.example.com.
;
NS1      IN      A        192.168.0.10
;
```

```
WWW      IN      A        192.168.1.10
```

Example of cid.urn.arpa. domain zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com. root.example.com. (
         2005081600       ; serial
         3600             ; refresh after 1 hr
         900              ; retry after 15 min
         604800           ; expire after 1 week
         3600             ; Minimum TTL of 1 hr
)
;
         IN      NS       NS1.example.com.
;
cid.urn.arpa. IN NAPTR 100 10 "" ""  "!^urn:cid:.+@([^¥¥.]+¥¥.)(.*)$!¥¥2!i" .
```

Procedure

This test sequence is following.

```
                                                   <-------------- TN --------------->
DNS Client1 (TN)           DNS Server1 (NUT)       DNS Server2 DNS Server3 DNS Server4
 |                          |                              |          |          |
 |--------------------------->|                              |          |          |
 | 1. Send standard query     |                              |          |          |
 |  QNAME=A.example.org       |                              |          |          |
 |  QTYPE=A                   |                              |          |          |
 |                            |------------------------------>|          |          |
 |                            | 2. Recv standard query         |          |          |
 |                            |  QNAME=A.example.org           |          |          |
 |                            |  QTYPE=A                       |          |          |
 |                            |<------------------------------|          |          |
 |                            | 3. Send standard query response |          |          |
 |                            |  QNAME=A.example.org           |          |          |
 |                            |  QTYPE=A                       |          |          |
 |                            |  AUTHORITY Name=org            |          |          |
 |                            |  AUTHORITY Name Server         |          |          |
 |                            |            =NS3.example.org    |          |          |
 |                            |  ADDITIONAL Name=NS3.example.org|          |          |
 |                            |  ADDITIONAL Address=192.168.1.30|          |          |
 |                            |                              v          |          |
 |                            |------------------------------------------>|          |
 |                            |            4. Recv standard query          |          |
 |                            |             QNAME=A.example.org            |          |
 |                            |             QTYPE=A                        |          |
 |                            |<------------------------------------------|          |
 |                            |            5. Send standard query response |          |
 |                            |             QNAME=A.example.org            |          |
 |                            |             QTYPE=A                        |          |
 |                            |             AUTHORITY Name=example.org     |          |
 |                            |             AUTHORITY Name Server          |          |
 |                            |                    = NS4.example.org       |          |
 |                            |             ADDITIONAL Name=NS4.example.org|          |
 |                            |             ADDITIONAL Address=192.168.1.40|          |
 |                            |                                        v          |
```

```
|                              |-------------------------------------------------------->|
|                              |                      6. Send standard query             |
|                              |                       QNAME=A.example.org               |
|                              |                       QTYPE=A                           |
|                              |<--------------------------------------------------------|
|                              |                      7. Send standard query response    |
|                              |                       QNAME=A.example.org               |
|                              |                       QTYPE=A                           |
|                              |                       ANSWER Name=A.example.org         |
|                              |                       ANSWER Address=192.168.1.10       |
|                              |                       ANSWER TTL=1 day                  |
|                              |                       AUTHORITY Name=example.org        |
|                              |                       AUTHORITY Name Server             |
|                              |                           = NS4.example.org             |
|                              |                       ADDITIONAL Name=NS4.example.org   |
|                              |                       ADDITIONAL Address=192.168.1.40   |
|<-----------------------------|                                                         |
| 8.Standard query response    |                                                         |
|  QNAME= A.example.org        |                                                         |
|  QTYPE=A                     |                                                         |
|  ANSWER Name=A.example.org   |                                                         |
|  ANSWER Address=192.168.1.10 |                                                         |
|  ANSWER TTL=1 day            |                                                         |
|  AUTHORITY Name=example.org  |                                                         |
|  AUTHORITY Name Server       |                                                         |
|   = NS4.example.org          |                                                         |
|  ADDITIONAL Name             |                                                         |
|   = NS4.example.org          |                                                         |
|  ADDITIONAL Address          |                                                         |
|   = 192.168.1.40             |                                                         |
|----------------------------->|                                                         |
| 9. Send standard query       |                                                         |
|  QNAME=B.example.org         |                                                         |
|  QTYPE=A                     |                                                         |
|                              |-------------------------------------------------------->|
|                              |                     10. Send standard query             |
|                              |                       QNAME=B.example.org               |
|                              |                       QTYPE=A                           |
|                              |<--------------------------------------------------------|
|                              |                     11. Send standard query response    |
|                              |                       QNAME=B.example.org               |
|                              |                       QTYPE=A                           |
|                              |                       ANSWER Name=B.example.org         |
|                              |                       ANSWER Type=CNAME                 |
|                              |                       ANSWER Primary Name               |
|                              |                                  =A.example.org         |
|                              |                       ANSWER Name=A.example.org         |
|                              |                       ANSWER Type=A                     |
|                              |                       ANSWER Address=192.168.1.10       |
|                              |                       ANSWER TTL=600                    |
|                              |                       AUTHORITY Name=example.org        |
|                              |                       AUTHORITY Name Server             |
|                              |                           = NS4.example.org             |
|                              |                       AUTHORITY TTL=1 day               |
|                              |                       ADDITIONAL Name=NS4.example.org   |
|                              |                       ADDITIONAL Address=192.168.1.40   |
```

```
|<----------------------------|                                                |
|12.Standard query response   |                                                |
|  QNAME= B.example.org       |                                                |
|  QTYPE=A                    |                                                |
|  ANSWER Name=B.example.org  |                                                |
|  ANSWER Type=CNAME          |                                                |
|  ANSWER Primary Name        |                                                |
|             =A.example.org  |                                                |
|  ANSWER Type=A              |                                                |
|  ANSWER Address=192.168.1.10|                                                |
|  ANSWER TTL=ANY             |                                                |
|  AUTHORITY Name=example.org |                                                |
|  AUTHORITY Name Server      |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Name            |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Address         |                                                |
|   = 192.168.1.40            |                                                |
|                             |                                                |
//     wait 15 seconds        //                                              //
|                             |                                                |
|---------------------------->|                                                |
| 13. Send standard query     |                                                |
|  QNAME=A.example.org        |                                                |
|  QTYPE=A                    |                                                |
|<----------------------------|                                                |
| 14.Standard query response  |                                                |
|  QNAME=A.example.org        |                                                |
|  QTYPE=A                    |                                                |
|  ANSWER Name=A.example.org  |                                                |
|  ANSWER Address=192.168.1.10|                                                |
|  ANSWER TTL=more than 600   |                                                |
|  AUTHORITY Name=example.org |                                                |
|  AUTHORITY Name Server      |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Name            |                                                |
|   = NS4.example.org         |                                                |
|  ADDITIONAL Address         |                                                |
|   = 192.168.1.40            |                                                |
v                             v                                                v
```

1. TN send standard query QNAME=A.example.org, QTYPE=A to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=A to DNS Server4 (TN: NS4.example.net) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=192.168.1.10.
8. NUT transmits query response to DNS Client1 (TN). (Judgment *8)
9. TN send standard query QNAME=B.example.org, QTYPE=A to NUT.
10. NUT transmits standard query QNAME=B.example.org, QTYPE=A to DNS4 Server4 (TN: NS4.example.org) (Judgment *10)
11. TN send query response to ANSWER Name=B.example.org, ANSWER Type=CNAME.
12. NUT transmits query response to DNS Client1 (TN). (Judgment *12)
13. TN send standard query QNAME=example.org, QTYPE=NS to NUT.
14. NUT transmits query response to DNS Client1 (TN). (Judgment *14)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	any
	Dst Port	53
DNS Header	ID	any
	QR	0
	OPCODE	0
	AA	any
	TC	0
	RD	0
	RA	any
	Z	any
	RCODE	any
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	any
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses

	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1

	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC03B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

9th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0

	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

10th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	ANY
	Z	ANY
	RCODE	ANY
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

11th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53

DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	Primary Name	A.example.org (A + Pointer 0xC00E)
DNS Answer section	NAME	A.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	600
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

12th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	1000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	B.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	B.example.org (Pointer 0xC00C)
	TYPE	CNAME (0x0005)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	Primary Name	A.example.org (Pointer 0xC00E)
DNS Answer section	NAME	A.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC04B)
	TYPE	A (0x0001)

	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

13th packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1002
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

14th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1002
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0

	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	more than 600
	RDLENGTH	4
	ADDRESS	192.168.1.10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	ANY
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=A.
4. Received standard query including QNAME=A.example.org, QTYPE=A.
6. Received standard query including QNAME=A.example.org, QTYPE=A.
8. Received standard query response.
10. Received standard query including QNAME=B.example.org, QTYPE=A.
12. Received standard query response.
14. Received standard query response.

References

RFC2181 Clarifications to the DNS Specification
5.4.1. Ranking data

5.195. Multiple Flags in NAPTR resource record (X,Y flag)

Purpose

Verify that a NUT transmits correct message including NAPTR resource record with multiple flags

- NAPTR RDATA field

FLAGS	A <character-string> containing flags to control aspects of the rewriting and interpretation of the fields in the record. Flags are single characters from the set A-Z and 0-9. The case of the alphabetic characters is not significant. The field can be empty

- Flags

It is anticipated that multiple flags will be allowed in the future, so implementers MUST NOT assume that the flags field can only contain 0 or 1 characters.

Category

Authoritative Server

Initialization

- **Network Topology**

  Refer the topology "Fig. 44 Topology No.44".

- **Setup**

  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
;
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
```

  Example of cid.urn.arpa. domain zone file:

```
$TTL     86400            ; TTL of 1 day
```

```
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh after 1 hr
         900              ; retry after 15 min
         604800           ; expire after 1 week
         3600             ; Minimum TTL of 1 hr
)
;
         IN      NS       NS1.example.com.
;
cid.urn.arpa.  IN NAPTR 100 10 "XY" "" "!^urn:cid:.+@([^¥¥.]+¥¥.)(.*)$!¥¥2!i" .
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |-------------------------------------->|
    |   1. Send standard query              |
    |      QNAME = cid.urn.arpa.            |
    |      QTYPE= NAPTR                     |
    |<--------------------------------------|
    |   2. Standard query response          |
    |                                       |
    v                                       v

 1. TN send standard query
    QNAME=cid.urn.arpa.,
    QTYPE=NAPTR to NUT.
 2. NUT reply query response w/ NAPTR resource record to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0

	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	cid.urn.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	cid.urn.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	cid.urn.arpa. (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	43
	ORDER	100
	PREFERENCE	10
	FLAGS	XY
	SERVICES	
	REGEXP	!^urn:cid:.+@([^¥.]+¥.)(.*)$!¥2!i
	REPLACEMENT	.
DNS Authority section	NAME	cid.urn.arpa. (Pointer 0xC00C)

	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	17
	NSDNAME	NS1.example.com
DNS Additional section	NAME	NS1.example.com (Pointer 0xC061)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response including NAPTR resource record.

References

RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Three: The Domain Name System (DNS) Database
4.1 Packet Format
RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Four: The Uniform Resource Identifiers (URI)
Resolution Application
4.3 Flags

5.196. Additional Section Processing for NAPTR resource record (A flag)

Purpose

Verify that a NUT transmits correct message including A record in Additional Section related to NAPTR record

- DNS servers MAY interpret Flag values and use that information to include appropriate SRV and A records in the Additional Information portion of the DNS packet.
- DNS servers MAY add RRsets to the additional information section that are relevant to the answer and have the same authenticity as the data in the answer section. Generally this will be made up of A and SRV records but the exact records depends on the application.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 44 Topology No.44".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
;
      IN NAPTR 100  50  "a"    "rcds+N2C"          ""    A.example.com.
;
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
```

  Example of cid.urn.arpa. domain zone file:

```
$TTL     86400            ; TTL of 1 day
```

```
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh after 1 hr
         900              ; retry after 15 min
         604800           ; expire after 1 week
         3600             ; Minimum TTL of 1 hr
)
;
         IN      NS       NS1.example.com.
;
cid.urn.arpa.  IN NAPTR 100 10 ""  ""  "!^urn:cid:.+@([^¥¥.]+¥¥.)(.*)$!¥¥2!i" .
```

Procedure

This test sequence is following.

```
    DNS Client1 (TN)                        DNS Server1 (NUT)
        |                                       |
        |-------------------------------------->|
        |   1. Send standard query              |
        |      QNAME = cid.urn.arpa.            |
        |      QTYPE= NAPTR                     |
        |<--------------------------------------|
        |   2. Standard query response          |
        |                                       |
        |-------------------------------------->|
        |   3. Send standard query              |
        |      QNAME = example.com.             |
        |      QTYPE= NAPTR                     |
        |<--------------------------------------|
        |   4. Standard query response          |
        |                                       |
        v                                       v

    1. TN send standard query
          QNAME=cid.urn.arpa.,
          QTYPE=NAPTR to NUT.
    2. NUT reply query response w/ NAPTR resource record to TN (Judgment *2)
    3. TN send standard query
       QNAME=example.com.,
       QTYPE=NAPTR to NUT.
    4. NUT reply query response w/ NAPTR resource record in Answer Section and w/ A resource record in
       Additional Section to TN (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000

	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	cid.urn.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	cid.urn.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	cid.urn.arpa. (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)

	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	41
	ORDER	100
	PREFERENCE	10
	FLAGS	
	SERVICES	
	REGEXP	!^urn:cid:.+@([^¥.]+¥.)(.*)$!¥2!i
	REPLACEMENT	.
DNS Authority section	NAME	cid.urn.arpa. (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	17
	NSDNAME	NS1.example.com
DNS Additional section	NAME	NS1.example.com (Pointer 0xC05F)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	example.com.

	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	example.com
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.com. (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	31
	ORDER	100
	PREFERENCE	50
	FLAGS	A
	SERVICES	rcds+N2C
	REGEXP	
	REPLACEMENT	A.example.com.
DNS Authority section	NAME	example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00C)

DNS Additional section	NAME	NS1.example.com (Pointer 0xC054)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	A.example.com (Pointer 0xC039)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.10

- **Termination**
  None

Judgment

2. Received standard query response including NAPTR resource record.
4. Received standard query response including NAPTR resource record in Answer Section and A resource record in Additional Section.
   *A resource record which regarding "A.example.com" must be included in Additional Section.

References

RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Three: The Domain Name System (DNS) Database
4.2.1 Additional Section Processing by DNS Servers
RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Four: The Uniform Resource Identifiers (URI)
Resolution Application
4.5 Valid Databases

5.197. Additional Section Processing for NAPTR resource record (S flag)

Purpose

Verify that a NUT transmits correct message including SRV record in Additional Section related to NAPTR record

- DNS servers MAY interpret Flag values and use that information to include appropriate SRV and A records in the Additional Information portion of the DNS packet.
- DNS servers MAY add RRsets to the additional information section that are relevant to the answer and have the same authenticity as the data in the answer section. Generally this will be made up of A and SRV records but the exact records depends on the application.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 44 Topology No.44".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
;
    IN NAPTR 100   50   "S"  "http+N2L+N2C+N2R"  ""  _http._tcp.example.com.
;
_http._tcp       IN      SRV     10      20      80      www.example.com.
;
NS1      IN      A        192.168.0.10
;
```

```
WWW      IN      A        192.168.1.10
```

Example of cid.urn.arpa. domain zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com. root.example.com. (
         2005081600       ; serial
         3600             ; refresh after 1 hr
         900              ; retry after 15 min
         604800           ; expire after 1 week
         3600             ; Minimum TTL of 1 hr
)
;
         IN      NS       NS1.example.com.
;
cid.urn.arpa. IN NAPTR 100 10 "" ""  "!^urn:cid:.+@([^¥¥.]+¥¥.)(.*)$!¥¥2!i" .
```

Procedure

This test sequence is following.

```
    DNS Client1 (TN)                        DNS Server1 (NUT)
        |                                       |
        |--------------------------------------->|
        |   1. Send standard query              |
        |      QNAME = cid.urn.arpa.            |
        |      QTYPE= NAPTR                     |
        |<---------------------------------------|
        |   2. Standard query response          |
        |                                       |
        |--------------------------------------->|
        |   3. Send standard query              |
        |      QNAME = example.com.             |
        |      QTYPE= NAPTR                     |
        |<---------------------------------------|
        |   4. Standard query response          |
        |                                       |
        v                                       v

  1. TN send standard query
     QNAME=cid.urn.arpa.,
     QTYPE=NAPTR to NUT.
  2. NUT reply query response w/ NAPTR resource record to TN (Judgment *2)
  3. TN send standard query
     QNAME=example.com.,
     QTYPE=NAPTR to NUT.
  4. NUT reply query response w/ NAPTR resource record in Answer Section and w/ SRV resource record in
     Additional Section to TN (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ

	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	cid.urn.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	cid.urn.arpa.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

DNS Answer section	NAME	cid.urn.arpa. (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	41
	ORDER	100
	PREFERENCE	10
	FLAGS	
	SERVICES	
	REGEXP	!^urn:cid:.+@([^¥.]+¥.)(.*)$!¥2!i
	REPLACEMENT	.
DNS Authority section	NAME	cid.urn.arpa. (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	17
	NSDNAME	NS1.example.com
DNS Additional section	NAME	NS1.example.com (Pointer 0xC05F)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0

	ARCOUNT	0
DNS Question section	QNAME	example.com.
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1001
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	0
	Z	ANY
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	2
DNS Question section	QNAME	example.com
	QTYPE	NAPTR (0x0023)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	example.com. (Pointer 0xC00C)
	TYPE	NAPTR (0x0023)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	48
	ORDER	100
	PREFERENCE	50
	FLAGS	S
	SERVICES	http+N2L+N2C+N2R
	REGEXP	
	REPLACEMENT	_http._tcp.example.com.
DNS Authority section	NAME	example.com (Pointer 0xC00C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)

	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00C)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC065)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10
DNS Additional section	NAME	_http._tcp.example.com.(Pointer 0xC041)
	TYPE	SRV (0x0021)
	CLASS	IN (0x0001)
	TTL	86400sec
	RDLENGTH	23
	Priority	10
	Weight	20
	Port	80
	Target	www.example.com.

- **Termination**
  None

Judgment

2. Received standard query response including NAPTR resource record.
4. Received standard query response including NAPTR resource record in Answer Section and SRV resource record in Additional Section.
   *SRV resource record must be included in Additional Section.

References

RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Three: The Domain Name System (DNS) Database
4.2.1 Additional Section Processing by DNS Servers
RFC3403 Dynamic Delegation Discovery System (DDDS)
Part Four: The Uniform Resource Identifiers (URI)
Resolution Application
4.5 Valid Databases

5.198. Returning Not Implemented error

Purpose

Verify that a NUT transmits Not Implemented (RCODE=4) when an IQUERY request is received.

Inverse queries using the IQUERY opcode were originally described as the ability to look up the names that are associated with a particular Resource Record (RR). Their implementation was optional and never achieved widespread use. Therefore IQUERY is now obsolete, and name servers SHOULD return a "Not Implemented" error when an IQUERY request is received.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1 Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL  86400                ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
      2005081600 ; serial
      3600                 ; refresh every 1 hr
      900                  ; retry every 15 min
      604800               ; expire after a week
      3600                 ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
```

Procedure

This test sequence is following.

```
    DNS Client1 (TN)                      DNS Server1 (NUT)
        |                                     |
        |------------------------------------->|
        |   1. Send standard query            |
        |       OPCODE=1(IQUERY)              |
        |       QNAME=A.example.com           |
        |       QTYPE=A                       |
        |<-------------------------------------|
        |   2. Standard query response        |
        |       Not Implemented (RCODE=4)     |
        |                                     |
        v                                     v

1. TN send standard query QNAME=A.example.com, QTYPE=A to NUT.
2. NUT reply query response to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	1
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	A (0x0001)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	1
	AA	ANY
	TC	0
	RD	1
	RA	ANY
	Z	0
	RCODE	4
	QDCOUNT	ANY
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	ANY
	QTYPE	ANY
	QCLASS	ANY

- **Termination**
  None

Judgment

2. Received standard query response including RCODE=4.

References

RFC3425 Obsoleting IQUERY
3 - Effect on RFC 1035

5.199. Resource record AAAA type

Purpose

Verify that a NUT transmits correct message including AAAA type in the QTYPE field.

- Query type AAAA.
  Header section field has the following value.

QR	0
QDCOUNT	1
ANCOUNT	0
NSCOUNT	0
ARCOUNT	*ANY*

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	A.example.org
QTYPE	AAAA (0x001C)
QCLASS	IN (0x0001)

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 22 Topology No.22".
  AP server1 has a domain name "A.example.org".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
.                       3600000          IN       NS       A.ROOT.NET.
```

```
 A.ROOT.NET.              3600000                    A        192.168.1.20
For IPv6
 .                        3600000          IN        NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA      3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                      <--------------- TN --------------->
DNS Client1 (TN)          DNS Server1 (NUT)            DNS Server2 DNS Server3 DNS Server4
  |                           |                                |         |         |
  |---------------------------->|                                |         |         |
  | 1.Send standard query     |                                |         |         |
  |    QNAME=A.example.org    |                                |         |         |
  |    QTYPE=AAAA             |                                |         |         |
  |                           |-------------------------------->|         |         |
  |                           | 2.Send standard query          |         |         |
  |                           |  QNAME=A.example.org           |         |         |
  |                           |  QTYPE=AAAA                    |         |         |
  |                           |<--------------------------------|         |         |
  |                           | 3.Send standard response       |         |         |
  |                           |  QNAME=A.example.org           |         |         |
  |                           |  QTYPE=AAAA                    |         |         |
  |                           |  AUTHORITY Name=org            |         |         |
  |                           |  AUTHORITY Name Server         |         |         |
  |                           |            =NS3.example.org    |         |         |
  |                           |  ADDITIONAL Name=NS3.example.org|        |         |
  |                           |  ADDITIONAL Address=192.168.1.30|        |         |
  |                           |                                v         |         |
  |                           |----------------------------------------->|         |
  |                           |            4.Send standard query         |         |
  |                           |             QNAME=A.example.org          |         |
  |                           |             QTYPE=AAAA                   |         |
```

```
|                            |<-----------------------------------------|         |
|                            |            5.Send standard response      |         |
|                            |             QNAME=A.example.org          |         |
|                            |             QTYPE=AAAA                   |         |
|                            |             AUTHORITY Name=example.org   |         |
|                            |             AUTHORITY Name Server        |         |
|                            |                    = NS4.example.org     |         |
|                            |             ADDITIONAL Name              |         |
|                            |                    = NS4.example.org     |         |
|                            |             ADDITIONAL Address           |         |
|                            |                    = 192.168.1.40        |         |
|                            |                                        v         |
|                            |-------------------------------------------------->|
|                            |                        6.Send standard query      |
|                            |                         QNAME=A.example.org       |
|                            |                         QTYPE=AAAA                |
|                            |<--------------------------------------------------|
|                            |                        7.Send standard response   |
|                            |                         QNAME=A.example.org       |
|                            |                         QTYPE=AAAA                |
|                            |                         ANSWER Name=A.example.org |
|                            |                         ANSWER Address            |
|                            |                            = 3ffe:501:ffff:101::10|
|                            |                         AUTHORITY Name=example.org|
|                            |                         AUTHORITY Name Server     |
|                            |                            = NS4.example.org      |
|                            |                         ADDITIONAL Name           |
|                            |                            = NS4.example.org      |
|                            |                         ADDITIONAL Address        |
|                            |                            = 192.168.1.40         |
|<---------------------------|                                                   |
| 8.Standard query response  |                                                 v
|  QNAME=A.example.org       |
|  QTYPE=AAAA                |
|  ANSWER Name=A.example.org |
|  ANSWER Address            |
|      = 3ffe:501:ffff:101::10|
|  AUTHORITY Name=example.org |
|  AUTHORITY Name Server     |
|            =NS4.example.org |
v                            v
```

1. TN send standard query QNAME=A.example.org, QTYPE=AAAA to NUT.
2. NUT transmits standard query to DNS Server2(TN: root name server)(Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=org, AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query QNAME=A.example.org, QTYPE=AAAA DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=example.org, AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query QNAME=A.example.org, QTYPE=AAAA DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to ANSWER Name=A.example.org, ANSWER Address=3ffe:501:ffff:101::10 to NUT.
8. NUT transmits query response to DNS Client1 (TN) (Judgment *8)

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	ANY
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1

	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	org (Pointer 0xC016)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS3.example.org (NS3 + Pointer 0xC00E)
DNS Additional section	NAME	NS3.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0

	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC02B)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	AD	0
	CD	1
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	ANY
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	Value that NUT uses
	Dst Port	53
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC047)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

8th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.org
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.org (Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::10
DNS Authority section	NAME	example.org (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS4.example.org (NS4 + Pointer 0xC00E)
DNS Additional section	NAME	NS4.example.org (Pointer 0xC047)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

- **Termination**
  None

Judgment

2. Received standard query including QNAME=A.example.org, QTYPE=AAAA.
4. Received standard query including QNAME=A.example.org, QTYPE=AAAA.
6. Received standard query including QNAME=A.example.org, QTYPE=AAAA.
8. Received standard query response including correct address in the ADDRESS field.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
RFC3596 DNS Extensions to Support IPv6
  2.1 AAAA record type
  2.2 AAAA data format
  2.3 AAAA query

5.200. Resource record of AAAA type

Purpose

Verify that a NUT transmits correct message including AAAA resource record

- Single host address case.
  Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	1

- Hosts that have multiple Internet addresses will have multiple AAA records.
  Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	2

- AAAA RDATA format

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
+                                               +
|                                               |
+                     ADDRESS                   +
|                                               |
+                                               +
|                                               |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

AAAA	A 128 bit IPv6 address is encoded in the data portion of an AAAA resource record in network byte order (high-order byte first).

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 1　Topology No.1".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.
  Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
```

```
        2005081600      ; serial
        3600            ; refresh every 1 hr
        900             ; retry every 15 min
        604800          ; expire after a week
        3600            ; Minimum TTL of a 1 hr
)
;
        IN      NS      NS1.example.com.
NS1     IN      A       192.168.0.10
;
A       IN      AAAA    3ffe:501:ffff:101::10
A1      IN      AAAA    3ffe:501:ffff:101::11
                AAAA    3ffe:501:ffff:101::12
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |-------------------------------------->|
    |   1. Send standard query              |
    |       QNAME=A.example.com             |
    |       QTYPE=AAAA                      |
    |<--------------------------------------|
    |   2. Standard query response          |
    |       AAAA=3ffe:501:ffff:101::10      |
    |-------------------------------------->|
    |   3. Send standard query to NUT       |
    |       QNAME=A1.example.com            |
    |       QTYPE=AAAA                      |
    |<--------------------------------------|
    |   4. Standard query response          |
    |       AAAA=3ffe:501:ffff:101::11      |
    |       AAAA=3ffe:501:ffff:101::12      |
    v                                       v

1. TN send standard query QNAME=A.example.com, QTYPE=AAAA to NUT.
2. NUT reply query response w/ AAAA=3ffe:501:ffff:101::10 to TN (Judgment *2)
3. TN send standard query QNAME=A1.example.com, QTYPE=AAAA to NUT.
4. NUT reply query response w/ AAAA=3ffe:501:ffff:101::11 and AAAA=3ffe:501:ffff:101::12 to TN
   (Judgment *4)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53

DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A.example.com
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A.example.com
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A.example.com (Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)

	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::10
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC047)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

3rd packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2001
	Dst Port	53
DNS Header	ID	0x1001
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	A1.example.com
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)

4th packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ

	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	2
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	A1.example.com
	QTYPE	AAAA (0x001C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	A1.example.com (Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::11
DNS Answer section	NAME	A1.example.com (Pointer 0xC00C)
	TYPE	AAAA (0x001C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	ADDRESS	3ffe:501:ffff:101::12
DNS Authority section	NAME	example.com (Pointer 0xC00E)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC00E)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC047)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4

	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response including AAAA type record.
4. Received standard query response including multiple AAAA type records.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
RFC3596 DNS Extensions to Support IPv6
  2.1 AAAA record type
  2.2 AAAA data format
  2.3 AAAA query

5.201. PTR type

Purpose

Verify that a NUT transmits correct message including PTR type in the QTYPE field.

- Query type PTR.
  Header section field has the following value.

QR	0
QDCOUNT	1
ANCOUNT	0
NSCOUNT	0
ARCOUNT	0

- Question section format

```
                                1  1  1  1  1  1
  0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                               |
/                     QNAME                     /
/                                               /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QTYPE                     |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                     QCLASS                    |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

QNAME	0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
QTYPE	PTR (0x000C)
QCLASS	IN (0x0001)

Category

Caching Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 46 Topology No.46".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of root server list:

For IPv4:

```
.                    3600000        IN    NS    A.ROOT.NET.
A.ROOT.NET.          3600000              A     192.168.1.20
```

```
For IPv6
 .                        3600000          IN       NS       A.ROOT.NET.
 A.ROOT.NET.              3600000          AAAA     3ffe:501:ffff:101::20
```

Example of example.com zone file:

```
$TTL     86400          ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600     ; serial
         3600           ; refresh every 1 hr
         900            ; retry every 15 min
         604800         ; expire after a week
         3600           ; Minimum TTL of a 1 hr
)
;
         IN        NS        NS1.example.com.
NS1      IN        A         192.168.0.10
;
```

Procedure

This test sequence is following.

```
                                                   <--------------- TN ------------------>
DNS Client1 (TN)      DNS Server1 (NUT)            DNS Server2 DNS Server3 DNS Server4 DNS Server5
 |                       |                            |           |           |           |
 |----------------------->|                            |           |           |           |
 | 1.Send standard query  |                            |           |           |           |
 |  QNAME                 |                            |           |           |           |
 |   = 0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.                |           |           |           |
 |     1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA        |           |           |           |
 |  QTYPE=PTR             |                            |           |           |           |
 |                        |------------------------------>|        |           |           |
 |                        | 2. Recv standard query     |           |           |           |
 |                        |  QNAME                     |           |           |           |
 |                        |   = 0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.    |           |           |
 |                        |     1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA      |           |
 |                        |  QTYPE=PTR                 |           |           |           |
 |                        |<------------------------------|        |           |           |
 |                        | 3.Send standard query response|        |           |           |
 |                        |  QNAME                     |           |           |           |
 |                        |   = 0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.    |           |           |
 |                        |     1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA      |           |
 |                        |  QTYPE=PTR                 |           |           |           |
 |                        |  AUTHORITY Name            |           |           |           |
 |                        |   = 1.0.5.0.e.f.f.3.IP6.ARPA |         |           |           |
 |                        |  AUTHORITY Nsdname         |           |           |           |
 |                        |   =NS3.example.org         |           |           |           |
 |                        |  ADDITIONAL Name           |           |           |           |
 |                        |   =NS3.example.org         |           |           |           |
 |                        |  ADDITIONAL Address        |           |           |           |
 |                        |   =192.168.1.30            |           |           |           |
 |                        |                            v           |           |           |
```

```
|                        |------------------------------------------->|            |            |
|                        |           4.Recv standard query            |            |            |
|                        |            QNAME                           |            |            |
|                        |             = 0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.         |            |
|                        |               1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA |            |
|                        |            QTYPE=PTR                       |            |            |
|                        |<-------------------------------------------|            |            |
|                        |           5.Send standard query response   |            |            |
|                        |            QNAME                           |            |            |
|                        |             = 0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.         |            |            |
|                        |               1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA |            |
|                        |            QTYPE=PTR                       |            |            |
|                        |            AUTHORITY Name                  |            |            |
|                        |             = f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA         |            |
|                        |            AUTHORITY Nsdname=NS4.example.org           |            |
|                        |            ADDITIONAL Name=NS4.example.org|            |            |
|                        |            ADDITIONAL Address=192.168.1.40|            |            |
|                        |                                          v            |            |
|                        |------------------------------------------------------>|            |
|                        |                    6.Send standard query              |            |
|                        |                     QNAME                             |            |
|                        |                      = 0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.            |
|                        |                        1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA |
|                        |                     QTYPE=PTR                         |            |
|                        |<------------------------------------------------------|            |
|                        |                    7.Send standard query response     |            |
|                        |                     QNAME                             |            |
|                        |                      = 0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.            |
|                        |                        1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA |
|                        |                     QTYPE=PTR                         |            |
|                        |                     AUTHORITY Name                    |            |
|                        |                      = 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA |
|                        |                     AUTHORITY Nsdname= NS5.example.org|            |
|                        |                     ADDITIONAL Name = NS5.example.org |            |
|                        |                     ADDITIONAL Address = 192.168.1.50 |            |
|                        |                                                   v            |
|                        |------------------------------------------------------------------>|
|                        |                    8.Send standard query                          |
|                        |                     QNAME                                         |
|                        |                      = 0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.            |
|                        |                        1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA |
|                        |                     QTYPE=PTR                                     |
|                        |<------------------------------------------------------------------|
|                        |                    9.Send standard query response                 |
|                        |                     QNAME                                         |
|                        |                      = 0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.            |
|                        |                        1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA |
|                        |                     QTYPE=PTR                                     |
|                        |                     ANSWER Name                                   |
|                        |                      = 0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.            |
|                        |                        1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA |
|                        |                     ANSWER Ptrdname = A.example.org               |
|                        |                     AUTHORITY Name                                |
|                        |                      = 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA |
|                        |                     AUTHORITY Nsdname = NS5.example.org           |
|                        |                     ADDITIONAL Name = NS5.example.org             |
|                        |                     ADDITIONAL Address = 192.168.1.50             |
|                        |                                                                   v
```

```
|<----------------------|
| 10.Recv Standard query |
|                 response|
|  QNAME                 |
|   = 0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
|      1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
|  QTYPE=PTR             |
|  ANSWER Name           |
|   = 0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
|      1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
|  ANSWER Ptrdname       |
|   = A.example.org      |
|  AUTHORITY Name        |
|   = 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
|  AUTHORITY Nsdname     |
|   = NS5.example.org    |
|  ADDITIONAL Name       |
|   = NS5.example.org    |
|  ADDITIONAL Address    |
|   = 192.168.1.50       |
v                        v

1. TN send standard query
QNAME=0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA, QTYPE=PTR to NUT.
2. NUT transmits standard query to DNS Server2 (TN: root name server) (Judgment *2)
3. TN send query response to NUT w/ AUTHORITY Name=1.0.5.0.e.f.f.3.IP6.ARPA,
   AUTHORITY Name Server=NS3.example.org.
4. NUT transmits standard query
QNAME=0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA,
   QTYPE=PTR to DNS Server3 (TN: NS3.example.org) (Judgment *4)
5. TN send query response to NUT w/ AUTHORITY Name=f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA,
   AUTHORITY Name Server=NS4.example.org.
6. NUT transmits standard query
QNAME=0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA,
   QTYPE=PTR to DNS Server4 (TN: NS4.example.org) (Judgment *6)
7. TN send query response to NUT w/ AUTHORITY Name
=1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA,
   AUTHORITY Name Server=NS5.example.org.
8. NUT transmits standard query
QNAME=0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA,
   QTYPE=PTR to DNS Server5 (TN: NS5.example.org) (Judgment *8)
9. TN send query response to NUT w/
ANSWER Name =0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA,
ANSWER Ptrdname=A.example.org to NUT.
10. NUT transmits query response to DNS Client1 (TN) (Judgment *10)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000

	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0. 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)

2nd packet.

Standard query from DNS Server1 (NUT) to Server2 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV2_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	Any
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0. 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)

3rd packet.

Standard query response from DNS Server2 (TN) to Server1 (NUT)		
IP Header	Source Address	SV2_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0. 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	1.0.5.0.e.f.f.3.IP6.ARPA (Pointer 0xC03C
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS3.example.org
DNS Additional section	NAME	NS3.example.org (Pointer 0xC066)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.30

4th packet.

Standard query from DNS Server1 (NUT) to Server3 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV3_NETY
UDP Header	Src Port	ANY
	Dst Port	53

DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	Any
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0. 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)

5th packet.

Standard query response from DNS Server3 (TN) to Server1 (NUT)		
IP Header	Source Address	SV3_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0. 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA (Pointer 0xC034)

	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS4.example.org
DNS Additional section	NAME	NS4.example.org (Pointer 0xC066)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.40

6th packet.

Standard query from DNS Server1 (NUT) to Server4 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV4_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	Any
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0. 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)

7th packet.

Standard query response from DNS Server4 (TN) to Server1 (NUT)		
IP Header	Source Address	SV4_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses

	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0. 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)
DNS Authority section	NAME	1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA (Pointer 0xC02C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS5.example.org
DNS Additional section	NAME	NS5.example.org (Pointer 0xC066)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.50

8th packet.

Standard query from DNS Server1 (NUT) to Server5 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	SV5_NETY
UDP Header	Src Port	ANY
	Dst Port	53
DNS Header	ID	ANY
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0

	Z	Any
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0. 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)

9th packet.

Standard query response from DNS Server5 (TN) to Server1 (NUT)		
IP Header	Source Address	SV5_NETY
	Destination Address	NUT_NETZ
UDP Header	Src Port	53
	Dst Port	Value that NUT uses
DNS Header	ID	Value that NUT uses
	QR	1
	OPCODE	0
	AA	1
	TC	0
	RD	0
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0. 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0. 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA (Pointer 0xC00C)
	TYPE	PTR (0x000C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	15
	NSDNAME	A.example.org
DNS Authority section	NAME	1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA (Pointer 0xC02C)

	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS5.example.org
DNS Additional section	NAME	NS5.example.org (Pointer 0xC081)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.50

10th packet.

Standard query response from DNS Server1 (NUT) to Client (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	0
	TC	0
	RD	0
	RA	0
	Z	Any
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0. 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0. 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA (Pointer 0xC00C)
	TYPE	PTR (0x000C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	15
	NSDNAME	A.example.org

DNS Authority section	NAME	1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA (Pointer 0xC02C)
	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	16
	NSDNAME	NS5.example.org
DNS Additional section	NAME	NS5.example.org (Pointer 0xC066)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.1.50

- **Termination**
  None

Judgment

2. Received standard query including QNAME=0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA, QTYPE=PTR.
4. Received standard query including QNAME=0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA, QTYPE=PTR.
6. Received standard query including QNAME=0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA, QTYPE=PTR.
8. Received standard query including QNAME=0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA, QTYPE=PTR.
10. Received standard query response including correct <domain-name> in the PTRDNAME field.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
  3.2.2 TYPE values
  3.3.12. PTR RDATA format
RFC3596 DNS Extensions to Support IPv6
  2.5 IP6.ARPA domain

5.202. Resource record of PTR type

Purpose

Verify that a NUT transmits correct message including PTR resource record

- A <domain-name> have single PTR resource record case.
  Header section field has the following value.

QR	1
QDCOUNT	1
ANCOUNT	1

- PTR RDATA format

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
/                    PTRDNAME                   /
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

PTRDNAME	A <domain-name> which points to some location in the domain name space.

Category

Authoritative Server

Initialization

- **Network Topology**
  Refer the topology "Fig. 44 Topology No.44".
- **Setup**
  Set the DNS Server1's (NUT) address as above mentioned Network Topology.
  Configure the Server1's (NUT) zone file to response query from TN.

  Example of example.com zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh every 1 hr
         900              ; retry every 15 min
         604800           ; expire after a week
         3600             ; Minimum TTL of a 1 hr
)
;
         IN      NS       NS1.example.com.
NS1      IN      A        192.168.0.10
;
A        IN      A        192.168.1.10
CL1      IN      A        192.168.0.20
```

Example of 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA domain zone file:

```
$TTL     86400            ; TTL of 1 day
@ IN SOA NS1.example.com.  root.example.com.  (
         2005081600       ; serial
         3600             ; refresh after 1 hr
         900              ; retry after 15 min
         604800           ; expire after 1 week
         3600             ; Minimum TTL of 1 hr
)
;
         IN      NS       NS1.example.com.
;
0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0   IN       PTR      A.example.com.
```

Procedure

This test sequence is following.

```
DNS Client1 (TN)                        DNS Server1 (NUT)
    |                                       |
    |--------------------------------------->|
    |   1. Send standard query              |
    |     QNAME=0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0. 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
    |     QTYPE=PTR                         |
    |<---------------------------------------|
    |   2. Standard query response          |
    v                                       v

 1. TN send standard query
 QNAME=0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA,
    QTYPE=PTR to NUT.
 2. NUT reply query response w/ PTR=A.example.com to TN (Judgment *2)
```

Packet Description

1st packet.

Standard query from DNS Client1 (TN) to Server1 (NUT)		
IP Header	Source Address	CL1_NETZ
	Destination Address	NUT_NETZ
UDP Header	Src Port	2000
	Dst Port	53
DNS Header	ID	0x1000
	QR	0
	OPCODE	0
	AA	0
	TC	0
	RD	1
	RA	0

	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	0
	NSCOUNT	0
	ARCOUNT	0
DNS Question section	QNAME	0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0. 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)

2nd packet.

Standard query response from DNS Server1 (NUT) to Client1 (TN)		
IP Header	Source Address	NUT_NETZ
	Destination Address	CL1_NETZ
UDP Header	Src Port	53
	Dst Port	2000
DNS Header	ID	0x1000
	QR	1
	OPCODE	0
	AA	ANY
	TC	0
	RD	1
	RA	1
	Z	0
	RCODE	0
	QDCOUNT	1
	ANCOUNT	1
	NSCOUNT	1
	ARCOUNT	1
DNS Question section	QNAME	0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0. 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA
	QTYPE	PTR (0x000C)
	QCLASS	IN (0x0001)
DNS Answer section	NAME	0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0. 1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA (Pointer 0xC00C)
	TYPE	PTR (0x000C)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	15
	PTRDNAME	A.example.com
DNS Authority section	NAME	1.0.1.0.f.f.f.f.1.0.5.0.e.f.f.3.IP6.ARPA (Pointer 0xC02C)

	TYPE	NS (0x0002)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	6
	NSDNAME	NS1.example.com (NS1 + Pointer 0xC068)
DNS Additional section	NAME	NS1.example.com (Pointer 0xC081)
	TYPE	A (0x0001)
	CLASS	IN (0x0001)
	TTL	1 day (86400)
	RDLENGTH	4
	ADDRESS	192.168.0.10

- **Termination**
  None

Judgment

2. Received standard query response including PTR resource record.

References

RFC1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
  3.6 Resource Records
RFC1035 DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION
  3.2.1 Format
  3.2.2 TYPE values
  3.3.12 PTR RDATA format
RFC3596 DNS Extensions to Support IPv6
  2.5 IP6.ARPA domain