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Nameservers for IPv4 and IPv6 Reverse Zones

Abstract

This document specifies a stable naming scheme for the nameservers that serve the zones IN-ADDR.ARPA and IP6.ARPA in the DNS. These zones contain data that facilitate reverse mapping (address to name).

Status of This Memo

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1. Introduction

The Domain Name System (DNS) is described in [RFC1034] and [RFC1035]. The DNS currently supports keyed data retrieval using three namespaces -- domain names, IPv4 addresses, and IPv6 addresses. Mapping of IPv4 addresses to names is accomplished using data published in the IN-ADDR.ARPA zone. For IPv6, the IP6.ARPA zone is used (see [RFC3596]). The process of mapping an address to a name is generally known as a "reverse lookup", and the IN-ADDR.ARPA and IP6.ARPA zones are said to support the "reverse DNS".

The secure and stable hosting of the IN-ADDR.ARPA and IP6.ARPA zones is critical to the operation of the Internet, since many applications rely upon timely responses to reverse lookups to be able to operate normally.

At the time of this writing, the IN-ADDR.ARPA zone is served by a subset of the DNS root servers, and IP6.ARPA by servers operated by APNIC, ARIN, ICANN, LACNIC, and the RIPE NCC (see Appendix A).

This document specifies a dedicated and stable set of nameserver names for each of the IN-ADDR.ARPA and IP6.ARPA zones.

The naming scheme specified in this document allows IN-ADDR.ARPA and IP6.ARPA to be delegated to two different sets of nameservers, to facilitate operational separation of the infrastructure used to serve each zone. This separation might help ensure that an operational failure of IN-ADDR.ARPA servers does not impact IPv6 reverse lookups as collateral damage, for example.

The choice of operators for individual nameservers is beyond the scope of this document and is an IANA function that falls under the scope of Section 4 of the Memorandum of Understanding (MoU) between the IETF and ICANN [RFC2860].

2. Nameservers for IN-ADDR.ARPA

This document specifies the following naming scheme for servers that host the IN-ADDR.ARPA zone:

```
A.IN-ADDR-SERVERS.ARPA
B.IN-ADDR-SERVERS.ARPA
C.IN-ADDR-SERVERS.ARPA
D.IN-ADDR-SERVERS.ARPA
E.IN-ADDR-SERVERS.ARPA
F.IN-ADDR-SERVERS.ARPA
...
```

The IN-ADDR-SERVERS.ARPA zone has been delegated to the same set of servers as IN-ADDR.ARPA. IPv4 and IPv6 glue records for each of those servers has been added to the ARPA zone.

The IN-ADDR-SERVERS.ARPA and IN-ADDR.ARPA zones are delegated to the same servers, since they are both dedicated for a single purpose and hence can reasonably share fate.

All servers in the set are named under the same domain to facilitate label compression. Since glue for all servers exist in the ARPA zone, the use of a single domain does not present a practical single point of failure.

3. Nameservers for IP6.ARPA

This document specifies the following nameserver set for the IP6.ARPA zone:

```
A.IP6-SERVERS.ARPA
B.IP6-SERVERS.ARPA
C.IP6-SERVERS.ARPA
D.IP6-SERVERS.ARPA
E.IP6-SERVERS.ARPA
F.IP6-SERVERS.ARPA
...
```

The IP6-SERVERS.ARPA zone has been delegated to the same set of servers as IP6.ARPA. IPv4 and IPv6 glue records for each of those servers has been added to the ARPA zone.

4. IAB Statement

In its capacity as the body that provides technical guidance to ICANN for the administration of the ARPA top-level domain as described in [RFC3172], the IAB has reviewed this proposal and supports it as an operational change that is in line with the respective roles of ICANN and the IAB.

5. IANA Considerations

With due consideration to the approval of the IAB (see Section 4), the IANA has delegated:

1. IN-ADDR-SERVERS.ARPA to the nameservers listed in Section 2;

2. IP6-SERVERS.ARPA to the nameservers listed in Section 3.

Additionally, IANA has installed IPv4 and IPv6 glue records for the nameservers concerned in the ARPA zone.

The choice of operators for all nameservers concerned is beyond the scope of this document and is an IANA function that falls under the scope of Section 4 of the MoU between the IETF and ICANN [RFC2860].

6. Security Considerations

This document introduces no additional security risks for the Internet.

7. References

7.1. Normative References

[RFC1034] Mockapetris, P., "Domain names - concepts and facilities", STD 13, RFC 1034, November 1987.

[RFC1035] Mockapetris, P., "Domain names - implementation and specification", STD 13, RFC 1035, November 1987.

[RFC3172] Huston, G., Ed., "Management Guidelines & Operational Requirements for the Address and Routing Parameter Area Domain ("arpa")", BCP 52, RFC 3172, September 2001.

7.2. Informative References

[RFC2860] Carpenter, B., Baker, F., and M. Roberts, "Memorandum of Understanding Concerning the Technical Work of the Internet Assigned Numbers Authority", RFC 2860, June 2000.

[RFC3596] Thomson, S., Huitema, C., Ksinant, V., and M. Souissi, "DNS Extensions to Support IP Version 6", RFC 3596, October 2003.

Appendix A. Existing NS RRSets

The NS RRSet for the IN-ADDR.ARPA zone at the time of this writing is as follows:

```
IN-ADDR.ARPA.          86400   IN      NS      A.ROOT-SERVERS.NET.
IN-ADDR.ARPA.          86400   IN      NS      B.ROOT-SERVERS.NET.
IN-ADDR.ARPA.          86400   IN      NS      C.ROOT-SERVERS.NET.
IN-ADDR.ARPA.          86400   IN      NS      D.ROOT-SERVERS.NET.
IN-ADDR.ARPA.          86400   IN      NS      E.ROOT-SERVERS.NET.
IN-ADDR.ARPA.          86400   IN      NS      F.ROOT-SERVERS.NET.
IN-ADDR.ARPA.          86400   IN      NS      G.ROOT-SERVERS.NET.
IN-ADDR.ARPA.          86400   IN      NS      H.ROOT-SERVERS.NET.
IN-ADDR.ARPA.          86400   IN      NS      I.ROOT-SERVERS.NET.
IN-ADDR.ARPA.          86400   IN      NS      K.ROOT-SERVERS.NET.
IN-ADDR.ARPA.          86400   IN      NS      L.ROOT-SERVERS.NET.
IN-ADDR.ARPA.          86400   IN      NS      M.ROOT-SERVERS.NET.
```

The NS RRSet for the IP6.ARPA zone at the time of this writing is as follows:

```
IP6.ARPA.              84600   IN      NS      NS-SEC.RIPE.NET.
IP6.ARPA.              86400   IN      NS      SEC1.APNIC.NET.
IP6.ARPA.              86400   IN      NS      NS2.LACNIC.NET.
IP6.ARPA.              86400   IN      NS      NS.ICANN.ORG.
IP6.ARPA.              86400   IN      NS      TINNIE.ARIN.NET.
```

For completeness, the NS RRSet for the ARPA zone at the time of this writing is as follows:

```
ARPA.                  86400   IN      NS      A.ROOT-SERVERS.NET.
ARPA.                  86400   IN      NS      B.ROOT-SERVERS.NET.
ARPA.                  86400   IN      NS      C.ROOT-SERVERS.NET.
ARPA.                  86400   IN      NS      D.ROOT-SERVERS.NET.
ARPA.                  86400   IN      NS      E.ROOT-SERVERS.NET.
ARPA.                  86400   IN      NS      F.ROOT-SERVERS.NET.
ARPA.                  86400   IN      NS      G.ROOT-SERVERS.NET.
ARPA.                  86400   IN      NS      H.ROOT-SERVERS.NET.
ARPA.                  86400   IN      NS      I.ROOT-SERVERS.NET.
ARPA.                  86400   IN      NS      K.ROOT-SERVERS.NET.
ARPA.                  86400   IN      NS      L.ROOT-SERVERS.NET.
ARPA.                  86400   IN      NS      M.ROOT-SERVERS.NET.
```

Appendix B. Performance Characteristics

B.1. Label Compression

The choice of names for the respective NS RRSets of the IN-ADDR.ARPA and IP6.ARPA zones have a relatively minor impact on the delegation response sizes from their parent zones, given other anticipated contributors such as DNSSEC. However, it is still considered good practice to use a naming scheme that is reasonably compressible: doing so for frequently queried zones such as these is likely to have at least measurable impact on aggregate DNS traffic in the Internet as a whole, and has potential transport benefits to clients whose queries will not result in secure replies.

The naming schemes described in Sections 2 and 3 are highly compressible. That is, once a single nameserver name has been encoded in a DNS message, subsequent nameservers can be specified with substantially smaller encoding.

In the DNS, a complete encoding of an a-label involves a one-byte length field, plus a one-byte-per-character encoding of the a-label itself. A domain name’s encoding consists of one or more a-labels, so-encoded, plus a single terminating zero byte. Where a terminating series of a-labels has already been encoded as described above, subsequent terminating references to the same series can be made using a two-byte pointer to that full encoding.

The non-compressed representation of the nameserver A.IN-ADDR-SERVERS.ARPA fills (1 + 1) + (15 + 1) + (4 + 1) + 1 = 24 bytes.

The non-compressed representation of A.IP6-SERVERS.ARPA fills (1 + 1) + (10 + 1) + (4 + 1) + 1 = 19 bytes.

Subsequent nameservers under either domain are encoded with the initial label, plus two bytes for a pointer to the repeated domain elsewhere in the message, i.e., (1 + 1) + 2 = 4 bytes.

The encoded size of the a-labels in a twelve-record NS RRSet named according to Section 2 for IN-ADDR.ARPA is as follows:

Nameserver	Encoded Size
A.IN-ADDR-SERVERS.ARPA	(1 + 1) + (15 + 1) + (4 + 1) + 1 = 24
B.IN-ADDR-SERVERS.ARPA	(1 + 1) + 2 = 4
C.IN-ADDR-SERVERS.ARPA	(1 + 1) + 2 = 4
D.IN-ADDR-SERVERS.ARPA	(1 + 1) + 2 = 4
E.IN-ADDR-SERVERS.ARPA	(1 + 1) + 2 = 4
F.IN-ADDR-SERVERS.ARPA	(1 + 1) + 2 = 4
G.IN-ADDR-SERVERS.ARPA	(1 + 1) + 2 = 4
H.IN-ADDR-SERVERS.ARPA	(1 + 1) + 2 = 4
I.IN-ADDR-SERVERS.ARPA	(1 + 1) + 2 = 4
J.IN-ADDR-SERVERS.ARPA	(1 + 1) + 2 = 4
K.IN-ADDR-SERVERS.ARPA	(1 + 1) + 2 = 4
L.IN-ADDR-SERVERS.ARPA	(1 + 1) + 2 = 4
Total	68 bytes

The encoded size of the a-labels in a six-record NS RRSet named according to Section 3 for IP6.ARPA is, hence, as follows:

Nameserver	Encoded Size
A.IP6-SERVERS.ARPA	(1 + 1) + (10 + 1) + (4 + 1) + 1 = 19
B.IP6-SERVERS.ARPA	(1 + 1) + 2 = 4
C.IP6-SERVERS.ARPA	(1 + 1) + 2 = 4
D.IP6-SERVERS.ARPA	(1 + 1) + 2 = 4
E.IP6-SERVERS.ARPA	(1 + 1) + 2 = 4
F.IP6-SERVERS.ARPA	(1 + 1) + 2 = 4
Total	39 bytes

By way of comparison, the encoded size of the labels in the NS RRSet for IP6.ARPA (shown in Appendix A) is as follows:

Nameserver	Encoded Size
NS-SEC.RIPE.NET	(6 + 1) + (4 + 1) + (3 + 1) + 1 = 17
SEC1.APNIC.NET	(4 + 1) + (5 + 1) + 2 + 1 = 14
NS2.LANIC.NET	(3 + 1) + (6 + 1) + 2 + 1 = 14
NS.ICANN.ORG	(2 + 1) + (5 + 1) + (3 + 1) + 1 = 14
TINNIE.ARIN.NET	(6 + 1) + (4 + 1) + 2 + 1 = 15
Total	74 bytes

B.2. Query Patterns

A brief description of likely query patterns for an empty cache with the existing and new NS RRSets follows.

B.2.1. QNAME under IN-ADDR.ARPA

Consider the IN-ADDR.ARPA NS RRSet (described in Appendix A) and a QNAME that is delegated beneath the IN-ADDR.ARPA zone:

1. Query sent to root server that is also authoritative for IN-ADDR.ARPA; response is a referral from the IN-ADDR.ARPA zone.

In the case where the initial query is sent to the J root server:

1. Query sent to J.ROOT-SERVERS.NET (which is not authoritative for the IN-ADDR.ARPA zone); response is a referral to an ARPA server with additional-section glue.

2. Query sent to an ARPA server (all of which are also authoritative in this case for IN-ADDR.ARPA); response is a referral from the IN-ADDR.ARPA zone.

Consider the same query with the IN-ADDR.ARPA NS RRSet (described in Section 2):

1. Query sent to a root server that is also authoritative for ARPA; response is a referral to an IN-ADDR.ARPA server, with additional-section glue.

2. Query sent to an IN-ADDR.ARPA server; response is a referral from the IN-ADDR.ARPA zone.

In the case where the first query is sent to the J root server:

1. Query sent to J.ROOT-SERVERS.NET (which is not authoritative for ARPA); response is a referral to an ARPA server, with additional-section glue.

2. Query sent to an ARPA server; response is a referral to an IN-ADDR.ARPA server, with additional-section glue.

3. Query sent to an IN-ADDR.ARPA server; response is a referral from the IN-ADDR.ARPA zone.

B.2.2. QNAME under IP6.ARPA

Consider the IP6.ARPA NS RRSet (described in Appendix A) and a QNAME that is delegated beneath the IP6.ARPA zone:

1. Query sent to root server that is also authoritative for ARPA; response is a referral from the ARPA zone to an IP6.ARPA server with no additional-section glue.

2. A recursive lookup for one of the nameservers specified in the referral must now be performed in order to obtain an address for an IP6.ARPA server. In all cases, three queries are required. Successive recursive lookups may be performed in the event that a server is unresponsive.

3. Query sent to IP6.ARPA server; response is a referral from the IP6.ARPA zone.

In the case where the first query is sent to the J root server:

1. Query sent to J.ROOT-SERVERS.NET; response is a referral to an ARPA server with additional-section glue.

2. Query sent to an ARPA server; response is a referral from the ARPA zone to an IP6.ARPA server with no additional-section glue.

3. A recursive lookup for one of the nameservers specified in the referral must now be performed in order to obtain an address for an IP6.ARPA server. In all cases, three queries are required. Successive recursive lookups may be performed in the event that a server is unresponsive.

4. Query sent to IP6.ARPA server; response is a referral from the IP6.ARPA zone.

Consider the same query with the IP6.ARPA NS RRSet (described in Section 3):

1. Query sent to a root server that is also authoritative for ARPA; response is a referral to an IP6.ARPA server, with additional-section glue.

2. Query sent to an IP6.ARPA server; response is a referral from the IP6.ARPA zone.

In the case where the first query is sent to the J root server:

1. Query sent to J.ROOT-SERVERS.NET (which is not authoritative for ARPA); response is a referral to an ARPA server, with additional-section glue.

2. Query sent to an ARPA server; response is a referral to an IP6.ARPA server with additional-section glue.

3. Query sent to an IP6.ARPA server; response is a referral from the IP6.ARPA zone.

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