                 Domain Name System (DNS) IANA Considerations

Status of this Memo

   This document specifies an Internet Best Current Practices for the
   Internet Community, and requests discussion and suggestions for
   improvements. Distribution of this memo is unlimited.

Abstract

   Internet Assigned Number Authority (IANA) parameter assignment
   considerations are given for the allocation of Domain Name System
   (DNS) classes, Resource Record (RR) types, operation codes, error
   codes, etc.

Table of Contents

1. Introduction

   The Domain Name System (DNS) provides replicated distributed secure
   hierarchical databases which hierarchically store "resource records"
   (RRs) under domain names.

   This data is structured into CLASSes and zones which can be
   independently maintained. See [RFC 1034, 1035, 2136, 2181, 2535]
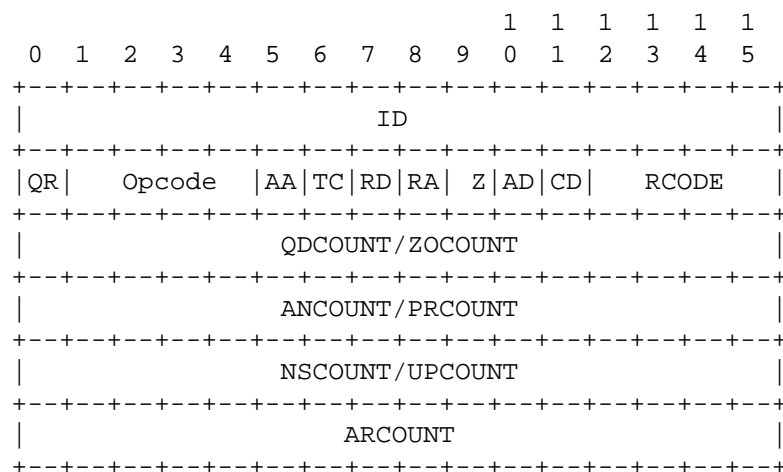   familiarity with which is assumed.

   This document covers, either directly or by reference, general IANA
   parameter assignment considerations applying across DNS query and
   response headers and all RRs. There may be additional IANA
   considerations that apply to only a particular RR type or
   query/response opcode. See the specific RFC defining that RR type or
   query/response opcode for such considerations if they have been
   defined.

   IANA currently maintains a web page of DNS parameters. See
   <http://www.iana.org/numbers.htm>.

   "IETF Standards Action", "IETF Consensus", "Specification Required",
   and "Private Use" are as defined in [RFC 2434].

2. DNS Query/Response Headers

   The header for DNS queries and responses contains field/bits in the
   following diagram taken from [RFC 2136, 2535]:

```
                                      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|AD|CD|   RCODE   |
      +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
      |                QDCOUNT/ZOCOUNT                |
      +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
      |                ANCOUNT/PRCOUNT                |
      +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
      |                NSCOUNT/UPCOUNT                |
      +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
      |                    ARCOUNT                    |
      +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

   The ID field identifies the query and is echoed in the response so
   they can be matched.

The QR bit indicates whether the header is for a query or a response.

The AA, TC, RD, RA, AD, and CD bits are each theoretically meaningful
only in queries or only in responses, depending on the bit. However,
many DNS implementations copy the query header as the initial value
of the response header without clearing bits. Thus any attempt to
use a "query" bit with a different meaning in a response or to define
a query meaning for a "response" bit is dangerous given existing
implementation. Such meanings may only be assigned by an IETF
Standards Action.

The unsigned fields query count (QDCOUNT), answer count (ANCOUNT),
authority count (NSCOUNT), and additional information count (ARCOUNT)
express the number of records in each section for all opcodes except
Update. These fields have the same structure and data type for
Update but are instead the counts for the zone (ZOCOUNT),
prerequisite (PRCOUNT), update (UPCOUNT), and additional information
(ARCOUNT) sections.

2.1 One Spare Bit?

There have been ancient DNS implementations for which the Z bit being
on in a query meant that only a response from the primary server for
a zone is acceptable. It is believed that current DNS
implementations ignore this bit.

Assigning a meaning to the Z bit requires an IETF Standards Action.

2.2 Opcode Assignment

New OpCode assignments require an IETF Standards Action.

Currently DNS OpCodes are assigned as follows:

```
   OpCode Name                      Reference

     0     Query                    [RFC 1035]
     1     IQuery  (Inverse Query)  [RFC 1035]
     2     Status                   [RFC 1035]
     3     available for assignment
     4     Notify                   [RFC 1996]
     5     Update                   [RFC 2136]
   6-15    available for assignment
```

2.3 RCODE Assignment

   It would appear from the DNS header above that only four bits of
   RCODE, or response/error code are available. However, RCODEs can
   appear not only at the top level of a DNS response but also inside
   OPT RRs [RFC 2671], TSIG RRs [RFC 2845], and TKEY RRs [RFC 2930].
   The OPT RR provides an eight bit extension resulting in a 12 bit
   RCODE field and the TSIG and TKEY RRs have a 16 bit RCODE field.
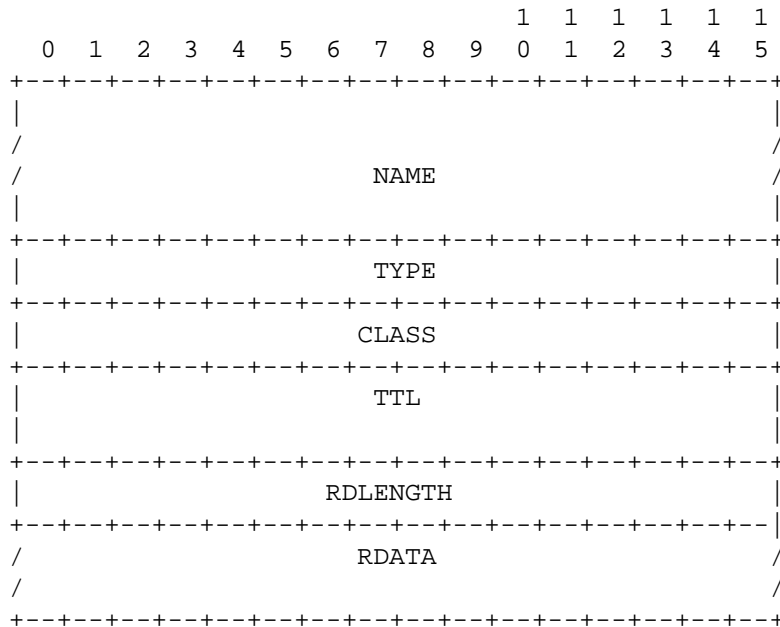
   Error codes appearing in the DNS header and in these three RR types
   all refer to the same error code space with the single exception of
   error code 16 which has a different meaning in the OPT RR from its
   meaning in other contexts. See table below.

```
   RCODE    Name     Description                      Reference
   Decimal
     Hexadecimal
    0    NoError   No Error                          [RFC 1035]
    1    FormErr   Format Error                      [RFC 1035]
    2    ServFail  Server Failure                    [RFC 1035]
    3    NXDomain  Non-Existent Domain               [RFC 1035]
    4    NotImp    Not Implemented                   [RFC 1035]
    5    Refused   Query Refused                     [RFC 1035]
    6    YXDomain  Name Exists when it should not    [RFC 2136]
    7    YXRRSet   RR Set Exists when it should not  [RFC 2136]
    8    NXRRSet   RR Set that should exist does not [RFC 2136]
    9    NotAuth   Server Not Authoritative for zone [RFC 2136]
   10    NotZone   Name not contained in zone        [RFC 2136]
   11-15           available for assignment
   16    BADVERS   Bad OPT Version                   [RFC 2671]
   16    BADSIG    TSIG Signature Failure            [RFC 2845]
   17    BADKEY    Key not recognized                [RFC 2845]
   18    BADTIME   Signature out of time window      [RFC 2845]
   19    BADMODE   Bad TKEY Mode                     [RFC 2930]
   20    BADNAME   Duplicate key name                [RFC 2930]
   21    BADALG    Algorithm not supported           [RFC 2930]
   22-3840         available for assignment
     0x0016-0x0F00
   3841-4095       Private Use
     0x0F01-0x0FFF
   4096-65535      available for assignment
     0x1000-0xFFFF
```

   Since it is important that RCODEs be understood for interoperability,
   assignment of new RCODE listed above as "available for assignment"
   requires an IETF Consensus.

3. DNS Resource Records

   All RRs have the same top level format shown in the figure below
   taken from [RFC 1035]:

```
                                      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 is an owner name, i.e., the name of the node to which this
   resource record pertains. NAMEs are specific to a CLASS as described
   in section 3.2. NAMEs consist of an ordered sequence of one or more
   labels each of which has a label type [RFC 1035, 2671].

   TYPE is a two octet unsigned integer containing one of the RR TYPE
   codes. See section 3.1.

   CLASS is a two octet unsigned integer containing one of the RR CLASS
   codes. See section 3.2.

   TTL is a four octet (32 bit) bit unsigned integer that specifies the
   number of seconds that the resource record may be cached before the
   source of the information should again be consulted. Zero is
   interpreted to mean that the RR can only be used for the transaction
   in progress.

   RDLENGTH is an unsigned 16 bit integer that specifies the length in
   octets of the RDATA field.

RDATA is a variable length string of octets that constitutes the
resource. The format of this information varies according to the
TYPE and in some cases the CLASS of the resource record.

3.1 RR TYPE IANA Considerations

There are three subcategories of RR TYPE numbers: data TYPEs, QTYPEs,
and MetaTYPEs.

Data TYPEs are the primary means of storing data. QTYPES can only be
used in queries. Meta-TYPEs designate transient data associated with
an particular DNS message and in some cases can also be used in
queries. Thus far, data TYPEs have been assigned from 1 upwards plus
the block from 100 through 103 while Q and Meta Types have been
assigned from 255 downwards (except for the OPT Meta-RR which is
assigned TYPE 41). There have been DNS implementations which made
caching decisions based on the top bit of the bottom byte of the RR
TYPE.

There are currently three Meta-TYPEs assigned: OPT [RFC 2671], TSIG
[RFC 2845], and TKEY [RFC 2930].

There are currently five QTYPEs assigned: * (all), MAILA, MAILB,
AXFR, and IXFR.

Considerations for the allocation of new RR TYPEs are as follows:

  Decimal
Hexadecimal

   0
0x0000 - TYPE zero is used as a special indicator for the SIG RR [RFC
        2535] and in other circumstances and must never be allocated
        for ordinary use.

   1 - 127
0x0001 - 0x007F - remaining TYPEs in this range are assigned for data
        TYPEs by IETF Consensus.

   128 - 255
0x0080 - 0x00FF - remaining TYPEs in this rage are assigned for Q and
        Meta TYPEs by IETF Consensus.

   256 - 32767
0x0100 - 0x7FFF - assigned for data, Q, or Meta TYPE use by IETF
        Consensus.

     32768 - 65279
   0x8000 - 0xFEFF - Specification Required as defined in [RFC 2434].

     65280 - 65535
   0xFF00 - 0xFFFF - Private Use.

3.1.1 Special Note on the OPT RR

   The OPT (OPTion) RR, number 41, is specified in [RFC 2671]. Its
   primary purpose is to extend the effective field size of various DNS
   fields including RCODE, label type, flag bits, and RDATA size. In
   particular, for resolvers and servers that recognize it, it extends
   the RCODE field from 4 to 12 bits.

3.2 RR CLASS IANA Considerations

   DNS CLASSes have been little used but constitute another dimension of
   the DNS distributed database. In particular, there is no necessary
   relationship between the name space or root servers for one CLASS and
   those for another CLASS. The same name can have completely different
   meanings in different CLASSes although the label types are the same
   and the null label is usable only as root in every CLASS. However,
   as global networking and DNS have evolved, the IN, or Internet, CLASS
   has dominated DNS use.

   There are two subcategories of DNS CLASSes: normal data containing
   classes and QCLASSes that are only meaningful in queries or updates.

   The current CLASS assignments and considerations for future
   assignments are as follows:

     Decimal
   Hexadecimal

      0
   0x0000 - assignment requires an IETF Standards Action.

      1
   0x0001 - Internet (IN).

      2
   0x0002 - available for assignment by IETF Consensus as a data CLASS.

      3
   0x0003 - Chaos (CH) [Moon 1981].

      4
   0x0004 - Hesiod (HS) [Dyer 1987].

      5 - 127
   0x0005 - 0x007F - available for assignment by IETF Consensus as data
         CLASSes only.

    128 - 253
   0x0080 - 0x00FD - available for assignment by IETF Consensus as
         QCLASSes only.

     254
   0x00FE - QCLASS None [RFC 2136].

     255
   0x00FF - QCLASS Any [RFC 1035].

    256 - 32767
   0x0100 - 0x7FFF - assigned by IETF Consensus.

    32768 - 65280
   0x8000 - 0xFEFF - assigned based on Specification Required as defined
         in [RFC 2434].

    65280 - 65534
   0xFF00 - 0xFFFE - Private Use.

     65535
   0xFFFF - can only be assigned by an IETF Standards Action.

3.3 RR NAME Considerations

   DNS NAMEs are sequences of labels [RFC 1035]. The last label in each
   NAME is "ROOT" which is the zero length label. By definition, the
   null or ROOT label can not be used for any other NAME purpose.

   At the present time, there are two categories of label types, data
   labels and compression labels. Compression labels are pointers to
   data labels elsewhere within an RR or DNS message and are intended to
   shorten the wire encoding of NAMEs. The two existing data label
   types are sometimes referred to as Text and Binary. Text labels can,
   in fact, include any octet value including zero octets but most
   current uses involve only [US-ASCII]. For retrieval, Text labels are
   defined to treat ASCII upper and lower case letter codes as matching.
   Binary labels are bit sequences [RFC 2673].

   IANA considerations for label types are given in [RFC 2671].

NAMEs are local to a CLASS. The Hesiod [Dyer 1987] and Chaos [Moon
1981] CLASSes are essentially for local use. The IN or Internet
CLASS is thus the only DNS CLASS in global use on the Internet at
this time.

A somewhat dated description of name allocation in the IN Class is
given in [RFC 1591]. Some information on reserved top level domain
names is in Best Current Practice 32 [RFC 2606].

4. Security Considerations

This document addresses IANA considerations in the allocation of
general DNS parameters, not security. See [RFC 2535] for secure DNS
considerations.

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Authors' Addresses

   Donald E. Eastlake 3rd
   Motorola
   140 Forest Avenue
   Hudson, MA 01749 USA

   Phone: +1-978-562-2827 (h)
          +1-508-261-5434 (w)
   Fax: +1-508-261-4447 (w)
   EMail: Donald.Eastlake@motorola.com

   Eric Brunner-Williams
   Engage
   100 Brickstone Square, 2nd Floor
   Andover, MA 01810

   Phone: +1-207-797-0525 (h)
          +1-978-684-7796 (w)
   Fax: +1-978-684-3118
   EMail: brunner@engage.com

   Bill Manning
   USC/ISI
   4676 Admiralty Way, #1001
   Marina del Rey, CA 90292 USA

   Phone: +1-310-822-1511
   EMail: bmanning@isi.edu

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