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Domain Name System (DNS) IANA Considerations

Status of this Memo

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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.

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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 Decimal Hexadecimal	Name	Description	Reference
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 0x0016-0x0F00		available for assignment	
3841-4095 0x0F01-0x0FFF		Private Use	
4096-65535 0x1000-0xFFFF		available for assignment	

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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