Network Working Group
Request for Comments: 5395
BCP: 42
Obsoletes: 2929
Updates: 1183, 3597
Category: Best Current Practice

D. Eastlake 3rd
Stellar Switches

November 2008

# Domain Name System (DNS) IANA Considerations

## Status of This Memo

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## Abstract

Internet Assigned Number Authority (IANA) parameter assignment considerations are specified for the allocation of Domain Name System (DNS) resource record types, CLASSes, operation codes, error codes, DNS protocol message header bits, and AFSDB resource record subtypes.

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## 1. Introduction

The Domain Name System (DNS) provides replicated distributed secure hierarchical databases that store "resource records" (RRs) under domain names. DNS data is structured into CLASSes and zones that can be independently maintained. See [RFC1034], [RFC1035], [RFC2136], [RFC2181], and [RFC4033], familiarity with which is assumed.

This document provides, either directly or by reference, the general IANA parameter assignment considerations that apply across DNS query and response headers and all RRs. There may be additional IANA considerations that apply to only a particular RRTYPE or query/response OpCode. See the specific RFC defining that RRTYPE or query/response OpCode for such considerations if they have been defined, except for AFSDB RR considerations [RFC1183], which are included herein. This RFC obsoletes [RFC2929].

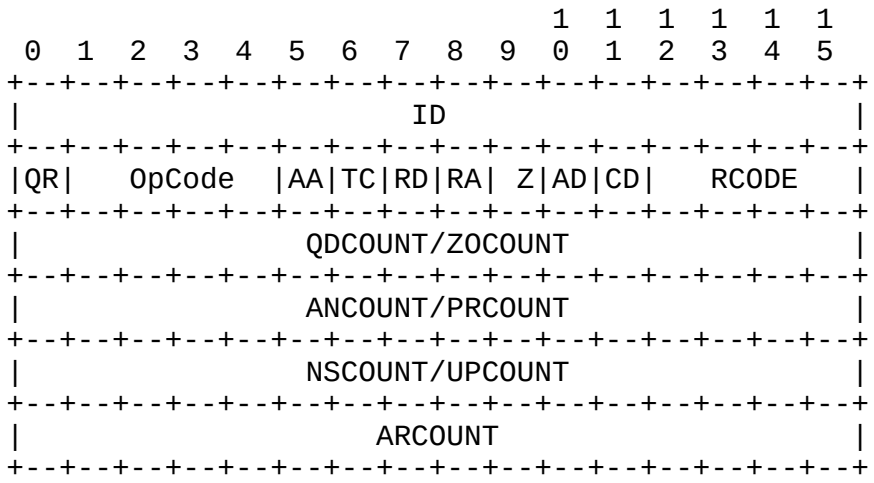
IANA currently maintains a web page of DNS parameters available from http://www.iana.org.

### 1.1. Terminology

"IETF Standards Action", "IETF Review", "Specification Required", and "Private Use" are as defined in [RFC5226].

## 2. DNS Query/Response Headers

The header for DNS queries and responses contains field/bits in the following diagram taken from [RFC2136] and [RFC2929]:




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, some 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 integer 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 [RFC2136]. 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

Currently DNS OpCodes are assigned as follows:

| OpCode | Name | Reference |
|---|---|---|
| 0 | Query | [RFC1035] |
| 1 | IQuery (Inverse Query, Obsolete) | [RFC3425] |
| 2 | Status | [RFC1035] |
| 3 | available for assignment | |
| 4 | Notify | [RFC1996] |
| 5 | Update | [RFC2136] |
| 6-15 | available for assignment | |

New OpCode assignments require an IETF Standards Action as modified by [RFC4020].

### 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 [RFC2671], TSIG RRs [RFC2845], and TKEY RRs [RFC2930]. The OPT RR provides an 8-bit extension resulting in a 12-bit RCODE field, and the TSIG and TKEY RRs have a 16-bit RCODE field.

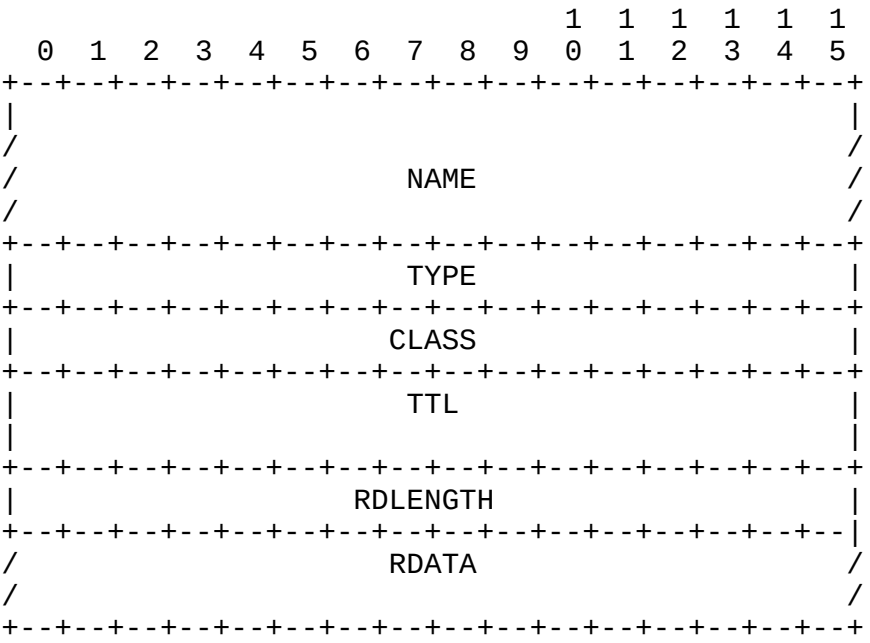
Error codes appearing in the DNS header and in these three RR types all refer to the same error code space with the single exception of error code 16, which has a different meaning in the OPT RR from its meaning in other contexts. See table below.

| RCODE Decimal / Hexadecimal | Name | Description | Reference |
|---|---|---|---|
| 0 | NoError | No Error | [RFC1035] |
| 1 | FormErr | Format Error | [RFC1035] |
| 2 | ServFail | Server Failure | [RFC1035] |
| 3 | NXDomain | Non-Existent Domain | [RFC1035] |
| 4 | NotImp | Not Implemented | [RFC1035] |
| 5 | Refused | Query Refused | [RFC1035] |
| 6 | YXDomain | Name Exists when it should not | [RFC2136] |
| 7 | YXRRSet | RR Set Exists when it should not | [RFC2136] |
| 8 | NXRRSet | RR Set that should exist does not | [RFC2136] |
| 9 | NotAuth | Server Not Authoritative for zone | [RFC2136] |
| 10 | NotZone | Name not contained in zone | [RFC2136] |
| 11 - 15 | | Available for assignment | |
| 16 | BADVERS | Bad OPT Version | [RFC2671] |
| 16 | BADSIG | TSIG Signature Failure | [RFC2845] |
| 17 | BADKEY | Key not recognized | [RFC2845] |
| 18 | BADTIME | Signature out of time window | [RFC2845] |
| 19 | BADMODE | Bad TKEY Mode | [RFC2930] |
| 20 | BADNAME | Duplicate key name | [RFC2930] |
| 21 | BADALG | Algorithm not supported | [RFC2930] |
| 22 | BADTRUC | Bad Truncation | [RFC4635] |
| 23 - 3,840 | | | |
| 0x0017 - 0x0F00 | | Available for assignment | |
| 3,841 - 4,095 | | | |
| 0x0F01 - 0x0FFF | | Private Use | |
| 4,096 - 65,534 | | | |
| 0x1000 - 0xFFFE | | Available for assignment | |
| 65,535 | | | |
| 0xFFFF | | Reserved, can only be allocated by an IETF Standards Action. | |

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

## 3. DNS Resource Records

All RRs have the same top-level format, shown in the figure below taken from [RFC1035].




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 [RFC1035] [RFC2671].

TYPE is a 2-octet unsigned integer containing one of the RRTYPE codes. See section 3.1.

CLASS is a 2-octet unsigned integer containing one of the RR CLASS codes. See section 3.2.

TTL is a 4-octet (32-bit) unsigned integer that specifies, for data TYPEs, 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. RRTYPE IANA Considerations

There are three subcategories of RRTYPE numbers: data TYPEs, QTYPEs, and Meta-TYPEs.

Data TYPEs are the means of storing data. QTYPES can only be used in queries. Meta-TYPEs designate transient data associated with a particular DNS message and, in some cases, can also be used in queries. Thus far, data TYPEs have been assigned from 1 upward plus the block from 100 through 103 and from 32,768 upward, while Q and Meta-TYPEs have been assigned from 255 downward except for the OPT Meta-RR, which is assigned TYPE 41. There have been DNS implementations that made caching decisions based on the top bit of the bottom byte of the RRTYPE.

There are currently three Meta-TYPEs assigned: OPT [RFC2671], TSIG [RFC2845], and TKEY [RFC2930]. There are currently five QTYPEs assigned: * (ALL), MAILA, MAILB, AXFR, and IXFR.

RRTYPEs have mnemonics that must be completely disjoint from the mnemonics used for CLASSes and that must match the following regular expression:

```
[A-Z][A-Z0-9-]*
```

Considerations for the allocation of new RRTYPEs are as follows:

```
  Decimal
Hexadecimal

     0
0x0000 - RRTYPE zero is used as a special indicator for the SIG (0)
       RR [RFC2931] and in other circumstances, and it must never be
       allocated for ordinary use.

     1 - 127
0x0001 - 0x007F - Remaining RRTYPEs in this range are assigned for
         data TYPEs by the DNS RRTYPE Allocation Policy as specified
         in Section 3.1.1.

   128 - 255
0x0080 - 0x00FF - Remaining RRTYPEs in this range are assigned for Q
         and Meta TYPEs by the DNS RRTYPE Allocation Policy as
         specified in Section 3.1.1.
```

256 - 61,439
0x0100 - 0xEFFF - Remaining RRTYPEs in this range are assigned for data RRTYPEs by the DNS RRTYPE Allocation Policy as specified in Section 3.1.1. (32,768 and 32,769 (0x8000 and 0x8001) have been assigned.)

61,440 - 65,279
0xF000 - 0xFEFF - Reserved for future use. IETF Review required to define use.

65,280 - 65,534
0xFF00 - 0xFFFE - Private Use.

65,535
0xFFFF - Reserved; can only be assigned by an IETF Standards Action.

### 3.1.1. DNS RRTYPE Allocation Policy

Parameter values specified in Section 3.1 above, as assigned based on DNS RRTYPE Allocation Policy, are allocated by Expert Review if they meet the two requirements listed below. There will be a pool of a small number of Experts appointed by the IESG. Each application will be ruled on by an Expert selected by IANA. In any case where the selected Expert is unavailable or states they have a conflict of interest, IANA may select another Expert from the pool.

Some guidelines for the Experts are given in Section 3.1.2. RRTYPEs that do not meet the requirements below may nonetheless be allocated by IETF Standards Action as modified by [RFC4020].

1. A complete template as specified in Appendix A has been posted for three weeks to the namedroppers@ops.ietf.org mailing list before the Expert Review decision.

   Note that partially completed or draft templates may be posted directly by the applicant for comment and discussion, but the formal posting to start the three week period is made by the Expert.

2. The RR for which an RRTYPE code is being requested is either (a) a data TYPE that can be handled as an Unknown RR as described in [RFC3597] or (b) a Meta-Type whose processing is optional, i.e., it is safe to simply discard RRs with that Meta-Type in queries or responses.

   Note that such RRs may include additional section processing, provided such processing is optional.

No less than three weeks and no more than six weeks after a completed template has been formally posted to namedroppers@ops.ietf.org, the selected Expert shall post a message, explicitly accepting or rejecting the application, to IANA, namedroppers@ops.ietf.org, and the email address provided by the applicant. If the Expert does not post such a message, the application shall be considered rejected but may be re-submitted to IANA.

IANA shall maintain a public archive of approved templates.

#### 3.1.2. DNS RRTYPE Expert Guidelines

The selected DNS RRTYPE Expert is required to monitor discussion of the proposed RRTYPE, which may occur on the namedroppers@ops.ietf.org mailing list, and may consult with other technical experts as necessary. The Expert should normally reject any RRTYPE allocation request that meets one or more of the following criterion:

1. Was documented in a manner that was not sufficiently clear to evaluate or implement.

2. The proposed RRTYPE or RRTYPEs affect DNS processing and do not meet the criteria in point 2 of Section 3.1.1 above.

3. The documentation of the proposed RRTYPE or RRTYPEs is incomplete. (Additional documentation can be provided during the public comment period or by the Expert.)

4. Application use as documented makes incorrect assumptions about DNS protocol behavior, such as wild cards, CNAME, DNAME, etc.

5. An excessive number of RRTYPE values is being requested when the purpose could be met with a smaller number or with Private Use values.

#### 3.1.3. Special Note on the OPT RR

The OPT (OPTion) RR (RRTYPE 41) and its IANA Considerations are specified in [RFC2671]. Its primary purpose is to extend the effective field size of various DNS fields including RCODE, label type, OpCode, flag bits, and RDATA size. In particular, for resolvers and servers that recognize it, it extends the RCODE field from 4 to 12 bits.

### 3.1.4. The AFSDB RR Subtype Field

The AFSDB RR [RFC1183] is a CLASS-insensitive RR that has the same RDATA field structure as the MX RR, but the 16-bit unsigned integer field at the beginning of the RDATA is interpreted as a subtype as follows:

```
  Decimal
Hexadecimal

     0
0x0000 - Reserved; allocation requires IETF Standards Action.

     1
0x0001 - Andrews File Service v3.0 Location Service [RFC1183].

     2
0x0002 - DCE/NCA root cell directory node [RFC1183].

     3 - 65,279
0x0003 - 0xFEFF - Allocation by IETF Review.

65,280 - 65,534
0xFF00 - 0xFFFE - Private Use.

65,535
0xFFFF - Reserved; allocation requires IETF Standards Action.
```

## 3.2. RR CLASS IANA Considerations

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

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 data CLASS and those for another data CLASS. The same DNS NAME can have completely different meanings in different CLASSes. The label types are the same, and the null label is usable only as root in every CLASS. As global networking and DNS have evolved, the IN, or Internet, CLASS has dominated DNS use.

As yet there has not be a requirement for "meta-CLASSes". That would be a CLASS to designate transient data associated with a particular DNS message, which might be usable in queries. However, it is possible that there might be a future requirement for one or more "meta-CLASSes".

CLASSes have mnemonics that must be completely disjoint from the mnemonics used for RRTYPEs and that must match the following regular expression:

```
[A-Z][A-Z0-9-]*
```

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

```
  Decimal
Hexadecimal

     0
0x0000 - Reserved; assignment requires an IETF Standards Action.

     1
0x0001 - Internet (IN).

     2
0x0002 - Available for assignment by IETF Review as a data CLASS.

     3
0x0003 - Chaos (CH) [Moon1981].

     4
0x0004 - Hesiod (HS) [Dyer1987].

     5 - 127
0x0005 - 0x007F - Available for assignment by IETF Review for data
                  CLASSes only.

   128 - 253
0x0080 - 0x00FD - Available for assignment by IETF Review for
                  QCLASSes and meta-CLASSes only.

   254
0x00FE - QCLASS NONE [RFC2136].

   255
0x00FF - QCLASS * (ANY) [RFC1035].

   256 - 32,767
0x0100 - 0x7FFF - Assigned by IETF Review.

32,768 - 57,343
0x8000 - 0xDFFF - Assigned for data CLASSes only, based on
                  Specification Required as defined in [RFC5226].
```

57,344 - 65,279
0xE000 - 0xFEFF - Assigned for QCLASSes and meta-CLASSes only, based on Specification Required as defined in [RFC5226].

65,280 - 65,534
0xFF00 - 0xFFFE - Private Use.

65,535
0xFFFF - Reserved; can only be assigned by an IETF Standards Action.

## 3.3. Label Considerations

DNS NAMEs are sequences of labels [RFC1035].

### 3.3.1. Label Types

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-value octets, but many current uses involve only [US-ASCII]. For retrieval, Text labels are defined to treat ASCII upper and lower case letter codes as matching [RFC4343]. Binary labels are bit sequences [RFC2673]. The Binary label type is Experimental [RFC3363].

IANA considerations for label types are given in [RFC2671].

### 3.3.2. Label Contents and Use

The last label in each NAME is "ROOT", which is the zero-length label. By definition, the null or ROOT label cannot be used for any other NAME purpose.

NAMEs are local to a CLASS. The Hesiod [Dyer1987] and Chaos [Moon1981] CLASSes are for essentially local use. The IN, or Internet, CLASS is thus the only DNS CLASS in global use on the Internet at this time.

A somewhat out-of-date description of name allocation in the IN Class is given in [RFC1591]. Some information on reserved top-level domain names is in BCP 32 [RFC2606].

## 4. Security Considerations

This document addresses IANA considerations in the allocation of general DNS parameters, not security. See [RFC4033], [RFC4034], and [RFC4035] for secure DNS considerations.

## 5. IANA Considerations

This document consists entirely of DNS IANA Considerations and includes the following changes from its predecessor [RFC2929]. It affects the DNS Parameters registry and its subregistries, which are available from http://www.iana.org.

1. In the Domain Name System "Resource record (RR) TYPES and QTYPEs" registry, it changes most "IETF Consensus" and all "Specification Required" allocation policies for RRTYPEs to be "DNS TYPE Allocation Policy" and changes the policy for RRTYPE 0xFFFF to be "IETF Standards Action". Remaining instances of "IETF Consensus" are changed to "IETF Review", per [RFC5226]. It also specifies the "DNS TYPE Allocation Policy", which is based on Expert Review with additional provisions and restrictions, including the submittal of a completed copy of the template in Appendix A to dns-rrtype-applications@ietf.org, in most cases, and requires "IETF Standards Action" as modified by [RFC4020] in other cases.

   IANA shall establish a process for accepting such templates, selecting an Expert from those appointed to review such template form applications, archiving, and making available all approved RRTYPE allocation templates. It is the duty of the selected Expert to post the formal application template to the namedroppers@ops.ietf.org mailing list. See Section 3.1 and Appendix A for more details.

2. For OpCodes (see Section 2.2), it changes "IETF Standards Action" allocation requirements to add "as modified by [RFC4020]".

3. It changes the allocation status of RCODE 0xFFFF to be "IETF Standards Action required". See Section 2.3.

4. It adds an IANA allocation policy for the AFSDB RR Subtype field, which requires the creation of a new registry. See Section 3.1.4.

5. It splits Specification Required CLASSes into data CLASSes and query or meta CLASSes. See Section 3.2.

## Appendix A. RRTYPE Allocation Template

DNS RRTYPE PARAMETER ALLOCATION TEMPLATE

When ready for formal consideration, this template is to be submitted to IANA for processing by emailing the template to dns-rrtype-applications@ietf.org.

A. Submission Date:

B. Submission Type:
[ ] New RRTYPE
[ ] Modification to existing RRTYPE

C. Contact Information for submitter:
Name:
Email Address:
International telephone number:
Other contact handles:

(Note: This information will be publicly posted.)

D. Motivation for the new RRTYPE application?
Please keep this part at a high level to inform the Expert and reviewers about uses of the RRTYPE. Remember most reviewers will be DNS experts that may have limited knowledge of your application space.

E. Description of the proposed RR type.
This description can be provided in-line in the template, as an attachment, or with a publicly available URL:

F. What existing RRTYPE or RRTYPEs come closest to filling that need and why are they unsatisfactory?

G. What mnemonic is requested for the new RRTYPE (optional)?
Note: This can be left blank and the mnemonic decided after the template is accepted.

H. Does the requested RRTYPE make use of any existing IANA Registry or require the creation of a new IANA sub-registry in DNS Parameters?
If so, please indicate which registry is to be used or created. If a new sub-registry is needed, specify the allocation policy for it and its initial contents. Also include what the modification procedures will be.

I. Does the proposal require/expect any changes in DNS servers/resolvers that prevent the new type from being processed as an unknown RRTYPE (see [RFC3597])?

J. Comments:

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## Author's Address

Donald E. Eastlake 3rd
Stellar Switches
155 Beaver Street
Milford, MA 01757 USA

Phone: +1-508-634-2066 (h)
EMail: d3e3e3@gmail.com