                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

   This memo documents an Internet Best Current Practice.

   This document is a product of the Internet Engineering Task Force
   (IETF). It represents the consensus of the IETF community. It has
   received public review and has been approved for publication by the
   Internet Engineering Steering Group (IESG). Further information on
   BCPs is available in Section 2 of RFC 5741.

   Information about the current status of this document, any errata,
   and how to provide feedback on it may be obtained at
   http://www.rfc-editor.org/info/rfc5855.

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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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