       Reverse Name Lookups of Encapsulated IPv4 Addresses in IPv6

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Abstract

   [RFC1884] specified two IPv6 address forms that encapsulated IPv4
   addresses. [RFC1886] specified a new DNS RR type (AAAA) to map
   domain names to IPv6 addresses, and also specified the form of the
   PTR RR owner name used to map IPv6 addresses back to the domain name
   of that host or interface.

   This memo amends [RFC1886] and gives two exceptions to its rules
   regarding PTR RR owner name correspondance to IPv6 addresses.
   Specifically, the two IPv4 encapsulation methods are exempted from
   [RFC1886]'s nybble mapping, and are made subject to the appropriate
   rules from [RFC1035] and [RFC1101].

1 - Overview

1.1. In [RFC1884 2.4.4] we see that addresses of the form ::D.D.D.D
(which means the first 96 bits of the address are binary zero, and the
last 32 bits are an IPv4 address) are used to ``tunnel IPv6 packets over
IPv4 routing infrastructure.'' Later in [ibid] we see that addresses of
the form ::FFFF:D.D.D.D (that is, 80 ``zero'' bits, 16 ``one'' bits, and
an IPv4 address) are used to ``represent the addresses of IPv4-only
nodes (those that *do not* support IPv6) as IPv6 addresses.''

1.2. In [RFC1886 2.5] we see that an inverse name lookup for an IPv6
address is done by reversing the nybbles, formatting them as hexadecimal
ASCII, and using each as a DNS label under the domain IP6.INT. Thus, to
find the name associated with address ``4321:0:1:2:3:4:567:89ab,'' one
would search for a PTR RR at the name:

b.a.9.8.7.6.5.0.4.0.0.0.3.0.0.0.2.0.0.0.1.0.0.0.0.0.0.0.1.2.3.4.IP6.INT

1.3. This leaves open the question of how to do inverse name lookups on
the two IPv6 address forms which actually describe IPv4 endpoints.
Should a resolver look under the IP6.INT for a nybble wise name, or
under IN-ADDR.ARPA for a byte wise name? Due to format differences,
there is no data oriented solution (such as CNAME RRs or replicate NS
RRs) available to simply make a union in the namespace so that it does
not matter which query name is used.

1.4. This memo recommends that the two IPv6 address forms which
encapsulate IPv4 addresses shall follow the usual IPv4 inverse naming
rules (i.e., IN-ADDR.ARPA). It is the author's view that inverse naming
authority and address allocation authority must always be delegated
together, and that any IPv4 address, no matter what context it is used
in, has a single correct PTR RRset denoting the name(s) of the host or
interface to which that address is bound.

2 - Detail

2.1. For a mapped or tunnelled IPv4 address represented in IPv6
notation, inverse name lookups are to be done by stripping off the first
96 bits of the address, and using the last 32 bits as a raw IPv4
address. From [RFC1884]:

```
                    IPv6-Tunnelled IPv4 Address

   |                80 bits                  | 16 |     32 bits      |
   +-----------------------------------------+----+------------------+
   |0000...............................0000|0000|   IPv4 address    |
   +-----------------------------------------+----+------------------+


                    IPv6-Mapped IPv4 Address

   |                80 bits                  | 16 |     32 bits      |
   +-----------------------------------------+----+------------------+
   |0000...............................0000|FFFF|   IPv4 address    |
   +-----------------------------------------+----+------------------+
```

2.2. The encapsulated 32 bit IPv4 is to be broken down into four octets,
and these octets are reversed, formatted in decimal ASCII, and used as
labels under the IN-ADDR.ARPA domain.

```
                            IPv4 Address

   |    8 bits     |    8 bits     |    8 bits     |    8 bits     |
   +---------------+---------------+---------------+---------------+
   |    Octet1     |    Octet2     |    Octet3     |    Octet4     |
   +---------------+---------------+---------------+---------------+

                    IN-ADDR.ARPA Owner Name

   <Octet4> . <Octet3> . <Octet2> . <Octet1> . IN-ADDR . ARPA
```

2.3. A normal DNS query for a PTR RR is done. If the response contains
an RRset matching the owner name and PTR type, then the RDATA(s) of
these RRs are the names associated with the hosts or interfaces using
the IPv4 address corresponding to this owner name. Multiple RRs can be
present in the response PTR RRset, if this address is reachable by more
than one A RR name. Thus, A RRs and PTR RRs are symmetric, while CNAME
aliases are single ended.

3 - Example

```
IPv6 Address             PTR Owner Name
-------------------------------------------------
::13.1.68.3              3.68.1.13.IN-ADDR.ARPA
::FFFF:129.144.52.38     38.52.144.129.IN-ADDR.ARPA
```

4 - Security Considerations

None.

5 - References

[RFC1035]
   P. Mockapetris, ``Domain Names - Implementation and Specification,''
   RFC 1035, USC/Information Sciences Institute, November 1987.

[RFC1101]
   P. Mockapetris, ``DNS Encoding of Network Names and Other Types,'',
   RFC 1101, USC/Information Sciences Institute, April 1898.

[RFC1884]
   R. Hinden, S. Deering, ``IP Version 6 Addressing Architecture,'' RFC
   1884, Ipsilon Networks and Xerox PARC, December, 1995.

[RFC1886]
   S. Thomson, C. Huitema, ``DNS Extensions to support IP version 6,''
   RFC 1886, Bellcore and INRIA, December 1995.

6 - Acknowledgements

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