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DHCPv6 Options for Discovery of 464XLAT IPv6 Prefixes
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Abstract

464XLAT provides limited IPv4 connectivity across an IPv6-only network using translation technology. The customer-side translator (CLAT) performs stateless 1:1 mapping of an IPv4 destination address into a provider-side translator (PLAT) IPv6 prefix, which subsequently translates it back into IPv4. Different PLATs will likely have different IPv6 prefixes, to attract traffic to the correct PLAT. Thus, an automatic PLAT-side prefix discovery method is necessary for CLATs.

This document defines a DHCPv6-based method to inform a CLAT of a PLAT’s IPv6 prefix and the IPv4 prefixes it serves.

Status of This Memo

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1. Introduction

464XLAT [RFC6877] describes an IPv4-over-IPv6 solution as one technique for IPv4 service extension and encouragement of IPv6 deployment. The 464XLAT architecture uses IPv4/IPv6 translation, described in [RFC6144], and standardized in [RFC6052], [RFC6145], and [RFC6146]. It encourages the IPv6 transition by making IPv4 service reachable across IPv6-only networks and providing IPv6 and IPv4 connectivity to single-stack IPv4 or IPv6 servers and peers. In the 464XLAT architecture, the CLAT must determine which of potentially several PLAT-side translation IPv6 prefix to use in order to send a packet to the PLAT with connectivity to its destination.

[RFC7050] describes a mechanism to learn the PLAT-side IPv6 prefix for protocol translation by DNS64 [RFC6147]. Although it supports multiple PLAT-side prefix by responding with multiple AAAA records to a DNS64 query, it does not support mapping IPv4 prefixes to IPv6 prefix, which would be required, for example, if one PLAT has connectivity to the general Internet following a default route, another has connectivity to a BGP peer, and a third has connectivity to a network using private addressing [RFC1918]. Therefore, in the scenario with multiple PLATs, [RFC7050] does not directly support destination-based IPv4 routing among PLATs; instead, the DNS64 database must contain equivalent information. It also requires the additional deployment of DNS64 service in customer-side networks, which is not required in 464XLAT deployment.

This document proposes a method for PLAT-side IPv6 prefix discovery based on DHCPv6, which is widely deployed and supported in customer networks. It defines two new dhcpv6 options for use by a CLAT to discover the PLAT-side translation IPv6 prefix(es). Also, the proposed mechanism can deal with the scenario with multiple independent DNS64 databases supporting separate PLATs.

2. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

3. New DHCPv6 Option

3.1. PLAT Prefix List Option Format

The PLAT Prefix List Option is a container for PLAT Prefix Option(s). A PLAT Prefix List Option MAY contain multiple PLAT Prefix Options.

The format of the PLAT Prefix List Option is:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   OPTION_PLAT_PREFIX_LIST     |       option-length           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
+                            PLAT_PREFIX-options                +
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

- o option-code: OPTION_PLAT_PREFIX_LIST (TBA1)

- o option-length: length of PLAT_PREFIX-options, specified in octets.

- o PLAT_PREFIX-options: one or more OPTION_PLAT_PREFIX options.

3.2. PLAT Prefix Option Format

The PLAT Prefix Option is encapsulated in the PLAT Prefix List Option. This option allows the mapping of destination IPv4 address ranges (contained in the IPv4 Prefix List) to a PLAT IPv6 prefix. If there is more than one such prefix, each prefix comes in its own option, with its associated IPv4 prefix list. In this way, the CLAT can select the PLAT with the corresponding destination IPv4 address.

The format of the PLAT Prefix Option is:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   OPTION_PLAT_PREFIX          |         option-length         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| platv6-prelen |                                               |
+-+-+-+-+-+-+-+-+          platv6-prefix                        |
|                        (variable length)                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
.                            (optional)                         .
.              IPv4 Prefix List (variable length)               .
.                        (see Figure 3)                         .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| IPv4-prelen   |   IPv4 Prefix (32 bits)                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    (cont.)    | IPv4-prelen   | IPv4 Prefix (32 bits)         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    IPv4 Prefix (cont)         |                ...            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                            ...                                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

- o option-code: OPTION_PLAT_PREFIX (TBA2)

- o option-length: 1 + length of platv6-prefix + length of IPv4 Prefix List, specified in octets.

- o platv6-prelen: length of platv6-prefix.

- o platv6-prefix: The PLAT IPv6 prefix that the CLAT used for IPv6 address synthesis.

- o IPv4 Prefix List: This is an optional field. The format of the

IPv4 Prefix List is shown in Figure 3. It is a list of zero or more IPv4 Prefixes. Each entry is formed by IPv4-prelen and IPv4 Prefix. The total length of the field is 5*number of IPv4 prefixes.

- o IPv4-prelen: the length of the IPv4 Prefix.

- o IPv4 Prefix: the destination-based IPv4 Prefix. The length is 4 octets.

4. Client Behavior

The client requests the OPTION_PLAT_PREFIX_LIST option using the Option Request option (ORO) in every Solicit, Request, Renew, Rebind, and Information-request message. If the DHCPv6 server includes the OPTION_PLAT_PREFIX_LIST option in its response, the CLAT may use the contained platv6-prefix to translate the destination IPv4 address into the destination IPv6 address.

When receiving the OPTION_PLAT_PREFIX option with IPv4 Prefix List, the CLAT MUST record the received IPv6 prefix and the corresponding IPv4 prefixes in IPv4 Prefix List. When receiving the OPTION_PLAT_PREFIX option without IPv4 Prefix List, the CLAT MUST treat the IPv6 prefix and the default IPv4 prefix 0.0.0.0/0 as one of the records.

If the CLAT loses contact with the DHCPv6 server, the CLAT SHOULD clear the prefix(es) it learned from the DHCPv6 server.

When translating the destination IPv4 address into the destination IPv6 address, CLAT MUST search an IPv4 routing database using the longest-match-first rule and select the IPv6 prefix offering that IPv4 prefix.

5. Message Flow Illustration

The figure below shows an example of message flow for a Client learning IPv6 prefixes using DHCPv6.

In this example, two IPv6 prefixes are provided by the DHCPv6 server. The first IPv6 prefix is 2001:db8:122:300::/56, the corresponding IPv4 prefixes are 192.0.2.0/24 and 198.51.100.0/24. The second IPv6 prefix is 2001:db8:122::/48, the corresponding IPv4 prefix is 192.0.2.128/25.

When the CLAT receives the packet with destination IPv4 address 192.0.2.1, according to the rule of longest prefix match, the PLAT with IPv6 prefix 2001:db8:122::/48 is chosen. In the same way, the

PLAT with IPv6 prefix 2001:db8:122::/48 is chosen.

```
   +----------+                                     +-----------------+
   |   CLAT   |                                     |  DHCPv6 server  |
   +----------+                                     +-----------------+
        |            DHCPv6 query for IPv6 prefix            |
        |---------------------------------------------------->|
        |         ORO with OPTION_V6_PLATPREFIX_LIST          |
        |                                                    |
        |       DHCPv6 response with:                        |
        |         PLATPREFIX{                                |
        |           platv6-pre = 2001:db8:122:300::/56       |
        |           platv6-pre = 192.0.2.0/24                |
        |           platv4-pre = 198.51.100.0/24}            |
        |         PLATPREFIX{                                |
        |           platv6-pre = 2001:db8:122::/48           |
        |           platv4-pre = 192.0.2.128/25}             |
        |<---------------------------------------------------|
        |                                                    |
        |
        |                     +-----------------+   +-----------------+
        |                     |     PLAT 1      |   |     PLAT 2      |
        |                     +-----------------+   +-----------------+
        |                         platv6-pre =          platv6-pre =
        |                    2001:db8:122:300::/56   2001:db8:122::/48
        |                         platv4-pre =          platv4-pre =
        |                        192.0.2.0/24       192.0.2.128/25
        |                        198.51.100.0/24             |
        |                              |                     |
        |       Dest IPv4 addr:        |                     |
        |        192.0.2.1             |                     |
        |       Dest IPv6 addr:        |                     |
        |  2001:db8:122:300::c000:201  |                     |
        |----------------------------->|                     |
        |                              |                     |
        |                                                    |
        |     Dest IPv4 addr: 192.0.2.193                    |
        |     Dest IPv6 addr: 2001:db8:122::c000:2c1         |
        |---------------------------------------------------->|
```

6. Security Considerations

Considerations for security in this type of environment are primarily around the operation of the DHCPv6 protocol and the databases it uses.

In the DHCPv6 server, should the database be compromised, it will deliver incorrect data to its CLAT clients. In the CLAT, should its database be compromised by attack or polluted by an incorrect DHCPv6 server database, it will route data incorrectly. In both cases, the security of the systems and their databases in an operational matter, not managed by protocol.

However, the operation of the DHCPv6 protocol itself is also required to be correct - the server and its clients must recognize valid requests and reject invalid ones. Therefore, DHCPv6 exchanges MUST be secured as described in [RFC3315].

7. IANA Considerations

We request that IANA allocate two DHCPv6 option codes for use by OPTION_V6_PLATPREFIX_LIST and OPTION_V6_PLATPREFIX from the "Option Codes" table

8. References

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