Home Network Autoconfiguration via DHCPv6 Relay
draft-gmann-homenet-relay-autoconf-00

Abstract

   This document describes a method for efficiently delegating subnets
   of an IPv6 prefix among home routers while simultaneously creating
   functional routing tables in all home routers without the need for a
   routing protocol.

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 RFC 2119 [RFC2119].

Status of this Memo

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1. Introduction

   There are several mechanisms for distributing IPv6 address and
   routing information within a home network. However, many of these
   require complex new protocols, or hierarchical addressing topologies.
   A simpler and more efficient solution to home network
   autoconfiguration is to provide centralized prefix delegation
   control, utilize an existing protocol [RFC3315], and remove the need
   for a routing protocol. This simpler approach can be achieved by
   relaying all DHCPv6 IA_PD [RFC3633] requests and responses to and
   from the CPE Edge Router (CER) and snooping their contents along the
   way. This approach is analogous to how many Service Providers plan
   to distribute IPv6 prefixes to subscribers in the WAN.

2. Expected Home Network Topologies

   It is expected that home networks will be arbitrarily constructed by
   home users. Figure 1 illustrates an example multi-router home
   network topology.

   This document assumes that the vast majority of home networks will
   connect to a single ISP and will be generally constructed in a tree
   architecture. This document also assumes that IPv6 hosts are capable
   of dealing with multiple IPv6 addresses and have some manner of
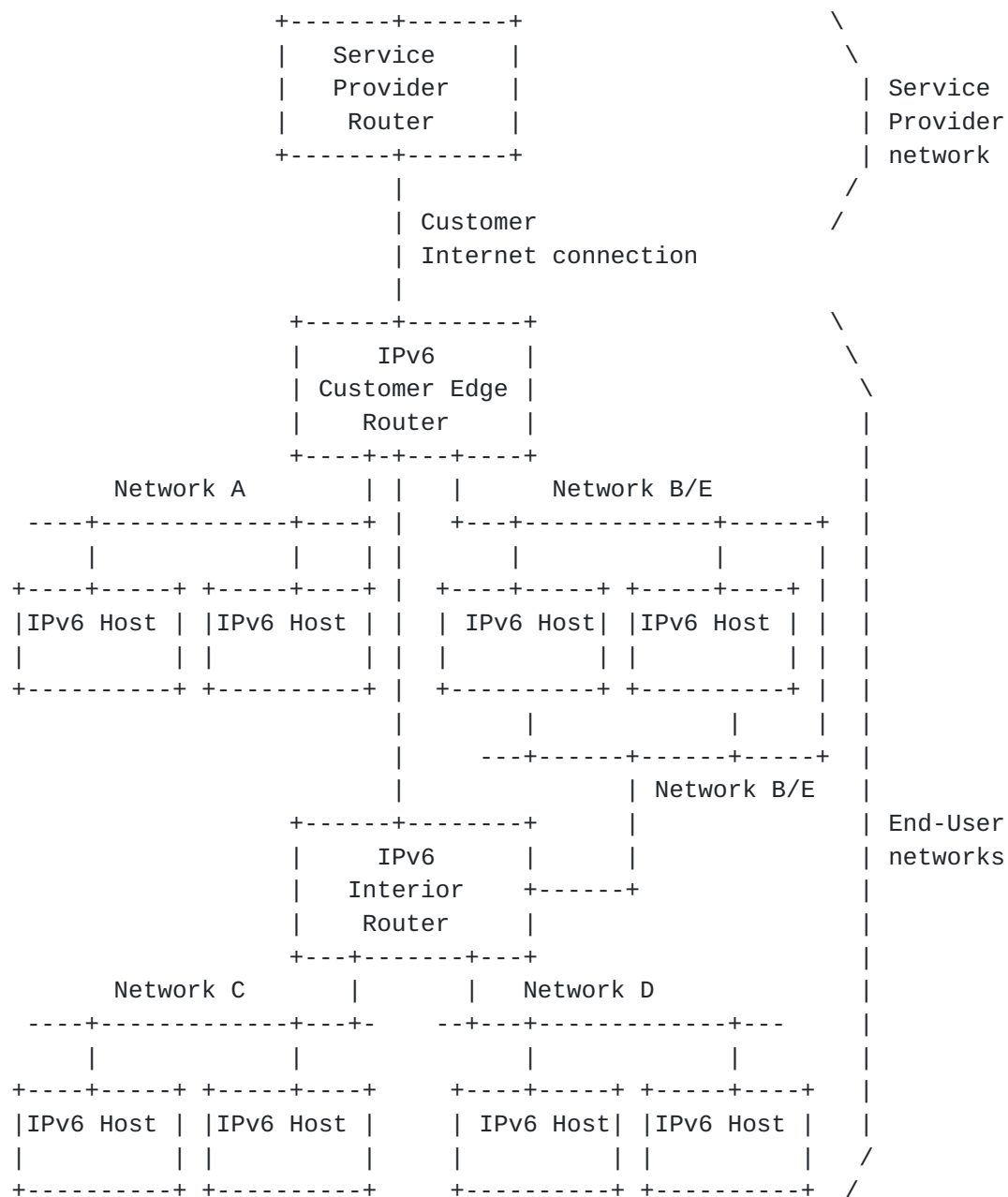   address selection functionality (internal multi-homing).

```
                    +-------+-------+                     \
                    |    Service    |                      \
                    |    Provider   |                    | Service
                    |     Router    |                    | Provider
                    +-------+-------+                    | network
                            |                            /
                            | Customer                  /
                            | Internet connection
                            |
                    +------+--------+                     \
                    |      IPv6     |                      \
                    | Customer Edge |                       \
                    |     Router    |                    |
                    +----+-+---+----+                    |
          Network A      | |   |      Network B/E        |
      ----+------------+----+ |  +---+------------+------+  |
          |            |    | | |    |            |    |  |
     +----+----+ +-----+----+ | +----+-----+ +-----+----+ |  |
     |IPv6 Host | |IPv6 Host | |  | IPv6 Host| |IPv6 Host | |  |
     |         | |          | | |          | |         | |  |
     +---------+ +----------+ |  +----------+ +----------+ |  |
                              |            |            |  |  |
                              |        ---+------+------+-----+  |
                              |          | Network B/E    |
                    +------+--------+     |              | End-User
                    |      IPv6     |     |              | networks
                    |    Interior   +------+            |
                    |     Router    |                  |
                    +---+-------+---+                  |
          Network C     |       |   Network D          |
      ----+------------+---+-   --+---+------------+---      |
          |            |           |            |       |
     +----+-----+ +-----+----+    +----+-----+ +-----+----+   |
     |IPv6 Host | |IPv6 Host |    | IPv6 Host| |IPv6 Host |   |
     |         | |          |    |          | |         |  /
     +---------+ +----------+    +----------+ +----------+ /
```

Figure 1

3. Home Router Behavior

   All routers within a home MUST be capable of determining whether or
   not they are the CER for their home. This draft recommends use of
   the [draft-donley-dhc-cer-id-option] but other methods may also be
   used.

3.1. CER Behavior

   Once a home router has determined that it is the CER, it is
   responsible for requesting, receiving and sub-delegating a GUA prefix
   from the ISP [RFC6204], [I-D.ietf-v6ops-6204bis].

   Once the CER obtains a GUA prefix, it responds to all DHCPv6 requests
   on its LAN interface. The CER MUST add a route to its routing table
   mapping each delegated prefix to the DHCP client or DHCP relay to
   which it was sent.

3.2. IR Behavior

   Once a home router has determined that it is an Internal Router (IR)
   (e.g. via receipt of the DHCP CER ID Option
   [draft-donley-dhc-cer-id-option] specifying a different router as
   CER) and received an IA_PD on its WAN interface, the IR MUST relay
   DHCPv6 IA_PD requests [RFC3633] received on its LAN interface to the
   delegating router or relay agent from which it received its IA_PD.

   The IR MUST install an entry for IA_PD observed in DHCPv6 Relay
   message in its routing and forwarding tables. This behavior is
   referred to as 'DHCP snooping'. When installing an entry in the
   routing and forwarding tables for the observed IA_PD assignments, the
   IR MUST map the IA_PD to the IR transmitting the request. The IR
   MUST purge the IA_PD entry and the route to the prefix upon IA_PD
   lease expiration.

4. Home Router Provisioning Example

   1.   CER Receives a GUA and IA_PD from the ISP.

   2.   CER configures a /64 on its LAN interface(s) and advertises
        itself as a default router candidate in its RA.

   3.   Directly attached internal routers (Level 1 IRs) install a
        default route based on RAs received from the CER.

   4.   Level 1 IRs initiate DHCPv6 with CER.

        A.   Requests include IA_NA, IA_PD and CER_ID options.

        B.   The CER responds to the IR with an IA_NA, IA_PD (e.g. /64),
             and a CER_ID that contains the CER's LAN IP.

5.   The CER records to which IR each delegated prefix is distributed
      and construct its routing and forwarding tables accordingly
      [RFC3633].

6.   Level 1 IRs (L1IRs) advertise themselves as default router
      candidates via their RAs and indicate whether DHCPv6 information
      is available.

7.   Indirectly attached (e.g. Level 2) IRs initiate DHCPv6.

      A.   Requests include IA_PD and CER_ID options, and may include
           an IA_NA.

      B.   The IR hints for the largest prefix it is capable of
           receiving (e.g. /48).

      C.   The directly upstream IR responds with: IA_NA and a CER_ID
           that contains the CER's LAN IP.

      D.   The directly attached IR relays the IA_PD request to the
           delegating router or relay from which it obtained its IA_PD.

      E.   The CER responds to the IA_PD request with an IR IPv6 Prefix
           (e.g. /64).

      F.   This response is relayed back to the IR via one or more
           relays.

8.   The CER records the IR or DHCPv6 relay to which the delegated
      prefix is distributed and uses the mapping to build its routing
      and forwarding tables.

9.   IRs inspect the contents of all relayed IA_PD response and
      record both the prefix contained and IR/downstream DHCPv6 relay
      the message is sent to. These prefix/address tuples are used to
      construct local routing and forwarding tables.

10.   Indirectly attached IRs advertise themselves as default router
      candidates via their RAs and indicate whether DHCPv6 information
      is available.

11.   Repeat steps 7 through 10 as needed.

5. IANA Considerations

    This document makes no request of IANA.

   Note to RFC Editor: this section may be removed on publication as an
   RFC.

6. Security Considerations

   TBD

7. Acknowledgements

   TBD

8. Normative References

   [I-D.ietf-v6ops-6204bis]
              Stark, B., Donley, C., Singh, H., Troan, O., and W.
              Beebee, "Basic Requirements for IPv6 Customer Edge
              Routers", draft-ietf-v6ops-6204bis-05 (work in progress),
              December 2011.

   [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
              Requirement Levels", BCP 14, RFC 2119, March 1997.

   [RFC3315] Droms, R., Bound, J., Volz, B., Lemon, T., Perkins, C.,
              and M. Carney, "Dynamic Host Configuration Protocol for
              IPv6 (DHCPv6)", RFC 3315, July 2003.

   [RFC3633] Troan, O. and R. Droms, "IPv6 Prefix Options for Dynamic
              Host Configuration Protocol (DHCP) version 6", RFC 3633,
              December 2003.

   [RFC6204] Singh, H., Beebee, W., Donley, C., Stark, B., and O.
              Troan, "Basic Requirements for IPv6 Customer Edge
              Routers", RFC 6204, April 2011.

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