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IPv6 Customer Edge Routers LAN Prefix Delegation

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Abstract

This document defines requirements for IPv6 Customer Edge (CE) routers to support

DHCPv6 Prefix Delegation for distributing unused prefixes that were

delegated to a IPv6 CE router.

This document updates RFC 7084.

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1. Introduction

This document defines requirements for DHCPv6 Prefix Delegation in IPv6 Customer Edge (CE) routers

[RFC7084] in order to properly utilize the IPv6 prefixes assigned

by service providers. Many service providers assign prefixes larger

than /64 to CE routers, as recommended in [RFC6177]. If an IPv6

CE router does not support the Identity Association for Prefix

Delegation (IA\_PD) Prefix Option (Section 21.21 of [RFC8415]) on the LAN, it will not

be able to assign any prefixes beyond its local interfaces, limiting

the usefulness of assigning prefixes larger than /64 by the operator.

Supporting IA\_PD on the LAN interfaces of a CE router will allow those unused

prefixes to be distributed into a network. Note that efforts such as Stub Networking Auto Configuration (SNAC) Working Group

depends on IPv6 prefixes being properly distributed in a LAN.

Two models, hierarchical prefix and flat, were proposed in the

past for prefix sub-delegation beyond an IPv6 CE router.

Hierarchical prefix delegation requires an IPv6 CE router to sub

delegate IPv6 prefixes based on set of rules. If more than one

router uses hierarchical prefix delegation, an IPv6 prefix tree is

created. When no routing protocol is enabled to discover the network

topology, it is possible to have unbalanced prefix delegation tree

which leads to running out of prefixes. More information on

hierarchical prefix delegation can be found, e.g., in Section 8.5 of

CableLabs IPv6 eRouter Specifiction [eRouter]. A flat prefix

delegation requires the router to be provisioned with the initial

prefix and to assign /64 prefixes to all other prefix requests from

routers in the LAN-facing interface.

The flat model is assumed to be used by the default to support zero configuration networking.

The Home Networking Working Group specified solutions for prefix

delegation for home networks, including [RFC7695]. However, these solutions haven't been deployed by service providers or

IPv6 CE routers since the publication, partially due to their

complexity.

This document does not cover dealing with multi-provisioned networks

with more than one service provider. Due to complexity of a solution that

would require routing, provisioning, and policy, this is out of scope

of this document.

2. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",

"SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and

"OPTIONAL" in this document are to be interpreted as described in

BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all

capitals, as shown here.

3. Terminology

The document makes use of the terms defined in Section 4 of [RFC8415] and Section 2 of [RFC7084].

The following terminology is defined for this document.

\* IPv6 CE router: A router intended for home or small-office use

that forwards packets not explicitly addressed to itself as

defined in [RFC7084].

\* Service Provider: An entity that provides access to the Internet

as defined in [RFC7084]

\* ULA: Unique Local Address as defined in [RFC4193].

\* GUA: Global Unique Addresses as defined in [RFC4291].

4. IPv6 End-User Network Architecture

The end-user network that has IPv6 CE routers with routers

and hosts downstream. Figure 1 illustrates the model topology.

+-----------+

| Service |

| Provider |

| Router |

+-----+-----+

|

|

| Customer

| Internet Connection

|

+-----v-----+

| IPv6 |

| CE |

| Router |

+-----+-----+

|

+------+-------+

| |

| |

+---+----+ +-----+------+

| IPv6 | | |

| Host | | Router |

| | | |

+--------+ +------------+

Figure 1: Example IPv6 End User Topology

5. Requirements

IPv6 CE routers distribute configuration information obtained

during WAN interface provisioning to LAN-facing IPv6 hosts and routers.

An [RFC7084]-compliant CE router would only provide IPv6

hosts with configuration information. This allows for addressing and

routing of IPv6 prefixes to both hosts and routers. These

requirements are in addition to the ones in Section 4.3 of [RFC7084].

5.1. LAN Prefix Delegation Requirements (LPD)

LPD-1: IPv6 CE routers MUST support IPv6 prefix assignment

according to [RFC8415] (Identity Association for Prefix

Delegation (IA\_PD) option) on its LAN interfaces.

LPD-2: IPv6 CE routers MUST assign a prefix from the delegated

prefix as specified by L-2 in Section 4.3 of [RFC7084]. If not insufficient

are available the IPv6 CE router SHOULD log a system

management error.

LPD-3: The prefix assigned to a link MUST NOT change in the absence

of topology or configuration changes.

LPD-4: After LAN link prefix assignments, the IPv6 CE router MUST

make the remaining IPv6 prefixes available to other routers

via Prefix Delegation.

LPD-5: IPv6 CE routers MUST install a route to the assigned

IA\_PD with a next-hop of the IPv6 node that was assigned the

prefix. The IPv6 CE router MUST remove the route when IA\_PD

lease expires.

LPD-6: By default, the IPv6 CE router filtering rules MUST allow

forwarding of packets with an outer IPv6 header containing a

source address belonging to Delegated Prefixes, along with

reciprocal packets from the same flow, following the

recommendations of [RFC6092]. This updates WPD-5 of

Section 4.2 of [RFC7084] to not drop packets from prefixes that have been

delegated.

LPD-7: IPv6 CE routers MUST provision IA\_PD prefixes with a

prefix-length of 64 unless configured to use a different prefix

length by a user. The prefix length of 64 is used as that

is the current prefix length supported by SLAAC (see [RFC7421]).

LPD-8: IPv6 CE routers are configured to generate an ULA prefix as

defined in ULA-1 of Section 4.3 of [RFC7084]. after LAN link prefix

assignment of the ULA prefixes the IPv6 CE router MUST make

the remaining IPv6 prefixes available to other routers via

Prefix Delegation.

LPD-9: If an IPv6 CE router is provisioning both ULA and GUA via prefix

delegation, the GUA SHOULD appear first in the packet.

LPD-10: IPv6 CE Routers MUST NOT delegate prefixes via DHCPv6 on the

LAN using lifetimes that exceed the remaining lifetimes of

the corresponding prefixes learned on the WAN.

6. Security Considerations

This document does not add any new security considerations beyond

those mentioned in Section 4 of [RFC8213] and Section 22 of

[RFC8415].

7. IANA Considerations

This document makes no request of IANA.

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