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# RFC 9818
# IPv6 Customer Edge (CE) Routers LAN DHCPv6 Prefix Delegation

## Abstract

This document defines requirements for IPv6 Customer Edge (CE) routers to support DHCPv6 Prefix Delegation for distributing available prefixes that were delegated to a IPv6 CE router. This document updates RFC 7084.

## Status of This Memo

This document is not an Internet Standards Track specification; it is published for informational purposes.

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). Not all documents approved by the IESG are candidates for any level of Internet Standard; see Section 2 of RFC 7841.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at https://www.rfc-editor.org/info/rfc9818.

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## 1. Introduction

This document describes guidelines for DHCPv6 Prefix Delegation in IPv6 Customer Edge (CE) routers [RFC7084] in order to properly utilize the IPv6 prefixes delegated by service providers. Many service providers assign larger address blocks 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 those of the Stub Networking Auto Configuration (SNAC) Working Group depend on IPv6 prefixes being properly distributed in the 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 a 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 an 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 specification [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 default configuration of CE router supporting prefix delegation is designed to be a flat model to support zero-configuration networking.

This document does not cover dealing with multi-provisioned networks with more than one provider. Due to the 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.

This document uses these keywords not strictly for the purpose of interoperability, but rather for the purpose of establishing industry-common baseline functionality. As such, the document points to several other specifications to provide additional guidance to implementers regarding any protocol implementation required to produce a successful CE router that interoperates successfully with a particular subset of currently deployed and planned common IPv6 access networks.

## 3. Terminology

The document makes use of the following terms, some of which are from Section 2 of [RFC8200]

IPv6 node: A device that implements IPv6 protocol.

IPv6 router: An IPv6 node that forwards IPv6 packets not explicitly addressed to itself.

IPv6 host: An IPv6 node that is not a router.

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

GUA: Global Unicast Address, as defined in [RFC4291].

## 4. IPv6 End-User Network Architecture

The end-user network for IPv6 that is a stub network. Figure 1 illustrates the model topology.

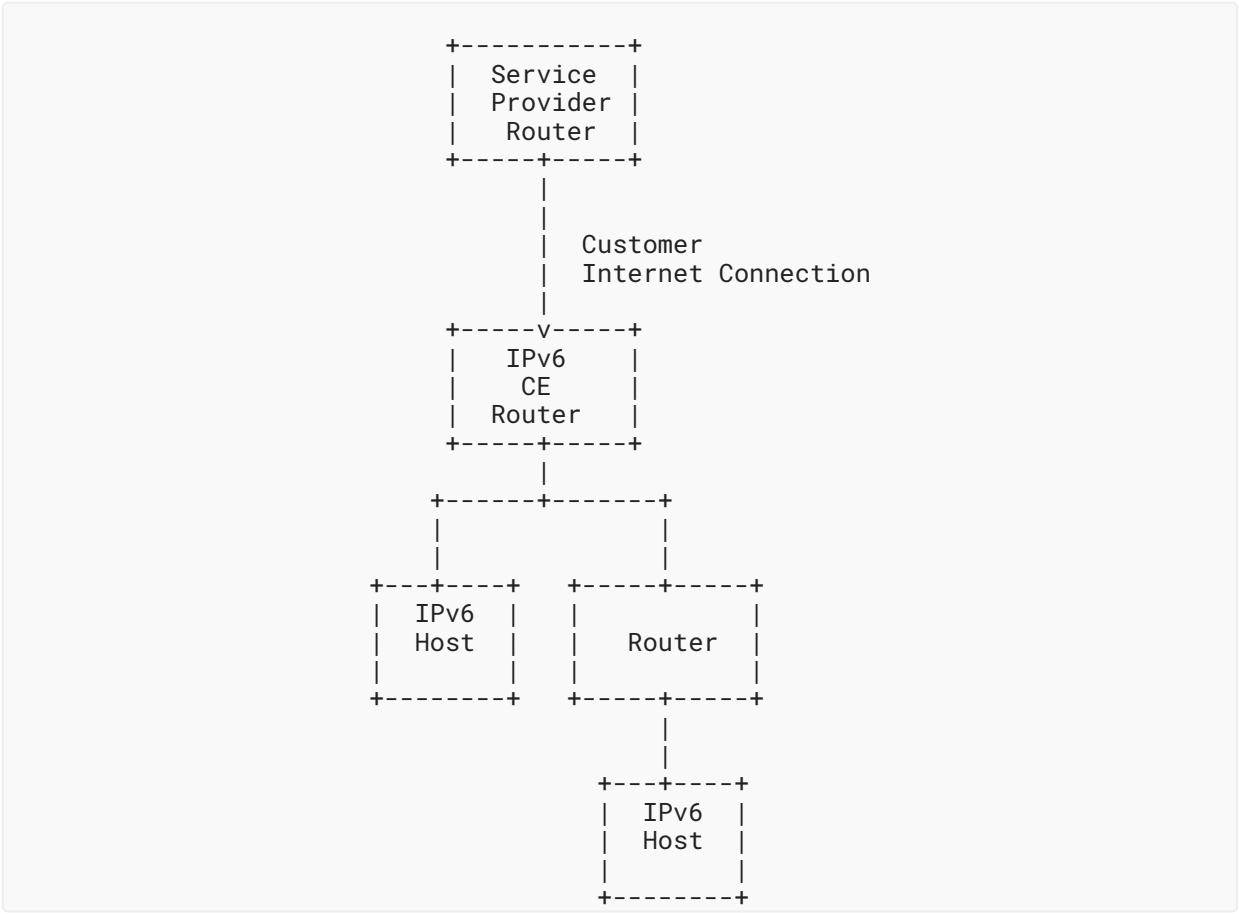


*Figure 1: Example IPv6 End-User Topology*

# 5. Requirements

IPv6 CE routers distribute configuration information obtained during WAN interface provisioning to LAN-facing IPv6 hosts and routers. A CE router that is compliant with [RFC7084] would only provide IPv6 hosts with configuration information. This document 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: Each IPv6 CE router **MUST** support IPv6 prefix assignment according to Section 13.3 of [RFC8415] (Identity Association for Prefix Delegation (IA_PD) option) on its LAN interface(s).

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 insufficient prefixes are available, the IPv6 CE router **MUST** log a system management error.

LPD-3: The prefix assigned to a link **MUST NOT** change in the absence of a local policy or a topology change.

LPD-4: After LAN link prefix assignments, the IPv6 CE router **MUST** keep the remaining IPv6 prefixes available to other routers via Prefix Delegation.

LPD-5: IPv6 CE routers **MUST** maintain a local routing table that is dynamically updated with leases and the associated next hops as they are delegated to clients. When a delegated prefix is released or expires, the associated route **MUST** be removed from the IPv6 CE router's routing table. A delegated prefix expires when the valid lifetime assigned in the IA_PD expires without being renewed. When a prefix is released or expires, it **MUST** be returned the pool of available prefixes.

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 [RFC7084] to not drop packets from prefixes that have been delegated. IPv6 CE routers **MUST** continue to drop packets including destination address that is not assigned to the LAN or delegated.

LPD-7: The IPv6 CE routers **MUST** provision IA_PD prefixes with a prefix-length of 64 on the LAN-facing interface unless configured to use a different prefix-length by the CE router administrator. The prefix length of 64 is used as that is the current prefix length supported by SLAAC [RFC4862]. For hierarchical prefix delegation, a prefix-length shorter than 64 may be configured.

LPD-8: IPv6 CE routers configured to generate a ULA prefix as defined in ULA-1 of Section 4.3 of [RFC7084] **MUST** continue to provision available GUA IPv6 prefixes.

LPD-9: If an IPv6 CE router is provisioning both ULA and GUA via prefix delegation, the GUA **SHOULD** appear first in the DHCPv6 packets.

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], Section 22 of [RFC8415], and Section 6 of [RFC6092].

## 7. IANA Considerations

This document has no IANA actions.

# 8. References

## 8.1. Normative References

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