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Requirements for a Zero-Configuration IPv6 CPE
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Abstract

This note is a breif exploration of what is required for a CPE to be auto-configurable from the perspective on an ISP or other upstream network. It assumes that the CPE may also be IPv4-capable (probably using NAPT), but that the requirements for that are well understood and need no further specification.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on December 19, 2017.

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1. Introduction

We observe that, in today's offerings, "IPv6-capable" has many different meanings. These often require specific configuration and are non-interoperable.

The objective is to enable a customer to purchase a CPE router from a mass market store, or for an ISP to purchase CPE Routers for its managed service offering, that implement IPv6 [RFC2460] and can be attached to any residential/SOHO network and any ISP or other upstream network "as is out of the box", and work correctly.

1.1. 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].

2. Operational Requirements

The goal stated in Section 1 requires that downstream, which is to say within the home or SOHO , the CPE must presume that there may exist systems that will autoconfigure [RFC4862] themselves using information in a Router Advertisement [RFC4861], and that there may exist systems that require address assignment using DHCPv6 [RFC3315]. It may offer a DNS service using a provider such as OpenDNS, Google Public DNS, Amazon Route 53, or some other such service, or relay the address of an ISP-provided DNS server.

Similarly, the stated goal requires that upstream, the CPE must presume that it will be required to solicit and observe a Router Advertisement [RFC4861], and

- o learn an upstream DHCPv6 server address,
- o either autoconfigure [RFC4862] its upstream address or derive one using DHCPv6 [RFC3315],
- o potentially learn an DNS server address from an RDNSS [RFC4339] or from DHCPv6,
- o and allocate IPv6 /64 prefixes for each of its interior subnets using the IPv6 Prefix Options for DHCP [RFC3633].

Given that, it is in a position to offer IPv6 services in the residential/SOHO network depending on the upstream IPv6 capabilities.

3. Expected Behavior

As a result, a CPE needs to perform several steps, and come out of the box configured to do so. These include:

1. Upon detecting the upstream interface as "up", emit a Router Solicitation [RFC4861] on it.
2. If it receives a Router Advertisement [RFC4861], verify its contents. These may include:
    * If the RA contains a valid Prefix Information Option whose prefix is available for autoconfiguration, create an address in that prefix for that interface as specified in SLAAC [RFC4862].
    * Failing that, use DHCPv6 [RFC3315] to request an address from the upstream network.
    * In that same DHCP request, it MAY request an IA_PD [RFC3633] delegation of a set of prefixes as described in Section 4.
3. If it has not already done so, the router should request an IA_PD [RFC3633] delegation of a set of prefixes as described in Section 4.
4. Given an upstream interface and a delegation of prefixes to use downstream, it should
    * subdelegate a /64 prefix to each downstream interface

* allocate an address to each downstream interface using the relevant prefixes

* start announcing a periodic RA on each downstream interface. This RA should include, in addition to usual information elements, the RDNSS [RFC4339].

4. Prefix Delegation

When the CPE requests a set of prefixes from its upstream network, there are several conditions that may apply:

o [RFC4291] and [RFC7421] presume a /64 prefix on each IPv6 subnet.

o Each LAN to which the CPE connects may be presumed to require a subnet - if not immediately, at some point in the future.

o There may be LANs in the residential/SOHO network that are not attached to the CPE, but require subdelegation within the network using DHCPv6 or HNCP [RFC7788].

The IA_PD requests a prefix, and indicates its preference for a "Length for this prefix in bits". By nature, this is exponential: if a home requires 17 subnets, it will require the prefix to be no longer than 59 bits, and therefore technically requesting at least 32 /64 prefixes. In fact, some ISPs have stated privately that they actually allocate prefix lengths of 56, 60, or 64 (and therefore sets of 256, 16, or 1 /64) depending on the CPE's request.

The CPE should request as many as it thinks it might need, including interior sub-delegation if it has an idea of what that may require.

5. IANA Considerations

This memo asks the IANA for no new parameters.

6. Security Considerations

This note describes the use of existing features, each of which has its own Security Considerations, and as such adds no new security vulnerabilities.

7. Privacy Considerations

This memo calls for no personally identifiable information. The data conveyed may, however, be correlatable with other data that is personally identifiable. Such things are beyond the scope of this document.

8. Human Rights Considerations

Technologies described in this memo are not necessarily associated with a human being, and as such violate no human rights.

9. Acknowledgements

10. References

10.1. Normative References

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Appendix A. Change Log

Initial Version: Jun 13 2017

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