IPv6 READY

Phase-2 Interoperability Test Scenario
CPE

Technical Document

Revision 1.0.0b2

IPv6 Forum ***http://www.ipv6forum.org***
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MODIFICATION RECORD

Version 1.0.0b2	March 17, 2011	E. Johnson	• Added Test 1.1 Part E: Router Forwarding (off-link) to cover General Requirement Section 4.1 of [ipv6-cpe-router].
Version 1.0.0b1	February 18, 2011	T. Winters	• Added multiple Prefixes for Prefix Delegation. • Added DHCP Timeout test cases. • Removed LAN2 • Renamed Stateless Autoconfiguration Assignment to Duplicate Address Detection • Renamed Router Advertisement Processing to Address Lifetime. • Added MTU Test Case • TAR-Router1 changed to Relay-Agent and Added a DHCP-Server to Network1. • Removed all-nodes ping test. • Added Appendix • Added Duplicate Address Detection test to LAN. • Added multiple Prefix Lengths to the prefix test. • Removed WAN to LAN No Address Test Case and Address Scope due to CE supporting the setup.
Version 1.0.0a2	February 11, 2011	T. Winters	• Added text to support address assignment for DHCP or SLAAC. • Removed redundant DHCP test cases for the LAN side. • Updated test title to CPEInterop • DNS Test cases now check DNS messages instead of using ping.
Version 1.0.0a1	February 8, 2011	T. Winters	• Created new test scenario.

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INTRODUCTION

Overview

The IPv6 forum plays a major role to bring together industrial actors, to develop and deploy the new generation of IP protocols. Contrary to IPv4, which started with a small closed group of implementers, the universality of IPv6 leads to a huge number of implementations. Interoperability has always been considered as a critical feature in the Internet community. Due to the large number of IPv6 implementations, it is important to give to the market a strong signal proving the interoperability degree of various products.

To avoid confusion in the mind of customers, a unique logo program has been defined. The IPv6 logo gives confidence to users that IPv6 is currently operational. This logo program contributes to the feeling that IPv6 is available and ready to be used.

Abbreviations and Acronyms

CE-Router: Customer Edge Router
CE LAN: CE Router LAN Interface
CE WAN: CE Router WAN Interface
DAD: Duplicate Address Detection
DHCP: Dynamic Host Configuration Protocol
NS: Neighbor Solicitation
NA: Neighbor Advertisement
NCE: Neighbor Cache Entry
NUT: Node Under Test
PD: Prefix Delegation
RA: Router Advertisement
RS: Router Solicitation
TAR: Targeted Device
REF: Reference Device

TEST ORGANIZATION

This document organizes tests by group based on related test methodology or goals. Each group begins with a brief set of comments pertaining to all tests within that group. This is followed by a series of description blocks; each block describes a single test. The format of the description block is as follows:

Test Label: The Test Label and Title comprise the first line of the test block. The Test Label is composed of the short test suite name, the group number, and the test number within the group, separated by periods.

Purpose: The Purpose is a short statement describing what the test attempts to achieve. It is usually phrased as a simple assertion of the feature or capability to be tested.

References: The References section lists cross-references to the specifications and documentation that might be helpful in understanding and evaluating the test and results.

Test Setup: The Test Setup section describes the configuration of all devices prior to the start of the test. Different parts of the procedure may involve configuration steps that deviate from what is given in the test setup. If a value is not provided for a protocol parameter, then the protocol's default is used.

Procedure: This section of the test description contains the step-by-step instructions for carrying out the test. These steps include such things as enabling interfaces, unplugging devices from the network, or sending packets from a test station. The test procedure also cues the tester to make observations, which are interpreted in accordance with the observable results given for that test part.

Observable Results: This section lists observable results that can be examined by the tester to verify that the DUT is operating properly. When multiple observable results are possible, this section provides a short discussion on how to interpret them. The determination of a pass or fail for each test is usually based on how the NUT's behavior compares to the results described in this section.

Possible Problems: This section contains a description of known issues with the test procedure, which may affect test results in certain situations.

REFERENCES

The following documents are referenced in these texts:

[RFC 2460] R. Hinden, S. Deering, Internet Protocol, Version 6 (IPv6) Specification, RFC 2460, December 1998.

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[RFC 3484] R. Draves, Default Address Selection for Internet Protocol version 6 (IPv6), RFC 3484, February 2003.

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

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[RFC 4291] R. Hinden, S. Deering, IP Version 6 Addressing Architecture, RFC 4291, February 2006.

[RFC 4294] J. Loughney, Ed. IPv6 Node Requirements, RFC 4294, April 2006.

[RFC 4443] A. Conta S. Deering, M. Gupta, Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification, RFC 4443, March 2006.

[RFC 4861] T. Narten, E. Nordmark, and W. Simpson, H. Soliman, Neighbor Discovery for IP Version 6 (IPv6), RFC 4861, September 2007.

[RFC 4862] S. Thomson, T. Narten, T. Jinmei, IPv6 Stateless Address Autoconfiguration, RFC 4862, September 2007.

[RFC 5942] H. Singh, W. Beebee, E. Nordmark, RFC 5942, July 2010.

[ipv6-cpe-router] Singh, H., W. Beebee, C. Donley, B. Stark, O. Troan. “Basic Requirements for IPv6 Customer Edge Routers”, draft-ietf-v6ops-ipv6-cpe-router-09. December 2010.

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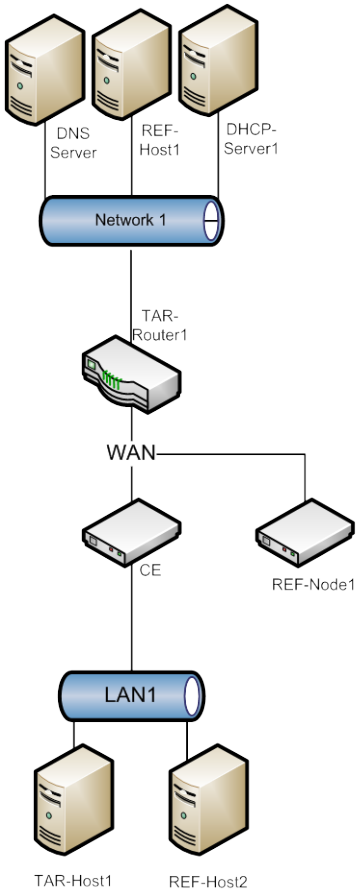
Common Topology

The following is the Common Topology used in all test cases.



Common Test Setup

1. TAR-Router1 assigns global addresses on Network1 to allow DNS-Server and REF-Host1 to have off-link routing.
2. TAR-Router1 has valid routes to LAN1 and LAN2.
3. TAR-Router1 assigns global address to CE on WAN1 using either DHCPv6 or SLAAC.
4. TAR-Router1 is a DHCPv6 Relay Agent for DHCPv6 Server.

Common Test Cleanup

1. Any information retained during the test case should be removed before the next test. (For Example DHCP Information or Neighbor Cache Information).

Common Defaults (for all tests)

Link MTU set to the associated media type default MTU for all nodes on all interfaces.

Section 1: General Requirements

Scope

The following tests cover the general requirements that CE Router must implement.

Overview

The tests in this group verify that a proper IPv6 CE Router implements IPv6 routing; that is, the IPv6 CE router properly looks up IPv6 addresses in the Routing table and sends IPv6 packets to the proper interface. This also verifies that the IPv6 CE Router acts as a proper IPv6 node.

Test CPEInterop.1.1: ICMPv6

Purpose: Verify that an IPv6 CE Router implements IPv6 Node Requirements.

References:

- [RFC 4294]
- [RFC 4443]
- [RFC 4291]
- [ipv6-cpe-router] – 4.1
- [ipv6-cpe-router] – G-1
- [ipv6-cpe-router] – G-2

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part.

- TAR-Router1 assigns global addresses to CE-Router and delegates prefixes for the LAN interfaces.
- CE-Router assigns global addresses to TAR-Host1 using either DHCP or SLAAC.

Procedure:

Part A: Link-Local Address (LAN)

1. Transmit ICMPv6 Echo Request from TAR-Host1 to the link-local address of CE-Router.
2. Observe the packets transmitted on LAN1.
3. Transmit ICMPv6 Echo Request from CE-Router to the link-local address of TAR-Host1.
4. Observe the packets transmitted on LAN1.

Part B: Global Unicast Address (LAN)

5. Transmit ICMPv6 Echo Request from TAR-Host1 to the global address of CE-Router.
6. Observe the packets transmitted on LAN1.
7. Transmit ICMPv6 Echo Request from CE-Router to the global address of TAR-Host1.
8. Observe packets transmitted on LAN1.

Part C: Link-Local Address (WAN)

9. Transmit ICMPv6 Echo Request from TAR-Router1 to the link-local address of CE-Router.
10. Observe the packets transmitted on WAN1.
11. Transmit ICMPv6 Echo Request from CE-Router to the link-local address of TAR-Router1.
12. Observe the packets transmitted on WAN1.

Part D: Global Unicast Address (WAN)

13. Transmit ICMPv6 Echo Request from TAR-Router1 to the global address of CE-Router.
14. Observe the packets transmitted on WAN1.
15. Transmit ICMPv6 Echo Request from CE-Router to the global address of TAR-Router1.
16. Observe the packets transmitted on WAN1.

Part E: Router Forwarding (Off-link)

17. Transmit ICMPv6 Echo Request from TAR-Host1 to the global address of REF-Host1.
18. Observe the packets transmitted on WAN1.

Observable Results:

- *Part A and B*

  Step 2, 6: CE-Router must receive all the ICMPv6 Echo Request sent from TAR-Host1 and respond with ICMPv6 Echo Replies. The Source Address of the Echo Reply must be equal to the Destination Address that was in the Echo Request, and the Destination Address of the Echo Reply must be equal to the Source Address that was in the Echo Request.
  Step 4, 8: TAR-Host1 must receive all the ICMPv6 Echo Request sent from CE-Router and respond with ICMPv6 Echo Replies. The Source Address of the Echo Reply must be equal to the Destination Address that was in the Echo Request, and the Destination Address of the Echo Reply must be equal to the Source Address that was in the Echo Request.
- *Part C and D*

  Step 10, 14: CE-Router must receive all the ICMPv6 Echo Request sent from TAR-Router1 and respond with ICMPv6 Echo Replies. The Source Address of the Echo Reply must be equal to the Destination Address that was in the Echo Request, and the Destination Address of the Echo Reply must be equal to the Source Address that was in the Echo Request.
  Step 12, 16: TAR-Router1 must receive all the ICMPv6 Echo Request sent from CE-Router and respond with ICMPv6 Echo Replies. The Source Address of the Echo Reply must be equal to the Destination Address that was in the Echo Request, and the Destination Address of the Echo Reply must be equal to the Source Address that was in the Echo Request.
- *Part E*

  Step 18: CE-Router must receive the ICMPv6 Echo Request sent from TAR-Host1 and forward the ICMP Echo Request to TAR-Router1 by sending it out its WAN interface. The Source and Destination Address of the Echo Request must not be changed. TAR-Router1 forwards the Echo Reply from REF-Host1 to CE-Router. CE-Router must forward the ICMPv6 Echo Reply to TAR-Host1. The Source and Destination Address of the Echo Reply must not be changed.

Possible Problems:

- A passive node does not implement an application for sending Echo Request.

Test CPEInterop.1.2: Default Address Selection

Purpose: To verify that an IPv6 CE Router implements default address selection properly.

References:

- [RFC 4294]
- [RFC 3484]
- [ipv6-cpe-router] – G-1

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Prefer appropriate scope

1. Transmit ICMPv6 Echo Request from CE-Router to the global address of TAR-Router1.
2. Observe the packets transmitted on WAN1.

Part B: Avoid deprecated addresses

3. Configure TAR-Router1 to distribute Prefix X and Y on WAN1 thru either DHCP or Router Advertisements. Prefix X is configured with a preferred and valid lifetime that last the entire test. Prefix Y is configured with a preferred lifetime shorter then valid lifetime.
4. Wait between the preferred lifetime and valid lifetime of Prefix Y.
5. Transmit ICMPv6 Echo Request from CE-Router to REF-Host1.
6. Observe the packets transmitted on Network1.

Part C: Use longest matching prefix

7. Configure TAR-Router1 to assign two addresses with prefixes of 3000::/64 and 3000:0001::/64 thru either DHCP or Router Advertisements to CE-Router. Allow time for CE-Router to apply both these addresses to the WAN interface.
8. Configure TAR-Router1 to assign a prefix of 3000:0001:0002::/64 on Network1.
9. Transmit ICMPv6 Echo Request from CE-Router to REF-Host1.
10. Observe the packets transmitted on Network1.

Observable Results:

- *Part A*
  Step 2: CE-Router must transmit ICMPv6 Echo Requests using CE-Router's global address as the source address. TAR-Router1 must transmit ICMPv6 Echo Replies to CE-Router.
- *Part B*
  Step 6: CE-Router must transmit ICMPv6 Echo Request using Prefix X source address to TAR-Host1. TAR-Host1 must transmit ICMPv6 Echo Replies to CE-Router.
- *Part C*
  Step 10: CE-Router must transmit ICMPv6 Echo Request using CE-Router's 3000:0001::/64 source address to TAR-Host1. TAR-Host1 must transmit ICMPv6 Echo Replies to CE-Router.

Possible Problems:

- A passive node does not implement an application for sending Echo Request.
- A CE-Router may be unable to configure two addresses on WAN interface, Parts B and C may be omitted.

Test CPEInterop.1.3: IPv6 Forwarding before Address Acquisition.

Purpose: Verify an IPv6 CE Router does not forward any IPv6 Traffic between LAN and WAN interfaces before address acquisition process.

References:

- [ipv6-cpe-router] – G-3

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part. No addresses should be assigned to CE-Router interface WAN1 in all parts.

Procedure:

Part A: LAN to WAN

1. Configure a global address on TAR-Host1.
2. TAR-Host1 transmits an ICMPv6 Echo Request to TAR-Router1 continuously.
3. Reboot CE-Router.
4. Observe the packets transmitted by the NUT.

Part B: WAN to LAN

5. Configure a global address on TAR-Host1.
6. TAR-Router1 transmits an ICMPv6 Echo Request to TAR-Host1 continuously.
7. Reboot CE-Router.
8. Observe the packets transmitted by the NUT.

Observable Results:

- *Part A*

  Step 3: CE-Router must not forward the ICMPv6 Echo Request to TAR-Router1 while it's acquiring an address during the rebooting process.
- *Part B*

  Step 6: CE-Router must not forward the ICMPv6 Echo Request to TAR-Host1 while it's acquiring an address during the rebooting process.

Possible Problems:

- None.

Test CPEInterop.1.4: No Default Route

Purpose: Verify an IPv6 CE Router does not advertise itself as a default route on LAN interfaces when no default route exists on the WAN interface.

References:

- [ipv6-cpe-router] – G-4
- [ipv6-cpe-router] – G-5

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: No Default Route

1. Configure TAR-Router1 transmits a Router Advertisement with a Router Lifetime of 0.
2. TAR-Host1 transmits ICMPv6 Echo Request to REF-Host1.
3. Observe the packets transmitted on LAN1.

Part B: Loses Default Route

4. Configure TAR-Router1 to transmit Router Advertisement with a Router Lifetime of 600.
5. TAR-Host1 transmits ICMPv6 Echo Request to REF-Host1.
6. Observe the packets transmitted on LAN1.
7. Configure TAR-Router1 to transmit Router Advertisement with a Router Lifetime of 0.
8. TAR-Host1 transmits ICMPv6 Echo Request to REF-Host1.
9. Observe the packet transmitted on LAN1.

Observable Results:

- *Part A*

  Step 3: CE-Router must not transmit Router Advertisements with a Router Lifetime greater then zero. TAR-Host1 must not transmit an ICMPv6 Echo Request to REF-Host1.
- *Part B*

  Step 6: TAR-Host1 must transmit an ICMPv6 Echo Request to REF-Host1. REF-Host1 must transmit Echo Replies in response to TAR-Host1.

  Step 9: CE-Router must not transmit Router Advertisements with a Router Lifetime greater than zero. TAR-Host1 must not transmit an ICMPv6 Echo Request to REF-Host1.

Possible Problems:

- None.

Section 2: WAN Side Configuration

Scope

The following tests cover IPv6 CE Router WAN Configuration.

Overview

The tests in this group verify that a node properly supports protocols necessary to access multiple network access architectures. This group is not specific to any particular architecture or Service Provider, and should support all commonly used architectures.

Test CPEInterop.2.1: Duplicate Address Detection

Purpose: Verify an IPv6 CE Router properly assigns addresses to the WAN interface using either stateless or stateful address assignment.

References:

- [ipv6-cpe-router] – W-1
- [ipv6-cpe-router] – W-2
- [ipv6-cpe-router] – WAA-1

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Duplicate Address Detection – Tentative Address Unique (Link-Local)

1. Disable all interfaces connected to WAN1.
2. Enable all interfaces on WAN1, enabling CE-Router before TAR-Router1.
3. Allow time for all devices on WAN1 for all devices to perform Duplicate Address Detection on its link-local address.
4. Transmit ICMPv6 Echo Request from REF-Node1 to the link-local address of CE-Router's WAN1 interface.
5. Observe the packets transmitted on WAN1.
6. Repeat Steps 1 thru 5, but in Step 2 enable TAR-Router1 before CE-Router.
7. Observe the packets transmitted on WAN1.

Part B: Duplicate Address Detection – Tentative Address Duplicated. (Link-Local)

8. Disable all interfaces connected to WAN1.
9. Configure TAR-Router1 to have the same link-local address as CE-Router's WAN1 interface.
10. Enable all interfaces on WAN1, enabling TAR-Router1 before CE-Router.
11. Allow time for all devices on WAN1 to perform Duplicate Address Detection on its link-local address.
12. Transmit ICMPv6 Echo Request from REF-Node1 to the link-local address of CE-Router.
13. Observe the packets transmitted on WAN1.
14. Disable all interfaces connected to WAN1.
15. Enable all interfaces on WAN1, enabling CE-Router before TAR-Router1.
16. Allow time for all devices on WAN1 to perform Duplicate Address Detection on its link-local address.
17. Transmit ICMPv6 Echo Request from REF-Node1 to the link-local address of CE-Router's WAN1 interface.
18. Observe the packets transmitted on WAN1.

Part C: Duplicate Address Detection – Tentative Address Unique (Global)

19. Disable all interfaces connected to WAN1.
20. Enable all interfaces on WAN1, enabling CE-Router before REF-Node1.
21. Assign addresses thru DHCPv6 or Router Advertisement. Allow time for all devices on WAN1 to perform Duplicate Address Detection on global addresses.
22. Transmit ICMPv6 Echo Request from TAR-Router1 to the global address of CE-Router's WAN1 interface.

23. Observe the packets transmitted on WAN1.
24. Repeat Steps 20 thru 24, but in Step 21 enable TAR-Router1 before CE-Router.
25. Observe the packets transmitted on WAN1.

Part D: Duplicate Address Detection – Tentative Address Duplicated (Global)

26. Disable all interfaces connected to WAN1.
27. Configure TAR-Router1 to have the same global address as CE-Router.
28. Enable all interfaces on WAN1, enabling TAR-Router1 before CE-Router.
29. Allow time for all devices on WAN1 to perform Duplicate Address Detection on its global address.
30. Transmit ICMPv6 Echo Request from REF-Node1 to the global address of CE-Router.
31. Observe the packets transmitted on WAN1.
32. Disable all interfaces connected to WAN1.
33. Enable all interfaces on WAN1, enabling CE-Router before TAR-Router1.
34. Allow time for all devices on WAN1 to perform Duplicate Address Detection on its global address.
35. Transmit ICMPv6 Echo Request from REF-Node1 to the global address of CE-Router's WAN1 interface.
36. Observe the packets transmitted on WAN1.

Observable Results:

- *Part A*
  Step 5: CE-Router must respond to all ICMPv6 Echo Requests from REF-Node1 with ICMPv6 Echo Replies.
  Step 7: CE-Router must respond to all ICMPv6 Echo Requests from REF-Node1 with ICMPv6 Echo Replies.
- *Part B*
  Step 13: TAR-Router1 must respond to all ICMPv6 Echo Requests from REF-Node1 with ICMPv6 Echo Replies.
  Step 18: CE-Router must respond to all ICMPv6 Echo Requests from REF-Node1 with ICMPv6 Echo Replies.
- *Part C*
  Step 23: CE-Router must respond to all ICMPv6 Echo Requests from REF-Node1 with ICMPv6 Echo Replies.
  Step 25: CE-Router must respond to all ICMPv6 Echo Requests from REF-Node1 with ICMPv6 Echo Replies.
- *Part D*
  Step 31: TAR-Router1 must respond to all ICMPv6 Echo Requests from REF-Node1 with ICMPv6 Echo Replies.
  Step 36: CE-Router must respond to all ICMPv6 Echo Requests from REF-Node1 with ICMPv6 Echo Replies.

Possible Problems:

- Part B may be omitted if TAR-Router1 is not able to configure the link-local address.
- Link Layer technology may prevent running Part D.

Test CPEInterop.2.2: Router Discovery

Purpose: Verify an IPv6 CE Router properly initializes interfaces and discovers route information.

References:

- [ipv6-cpe-router] – W-2
- [ipv6-cpe-router] – W-3

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part. Configure TAR-Router1 assigns global address to CE-Router on WAN1 using either DHCP or SLAAC.

Procedure:

1. Reboot CE-Router.
2. Observe the packets transmitted on WAN1.
3. Allow time for CE-Router to obtain a global address thru either DHCP or Router Advertisements.
4. REF-Host1 transmits an ICMPv6 Echo Request to CE-Router's WAN1 interface.
5. Observe the packets transmitted on WAN1.

Observable Results:

Step 2: CE-Router must complete DAD before transmitting Router Solicitations. Router Solicitations must be transmitted and must have a link-local source address.
Step 5: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.

Possible Problems:

- None.

Test CPEInterop.2.3: Address Lifetime

Purpose: Verify an IPv6 CE Router properly processes Router Advertisements.

References:

- [ipv6-cpe-router] – WAA-2
- [ipv6-cpe-router] – WAA-6
- [RFC 5942]
- [RFC 3315]

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part. No addresses should be assigned to CE-Router on WAN1 for the beginning of each part.

Procedure:

Part A: Lifetime expires

1. Configure TAR-Router1 to transmit Router Advertisements with one prefix (valid lifetime = 30 sec) on WAN1 or DHCP-Server1 assigns an address with a valid lifetime of 30 seconds. Allow time for CE-Router to perform Duplicate Address Detection.
2. Transmit an ICMPv6 Echo Request from REF-Host1 to the global address of CE-Router.
3. Observe the packets transmitted on WAN1.
4. Suppress Router Advertisements on TAR-Router1 or DHCP-Server1 to not answer DHCPv6 Renew from CE-Router. Allow 35 seconds to pass.
5. Transmit an ICMPv6 Echo Request from REF-Host1 to the global address of CE-Router.
6. Observe the packets transmitted on WAN1.

Part B: Multiple Prefix Discovery

7. Configure TAR-Router1 to transmit Router Advertisements with two prefixes: Prefix X, Prefix Y (valid lifetimes > 0) on WAN1. Allow time for CE-Router to performs Duplicate Address Detection.
8. Transmit an ICMPv6 Echo Request from REF-Host1 to the global address of CE-Router associated with Prefix X.
9. Observe the packets transmitted on WAN1.
10. Transmit an ICMPv6 Echo Request from REF-Host1 to the global address of CE-Router associated with Prefix Y.
11. Observe the packets transmitted on WAN1.

Part C: L-Flag processing

12. Configure TAR-Router1 to transmit Router Advertisements with one prefix (valid lifetime = 30 sec) and WAN1 and the L-flag clear and allow time for CE-Router to perform Duplicate Address Detection.
13. Transmit an ICMPv6 Echo Request from TAR-Router1 to the global address of CE-Router.
14. Observe the packets transmitted on WAN1.

Observable Results:

- *Part A*

Step 3: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
Step 6: CE-Router must respond not respond to ICMPv6 Echo Request from REF-Host1.

- *Part B*
  Step 9: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies associated with Prefix X.
  Step 11: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies associated with Prefix Y.
- *Part C*
  Step 15: CE-Router must respond not respond to ICMPv6 Echo Requests from TAR-Router1 with ICMPv6 Echo Replies.

Possible Problems:

- Part B and C may be omitted if a device only supports DHCP assignment on the interface.
- Some access technologies will prevent the routing of deprecated addresses therefore these test cases may be omitted.

Test CPEInterop.2.4: DHCPv6

Purpose: Verify an IPv6 CE Router properly supports DHCPv6 Client on the WAN interface.

References:

- [ipv6-cpe-router] – W-6
- [ipv6-cpe-router] – WAA-3
- [ipv6-cpe-router] – WAA-4
- [RFC 3315]
- [RFC 3646]

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part.

In all parts perform the following steps before every test case.

- Disable CE on WAN1.
- Configure TAR-Router1 to transmit Router Advertisements with the M-flag set to 1.
- Configure TAR-Router1 to be a DHCP Server.

Procedure:

Part A: Initialization

1. Enable CE-Router on WAN1.
2. Observe the packets transmitted on WAN1.
3. REF-Host1 transmits ICMPv6 Echo Request to CE-Router global address.
4. Observe the packets transmitted on WAN1.

Part B: Confirm messages

5. Enable CE-Router on WAN1.
6. Observe the packets transmitted on WAN1.
7. REF-Host1 transmits ICMPv6 Echo Request to CE-Router global address.
8. Observe the packets transmitted on WAN1.
9. Reboot CE-Router.
10. Observe the packets transmitted on WAN1.
11. REF-Host1 transmits ICMPv6 Echo Request to CE-Router global address.
12. Observe the packets transmitted on WAN1.

Part C: Renew message

13. Enable CE-Router on WAN1.
14. CE-Router should have received IPv6 address information from DHCP-Server1. DHCP-Server1 assigns the T1 and T2 parameters to the CE-Router IA (DHCP-Server1 set T1 to 50s and T2 80s).
15. After time T1 observe the messages transmitted on WAN1.
16. REF-Host1 transmits an ICMPv6 Echo Request to CE-Router global address.
17. Observe the packets transmitted on WAN1.

Part D: Rebind message

18. Enable CE-Router on WAN1.
19. Allow enough time for the CE-Router to receive IPv6 address information from TAR-Router1. The TAR-Router1 assigns the T1 and T2 parameters to CE-Router IA_NA (the TAR-Router1 set T1 to 50s and T2 to 80s).

20. Disable DHCP-Server1.
21. After time T2 (80s after the Reply message), observe the messages transmitted on WAN1.
22. Enable DHCP-Server1 and confirm that CE-Router address is renewed on the next rebind.
23. REF-Host1 transmits an ICMPv6 Echo Request to the CE-Router global address.
24. Observe the packets transmitted on WAN1.

Part E: Release Message

25. Enable CE-Router on WAN1. Allow enough time for CE-Router to receive IPv6 address information from DHCP-Server1.
26. Configure CE-Router to release the IPv6 global address.
27. Observe the packets transmitted on WAN1.
28. REF-Host1 transmits an ICMPv6 Echo Request to the CE-Router global address.
29. Observe the packets transmitted on WAN1.

Part F: Decline Message

30. Configure DHCP-Server1 to only assign REF-Node1 address to CE-Router.
31. Enable CE-Router on WAN1. Allow enough time for CE-Router to receive IPv6 address information from DHCP-Server1.
32. Observe the packets transmitted on WAN1.

Part G: DNS Recursive Name Server Option

33. Configure DHCP-Server1 to include a DNS Recursive Name Server option that includes DNS-Server global IPv6 address.
34. Enable CE-Router on WAN1. Allow enough time for CE-Router to receive IPv6 address information from DHCP-Server1.
35. CE-Router transmits an ICMPv6 Echo Request to “dhcpv6.test.example.com”.
36. Observe the packets transmitted on WAN1.

Part H: Domain Search List Option

37. Configure DHCP-Server1 to include a DNS Recursive Name Server option that includes DNS-Server global IPv6 address as the name server and a Domain Search List option that includes “test.example.com”.
38. Enable CE-Router on WAN1. Allow enough time for CE-Router to receive IPv6 address information from DHCP-Server1.
39. CE-Router transmits an ICMPv6 Echo Request to “dhcpv6”.
40. Observe the packets transmitted on WAN1.

Part I: DUID persistent

41. Enable CE-Router on WAN1.
42. Observe the packets transmitted on WAN1.
43. Reboot CE-Router.
44. Observe the packets transmitted on WAN1.

Part J: Timeout

45. Enable CE-Router on WAN1.
46. Allow enough time for the CE-Router to receive IPv6 address information from TAR-Router1. The TAR-Router1 assigns the T1 and T2 parameters to CE-Router IA_NA (the TAR-Router1 set T1 to 50s and T2 to 80s).
47. Disable DHCP-Server1.
48. After time T2 (80s after the Reply message), observe the messages transmitted on WAN1.
49. REF-Host1 transmits an ICMPv6 Echo Request to the CE-Router global address.
50. Observe the packets transmitted on WAN1.

Observable Results:

- *Part A*

  Step 2: CE-Router must transmit a DHCPv6 Solicit message including a Reconfigure Accept Option. DHCP-Server1 sends a DHCPv6 Advertisement message with the IPv6 address information included. CE-Router sends a DHCPv6 Request messages to confirm the IPv6 address and ask for additional information. DHCP-Server1 responds with a DHCPv6 Reply message that contains the confirmed address.
  Step 4: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
- *Part B*

  Step 6: CE-Router performs duplicate address detection on each of the addresses in the IAs it receives in the DHCPv6 Reply message from TAR-Router1.
  Step 8: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
  Step 10: CE-Router transmits a DHCPv6 Confirm message to TAR-Router1. TAR-Router1 responds with a DHCPv6 Reply message without a status code option or with a status code option including a status code of 0 (Success) stating that the addresses are appropriate for the link. The DHCPv6 Reply message does not contain an IA_NA Option.
  Step 12: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
- *Part C*

  Step 15: CE-Router transmits its first DHCPv6 Renew message T1 (50) seconds after the reception of the DHCPv6 Reply message from TAR-Router1. TAR-Router1 transmits a properly formatted Reply message in response to the DHCP Renew message.
  Step 17: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
- *Part D*

  Step 21: CE-Router transmits a DHCPv6 Rebind Message.
  Step 24: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
- *Part E*

  Step 27: CE-Router transmits a DHCPv6 Release Message.
  Step 29: CE-Router must not respond to any ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
- *Part F*

  Step 33: CE-Router transmits a DAD NS for its global address. DHCP-Server1 transmits a solicited NA in response to the DAD NS with non-unique tentative address. CE-Router transmits a DHCPv6 Decline message. DHCP-Server transmits a DHCPv6 Reply message.
- *Part G*

  Step 37: TAR-Host must transmit a valid DNS request to DNS-Server1. DNS-Server1 must transmit a valid DNS response.
- *Part H*

  Step 41: TAR-Host must transmit a valid DNS request to DNS-Server1. DNS-Server1 must transmit a valid DNS response.
- *Part I*

  Step 43: CE-Router sends a DHCPv6 Request messages to confirm the IPv6 address and ask for additional information. DHCP-Server1 responds with a DHCPv6 Reply message that contains the confirmed address.

Step 45: CE-Router sends a DHCPv6 Request messages to confirm the IPv6 address. The DHCPv6 Request message must contain the same DUID has in Step 43. DHCP-Server1 responds with a DHCPv6 Reply message that contains the confirmed address.

- *Part J*

  Step 48: CE-Router transmits a DHCPv6 Rebind Message.
  Step 50: CE-Router must not respond to ICMPv6 Echo Requests from REF-Host1.

Possible Problems:

- DHCP Confirm and Release messages may not be triggered by a reboot. Other methods such as unplugging the interfaces can be used.
- The recommend behavior is to support DHCPv6 Confirm message when may have moved links. If a device doesn't support the Confirm, the device must restart the DHCPv6 Discovery process. Part B may be omitted.
- Some access technologies will prevent the routing of deprecated addresses therefore Part J may be omitted.

Test CPEInterop.2.5: DHCPv6 Prefix Delegation

Purpose: Verify an IPv6 CE Router properly supports prefix delegation.

References:

- [ipv6-cpe-router] – W-4
- [ipv6-cpe-router] – WPD-1
- [ipv6-cpe-router] – WPD-2
- [ipv6-cpe-router] – WPD-3
- [ipv6-cpe-router] – WPD-4

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part.

In all parts perform the following steps before every test case.

- Configure TAR-Router1 to transmit Router Advertisements with the M-flag set to 1.
- Configure TAR-Router1 to be a DHCP PD Server.
- Disable DHCPv6 on all devices after test.
- Configure TAR-Router1 timer T1 to 50s and T2 to 80s.

Procedure:

Part A: Prefix Delegation

1. Configure CE-Router to enable DHCPv6-PD.
2. Observe the packets transmitted on WAN1.
3. Wait for timer T1 (50s) to expire.
4. Observe the packets transmitted on WAN1.

Part B: Renew Message

5. Configure CE-Router to enable DHCPv6-PD.
6. Observe the packets transmitted on WAN1.
7. CE-Router receives IPv6 prefix information from DHCP-Server1. DHCP-Server1 assigns the T1 and T2 parameters to CE-Router IA_PD (TAR-Router1 sets T1 to 50s and T2 to 80s).
8. Wait for timer T1 (50s) to expire.
9. Observe the packets transmitted on WAN1.
10. Wait for timer T1 (50s) to expire.
11. Observe the packets transmitted on WAN1.

Part C: Rebind Message

12. Configure CE-Router to enable DHCPv6-PD.
13. Observe the packets transmitted on WAN1.
14. CE-Router receives IPv6 prefix information from DHCP-Server1. DHCP-Server1 assigns the T1 and T2 parameters to CE-Router IA_PD (TAR-Router1 sets T1 to 50s and T2 to 80s).
15. Disable DHCP-Server1.
16. Wait for timer T2 (80s) to expire and re-enable DHCP-Server1.
17. Observe the packets transmitted on WAN1.
18. Wait for timer T1 (50s) to expire.
19. Observe the packets transmitted on WAN1.

Part D: Release Message

20. Configure CE-Router to enable DHCPv6-PD.
21. Observe the packets transmitted on WAN1.
22. CE-Router receives IPv6 prefix information from DHCP-Server1. DHCP-Server1 assigns the T1 and T2 parameters to CE-Router IA_PD (DHCP-Server1 sets T1 to 50s and T2 to 80s).
23. Configure CE-Router to release the IPv6 Prefix.
24. Observe the packets transmitted on WAN1.
25. Wait for time T1 (50s) to expire.
26. Observe the packets transmitted on WAN1.

Part E: Hint

27. Configure CE-Router to enable DHCPv6-PD.
28. Observe the packets transmitted on WAN1.
29. DHCP-Server1 transmits a Reply message with a prefix different then the hint in the DHCPv6 Request message from CE-Router.
30. Wait for timer T1 (50s) to expire.
31. Observe the packets transmitted on WAN1.

Part F: M and O Flag

32. Configure TAR-Router1 to transmit Router Advertisement with the M and O flag set to zero.
33. Configure CE-Router to enable DHCPv6-PD.
34. Observe the packets transmitted on WAN1.

Part G: Timeout

35. Configure CE-Router to enable DHCPv6-PD.
36. CE-Router receives IPv6 prefix information from DHCP-Server1. DHCP-Server1 assigns the T1 and T2 parameters to CE-Router IA_PD (DHCP-Server1 sets T1 to 50s and T2 to 80s).
37. Disable DHCP-Server1.
38. After time T2 (80s after the Reply message), observe the messages transmitted on WAN1.
39. REF-Host1 transmits an ICMPv6 Echo Request to the CE-Router global address.
40. Observe the packets transmitted on WAN1.

Observable Results:

- *Part A*

  Step 2: CE-Router transmits a valid DHCPv6 Solicit Message. DHCP-Server1 transmits a valid DHCPv6 Advertise Message to CE-Router. CE-Router transmits a valid DHCPv6 Request Message. DHCP-Server1 transmits a valid DHCPv6 Reply message to CE-Router.
  Step 4: CE-Router transmits a valid DHCPv6 Renew Message with the same prefix as given in the DHCPv6 Reply message in step 2.
- *Part B*

  Step 6: CE-Router transmits a valid DHCPv6 Solicit Message. DHCP-Server1 transmits a valid DHCPv6 Advertise Message to CE-Router. CE-Router transmits a valid DHCPv6 Request Message. DHCP-Server1 transmits a valid DHCPv6 Reply message to CE-Router.
  Step 9: CE-Router transmits a valid DHCPv6 Renew message with the same prefix as given in DHCPv6 Reply Message from Step 6. DHCP-Server1 transmits a valid DHCP Reply message with status of success.
  Step 11: CE-Router transmits a valid DHCPv6 Renew message with the same prefix as given in the DHCPv6 Reply message from steps 6 and 9.
- *Part C*

Step 13: CE-Router transmits a valid DHCPv6 Solicit Message. DHCP-Server1 transmits a valid DHCPv6 Advertise Message to CE-Router. CE-Router transmits a valid DHCPv6 Request Message. DHCP-Server1 transmits a valid DHCPv6 Reply message to CE-Router.
Step 17: CE-Router transmits a valid DHCPv6 Rebind message with the same prefix as given in DHCPv6 Reply Message from Step 13.
Step 19: CE-Router transmits a valid DHCPv6 Rebind message with the same prefix as given in the DHCPv6 Reply message from steps 13 and 17.

- *Part D*

  Step 21: CE-Router transmits a valid DHCPv6 Solicit Message. DHCP-Server1 transmits a valid DHCPv6 Advertise Message to CE-Router. CE-Router transmits a valid DHCPv6 Request Message. TAR-Router1 transmits a valid DHCPv6 Reply message to CE-Router.
  Step 24: CE-Router transmits a valid DHCPv6 Release message with the same prefix as given in DHCPv6 Reply Message from Step 21.
  Step 26: CE-Router transmits a valid DHCPv6 Release message with the same prefix as given in the DHCPv6 Reply message from steps 21 and 24.

- *Part E*

  Step 28: CE-Router transmits a valid DHCPv6 Solicit Message. DHCP-Server1 transmits a valid DHCPv6 Advertise Message to CE-Router. CE-Router transmits a valid DHCPv6 Request Message.
  Step 31: CE-Router transmits a valid DHCPv6 Renew Message with the same prefix as given in the DHCPv6 Reply message in step 2.

- *Part F*

  Step 34: CE-Router transmits a valid DHCPv6 Solicit Message. DHCP-Server1 transmits a valid DHCPv6 Advertise Message to CE-Router. CE-Router transmits a valid DHCPv6 Request Message. DHCP-Server1 transmits a valid DHCPv6 Reply message to CE-Router.

- *Part G*

  Step 38: CE-Router transmits a DHCPv6 Rebind Message.
  Step 40: CE-Router must not respond to ICMPv6 Echo Requests from REF-Host1.

Possible Problems:

- Part E may be omitted if the CE-Router doesn't support DHCP-PD hints.
- DHCP Release message may not be triggered by a reboot. Other methods such as unplugging the interfaces can be used.

Test CPEInterop.2.6: Address Scope

Purpose: Verify an IPv6 CE Router properly follows the weak host model when no suitable scope exist for a source address.

References:

- [ipv6-cpe-router] – WAA-9

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part.

Procedure:

1. Configure TAR-Router1 is configured to transmit Router Advertisement with no prefixes. DHCP-Server1 is not configured to give out DHCP addresses.
2. Configure CE-Router to enable DHCPv6-PD.
3. Observe the packets transmitted on WAN1.
4. REF-Host1 transmits an ICMPv6 Echo Request to CE-Router LAN interface.
5. Observe the packets transmitted on WAN1.

Observable Results:

Step 3: CE-Router transmits a valid DHCPv6 Solicit Message. DHCP-Server1 transmits a valid DHCPv6 Advertise Message to CE-Router. CE-Router transmits a valid DHCPv6 Request Message. DHCP-Server1 transmits a valid Reply message to CE-Router.
Step 5: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.

Possible Problems:

- None.

Test CPEInterop.2.7: Forwarding Loops

Purpose: Verify an IPv6 CE Router properly prevents routing loops by discarding packets that match aggregate routes in the delegated prefixes.

References:

- [ipv6-cpe-router] – WPD-6

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part.

Procedure:

1. Configure DHCP-Server1 to delegate a prefixes larger than CE-Router can delegate.
2. Configure CE-Router to enable DHCPv6-PD.
3. Observe the packets transmitted on WAN1.
4. TAR-Host1 transmits ICMPv6 Echo Request to an address that was not assigned to a LAN interface on the CE-Router.
5. Observe the packets transmitted on WAN1.

Observable Results:

Step 3: CE-Router transmits a valid DHCPv6 Solicit Message. DHCP-Server1 transmits a valid DHCPv6 Advertise Message to CE-Router. CE-Router transmits a valid DHCPv6 Request Message. DHCP-Server transmits a valid DHCPv6 Reply message to CE-Router.
Step 5: CE-Router should not transmit any ICMPv6 Echo Request to TAR-Router1. CE-Router should transmit an ICMPv6 Destination Unreachable message to TAR-Host1.

Possible Problems:

- None.

Test CPEInterop.2.8: Dynamic Routing Protocols

Purpose: Verify an IPv6 CE Router does not initiate a dynamic routing protocol on the WAN interface.

References:

- [ipv6-cpe-router] – WPD-8

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part.

Procedure:

1. Reboot CE-Router.
2. Observe the packets transmitted by the NUT.

Observable Results:

Step 2: CE-Router must not initiate any dynamic routing protocols on the WAN interface.

Possible Problems:

- None.

Section 3: LAN Side Configuration

Scope

The following tests cover IPv6 CE Router LAN side Configuration.

Overview

The tests in this group verify that a node properly distributes configuration information obtained from the WAN interface to IPv6 hosts. It also verifies that support connectivity of IPv6 host in the absence of any working WAN interface.

Test CPEInterop.3.1: Duplicate Address Detection and Neighbor Discovery

Purpose: Verify an IPv6 CE Router properly assigns addresses to the LAN interface using either stateless or stateful address assignment.

References:

- [ipv6-cpe-router] – G-1
- [ipv6-cpe-router] – L-1

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Duplicate Address Detection – Tentative Address Unique (Link-Local)

1. Disable all interfaces connected to LAN1.
2. Enable all interfaces on LAN1, enabling CE-Router before TAR-Host1.
3. Allow time for all devices on LAN1 for all devices to perform Duplicate Address Detection on its their link-local addresses.
4. Transmit ICMPv6 Echo Request from REF-Host2 to the link-local address of CE-Router's LAN1 interface.
5. Observe the packets transmitted on LAN1.
6. Repeat Steps 1 thru 5, but in Step 2 enable TAR-Host1 before CE-Router.
7. Observe the packets transmitted on LAN1.

Part B: Duplicate Address Detection – Tentative Address Duplicated. (Link-Local)

8. Disable all interfaces connected to LAN1.
9. Configure TAR-Host1 to have the same link-local address as CE-Router.
10. Enable all interfaces on LAN1, enabling CE-Router before TAR-Host1.
11. Allow time for all devices on LAN1 to perform Duplicate Address Detection on their link-local address.
12. Transmit ICMPv6 Echo Request from REF-Host2 to the link-local address of CE-Router's LAN1 interface.
13. Observe the packets transmitted on LAN1.
14. Disable all interfaces connected to LAN1.
15. Enable all interfaces on LAN1, enabling TAR-Host1 before CE-Router.
16. Allow time for all devices on LAN1 to perform Duplicate Address Detection on their link-local address.
17. Transmit ICMPv6 Echo Request from REF-Host2 to the link-local address of CE-Router's LAN1 interface.
18. Observe the packets transmitted on LAN1.

Part C: Duplicate Address Detection – Tentative Address Unique (Global)

19. Disable all interfaces connected to LAN1.
20. Enable all interfaces on LAN1, enabling CE-Router before TAR-Host1.
21. Assign addresses thru DHCPv6 or Router Advertisement. Allow time for all devices on LAN1 to perform Duplicate Address Detection on global addresses.
22. Transmit ICMPv6 Echo Request from REF-Host2 to the global address of CE-Router's LAN1 interface.

23. Observe the packets transmitted on LAN1.
24. Repeat Steps 19 thru 23, but in Step 20 enable TAR-Host1 before CE-Router.
25. Observe the packets transmitted on LAN1.

Part D: Duplicate Address Detection – Tentative Address Duplicated (Global)

26. Disable all interfaces connected to LAN1.
27. Configure TAR-Host1 to have the same global address as CE-Router.
28. Enable all interfaces on LAN1, enabling CE-Router before TAR-Host1.
29. Allow time for all devices on LAN1 to perform Duplicate Address Detection on its global address.
30. Transmit ICMPv6 Echo Request from REF-Host2 to the global address of CE-Router.
31. Observe the packets transmitted on LAN1.
32. Disable all interfaces connected to LAN1.
33. Enable all interfaces on LAN1, enabling TAR-Host1 before CE-Router.
34. Allow time for all devices on WAN1 to perform Duplicate Address Detection on its global address.
35. Transmit ICMPv6 Echo Request from REF-Host2 to the global address of CE-Router's WAN interface.
36. Observe the packets transmitted on WAN1.

Observable Results:

- *Part A*
  Step 5: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host2 with ICMPv6 Echo Replies.
  Step 7: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host2 with ICMPv6 Echo Replies.
- *Part B*
  Step 13: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host2 with ICMPv6 Echo Replies.
  Step 19: TAR-Host1 must respond to all ICMPv6 Echo Requests from REF-Host2 with ICMPv6 Echo Replies.
- *Part C*
  Step 24: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host2 with ICMPv6 Echo Replies.
  Step 26: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host2 with ICMPv6 Echo Replies.
- *Part D*
  Step 32: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host2 with ICMPv6 Echo Replies.
  Step 37: TAR-Host1 must respond to all ICMPv6 Echo Requests from REF-Host2 with ICMPv6 Echo Replies.

Possible Problems:

- Part B may be omitted if TAR-Router1 is not able to configure the link-local address.
- Link Layer technology may prevent running Part D.

Test CPEInterop.3.2: Assigning Prefixes to LAN Interfaces

Purpose: Verify an IPv6 CE Router properly assigns /64 address from prefix delegation to LAN interfaces.

References:

- [ipv6-cpe-router] – L-2

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Prefix Length of /64

1. Configure DHCP-Server1 to assign a /64 prefix thru Prefix Delegation.
2. CE-Router enables DHCPv6-PD.
3. Observe the packets transmitted on WAN1.
4. Allow time for address configuration and transmission of Router Advertisements on LAN1.
5. Observe the packets transmitted on LAN1.
6. TAR-Host1 transmits ICMPv6 Echo Request to CE-Router's global address on LAN1.
7. Observe the packets transmitted on LAN1.
8. TAR-Host transmits ICMPv6 Echo Request to REF-Host1.
9. Observe the packets transmitted on LAN1 and WAN1.

Part B: Prefix Length of /60

10. Configure DHCP-Server1 to assign a /60 prefix thru Prefix Delegation.
11. CE-Router enables DHCPv6-PD.
12. Observe the packets transmitted on WAN1.
13. Allow time for address configuration and transmission of Router Advertisements on LAN1.
14. Observe the packets transmitted on LAN1.
15. TAR-Host1 transmits ICMPv6 Echo Request to CE-Router's global address on LAN1.
16. Observe the packets transmitted on LAN1.
17. TAR-Host transmits ICMPv6 Echo Request to REF-Host1.
18. Observe the packets transmitted on LAN1 and WAN1.

Part C: Prefix Length of /52

19. Configure DHCP-Server1 to assign a /52 prefix thru Prefix Delegation.
20. CE-Router enables DHCPv6-PD.
21. Observe the packets transmitted on WAN1.
22. Allow time for address configuration and transmission of Router Advertisements on LAN1.
23. Observe the packets transmitted on LAN1.
24. TAR-Host1 transmits ICMPv6 Echo Request to CE-Router's global address on LAN1.
25. Observe the packets transmitted on LAN1.
26. TAR-Host transmits ICMPv6 Echo Request to REF-Host1.
27. Observe the packets transmitted on LAN1 and WAN1.

Observable Results:

- *Part A*

Step 3: CE-Router transmits a valid DHCPv6 Solicit Message. DHCP-Server1 transmits a valid DHCPv6 Advertise Message to CE-Router. CE-Router transmits a valid DHCPv6 Request Message. DHCP-Server1 transmits a valid DHCP Reply message to CE-Router.
Step 5: CE-Router must perform Duplicate Address Detection for addresses assigned to its interfaces. CE-Router must transmit Router Advertisements with prefix assigned in Step 1.
Step 7: CE-Router must respond to all ICMPv6 Echo Requests from TAR-Host1 with ICMPv6 Echo Replies.
Step 9: REF-Host1 must respond to all ICMPv6 Echo Requests from TAR-Host1 with ICMPv6 Echo Replies.

- *Part B*

  Step 12: CE-Router transmits a valid DHCPv6 Solicit Message. DHCP-Server1 transmits a valid DHCPv6 Advertise Message to CE-Router. CE-Router transmits a valid DHCPv6 Request Message. DHCP-Server1 transmits a valid DHCP Reply message to CE-Router.
  Step 14: CE-Router must perform Duplicate Address Detection for addresses assigned to interfaces. CE-Router must transmit Router Advertisements with prefix assigned in Step 10.
  Step 16: CE-Router must respond to all ICMPv6 Echo Requests from TAR-Host1 with ICMPv6 Echo Replies.
  Step 18: REF-Host1 must respond to all ICMPv6 Echo Requests from TAR-Host1 with ICMPv6 Echo Replies.

- *Part C*

  Step 21: CE-Router transmits a valid DHCPv6 Solicit Message. DHCP-Server1 transmits a valid DHCPv6 Advertise Message to CE-Router. CE-Router transmits a valid DHCPv6 Request Message. DHCP-Server1 transmits a valid DHCP Reply message to CE-Router.
  Step 23: CE-Router must perform Duplicate Address Detection for addresses assigned to its interfaces. CE-Router must transmit Router Advertisements with prefix assigned in Step 19.
  Step 25: CE-Router must respond to all ICMPv6 Echo Requests from TAR-Host1 with ICMPv6 Echo Replies.
  Step 27: REF-Host1 must respond to all ICMPv6 Echo Requests from TAR-Host1 with ICMPv6 Echo Replies.

Possible Problems:

- None.

Test CPEInterop.3.3: Router Advertisement

Purpose: Verify an IPv6 CE Router advertises itself as a router for delegated prefixes.

References:

- [ipv6-cpe-router] – L-3
- [ipv6-cpe-router] – L-4
- [ipv6-cpe-router] – L-5
- [ipv6-cpe-router] – L-6
- [RFC 4191]

Test Setup: The network is setup according to Common Topology. Common Test Setup 1.2 is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Route Information Option

1. CE-Router enables DHCPv6-PD.
2. Observe the packets transmitted on WAN1.
3. Observe the packets transmitted on LAN1.
4. REF-Host1 transmits an ICMPv6 Echo Request to TAR-Host1's global address.
5. Observe the packets transmitted on LAN1.

Part B: No Prefixes

6. Disable CE-Router on WAN1.
7. Configure TAR-Router1 to transmit Router Advertisement with no prefixes. DHCP-Server1 is disabled.
8. Enable CE-Router on WAN1.
9. Observe the packets transmitted on LAN1.

Part C: Advertising Interface

10. Disable TAR-Host1 on LAN1.
11. Enable TAR-Host1 on LAN1.
12. Observe the packets transmitted on LAN1.

Observable Results:

- *Part A*

  Step 2: CE-Router transmits a valid DHCP Solicit Message. DHCP-Server1 transmits a valid DHCP Advertise Message to CE-Router. CE-Router transmits a valid DHCP Request Message. DHCP-Server1 transmits a valid DHCP Reply message to CE-Router.
  Step 3: CE-Router transmits a Router Advertisement containing the Route Information Option containing a delegated prefix. The Prefix Length and Route Lifetime must match the information supplied from DHCPv6 Prefix Delegation.
  Step 5: TAR-Host1 must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
- *Part B*

Step 9: CE-Router must transmit Router Advertisements with a router lifetime of zero on LAN1.

- *Part C*

  Step 12: TAR-Host1 transmits a Router Solicitation. CE-Router must transmit Router Advertisements. The Prefix Information Option A and L flags must be set to one.

Possible Problems:

- None.

Test CPEInterop.3.4: Stateless DHCP Server

Purpose: Verify an IPv6 CE Router implements a stateless DHCPv6 Server on the LAN interfaces.

References:

- [ipv6-cpe-router] – L-8
- [RFC 3736]

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: DNS Recursive Name Server Option

1. Configure DHCP-Server1 to include a DNS Recursive Name Server option that includes DNS-Server global IPv6 address as the name server.
2. CE-Router obtains addressing and DNS information from DHCP-Server1.
3. Configure CE-Router and TAR-Host1 to enable stateless DHCPv6.
4. Observe the packets transmitted on LAN1.
5. Configure TAR-Host1 to transmit an ICMPv6 Echo Request to “dhcpv6.test.example.com”.
6. Observe the packets transmitted on LAN1.

Part B: Domain Search List Option

7. Configure DHCP-Server1 to include a DNS Recursive Name Server option that includes DNS-Server global IPv6 address as the name server and a Domain Search List option that includes “test.example.com”.
8. CE-Router obtains addressing and DNS information from DHCP-Server1.
9. Configure TAR-Host1 to enable DHCPv6 stateless DHCPv6.
10. Observe the packets transmitted on LAN1.
11. Configure TAR-Host1 to transmit an ICMPv6 Echo Request to “dhcpv6”.
12. Observe the packets transmitted on LAN1.

Observable Results:

- *Part A*

  Step 4: TAR-Host1 must transmit a DHCPv6 Information Request message. CE-Router transmits a DHCPv6 Reply message with DNS Recursive Name Server Option from Step 1.

  Step 6: TAR-Host1 must transmit a valid DNS request to DNS-Server1. DNS-Server1 must transmit a valid DNS response.
- *Part B*

  Step 10: TAR-Host1 must transmit a DHCPv6 Information Request message. CE-Router transmits a DHCPv6 Reply message with a DNS Recursive Name Server Option and Domain Search List Option from Step 7.

  Step 12: TAR-Host must transmit a valid DNS request to DNS-Server1. DNS-Server1 must transmit a valid DNS response.

Possible Problems:

- The NUT may not support a stateless DHCP server. The NUT must support a DHCP Server capable of IPv6 address assignment if this is the case.

Test CPEInterop.3.5: DHCP Server

Purpose: Verify an IPv6 CE Router implements a DHCPv6 Server capable of assigning addresses on the LAN interfaces.

References:

- [ipv6-cpe-router] – L-8
- [RFC 3315]

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part. Disable TAR-Host1 on LAN1 before each part. Enable DHCP on TAR-Host1 for each test case.

Procedure:

Part A: Initialization

1. Enable TAR-Host1 on LAN1.
2. Observe the packets transmitted on LAN1.
3. REF-Host1 transmits ICMPv6 Echo Request to TAR-Host1's global address.
4. Observe the packets transmitted on LAN1.

Part B: Renew message

5. Enable TAR-Host1 on LAN1.
6. TAR-Host1 should have received IPv6 address information from CE-Router. CE-Router assigns the T1 and T2 parameters to the TAR-Host1 IA (TAR-Router1 set T1 to 50s and T2 80s).
7. After time T1 observe the messages transmitted on LAN1.
8. REF-Host1 transmits an ICMPv6 Echo Request to TAR-Host1 global address.
9. Observe the packets transmitted on LAN1.

Part C: Rebind message

10. Enable TAR-Host1 on LAN1.
11. Allow enough time for the TAR-Host1 to receive IPv6 address information from CE-Router. CE-Router assigns the T1 and T2 parameters to TAR-Host1 IA (the TAR-Router1 set T1 to 50s and T2 to 80s).
12. Disable the LAN1 interface on CE-Router.
13. After time T2 (80s after the Reply message), observe the messages transmitted on LAN1.
14. Enable the LAN Interface on CE-Router and confirm that TAR-Host1 address is renewed on the next rebind.
15. REF-Host1 transmits an Echo Request to the TAR-Host1 global address.
16. Observe the packets transmitted on LAN1.

Part D: Decline Message

17. Configure CE-Router to only have a REF-Host2 address in its address pool.
18. Enable CE-Router on LAN1. Allow enough time for TAR-Host1 to receive IPv6 address information from CE-Router.
19. Observe the packets transmitted on LAN1.

Part E: DNS Recursive Name Server Option

20. Configure CE-Router to include a DNS Recursive Name Server option that includes DNS-Server global IPv6 address.

21. Enable TAR-Host1 on LAN1. Allow enough time for TAR-Host1 to receive IPv6 address information from CE-Router.
22. TAR-Host1 transmits an ICMPv6 Echo Request to “dhcpv6.test.example.com”.
23. Observe the packets transmitted on LAN1.

Part F: Domain Search List Option

24. Configure CE-Router to include a DNS Recursive Name Server option that includes DNS-Server global IPv6 address as the name server and a Domain Search List option that includes “test.example.com”.
25. Enable TAR-Host1 on LAN1. Allow enough time for CE-Router to receive IPv6 address information from CE-Router.
26. TAR-Host1 transmits an Echo Request to “dhcpv6”.
27. Observe the packets transmitted on LAN1.

Part G: No Address Available

28. Configure CE-Router to only have one address available in its address pool.
29. Enable REF-Host2 on LAN1. Allow enough time for REF-Host2 to receive IPv6 address information from CE-Router.
30. Enable TAR-Host1 on LAN1. Allow enough time for TAR-Host1 to receive IPv6 address information from CE-Router.
31. Observe the packets transmitted on LAN1.

Observable Results:

- *Part A*

  Step 2: TAR-Host1 must transmit a DHCPv6 Solicit message. CE-Router sends a DHCPv6 Advertisement message with the IPv6 address information included. TAR-Host1 sends a DHCPv6 Request messages to confirm the IPv6 address and ask for additional information. CE-Router responds with a DHCPv6 Reply message that contains the confirmed address.
  Step 4: TAR-Host1 must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
- *Part B*

  Step 7: TAR-Host1 transmits its first DHCPv6 Renew message T1 (50) seconds after the reception of the DHCPv6 Reply message from CE-Router. CE-Router transmits a properly formatted DHCP Reply message in response to the DHCPv6 Renew message.
  Step 9: TAR-Host1 must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
- *Part C*

  Step 13: TAR-Host1 transmits a DHCPv6 Rebind Message.
  Step 16: TAR-Host1 must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
- *Part D*

  Step 19: TAR-Host1 transmits a DAD NS for its global address. TAR-Host2 transmits a solicited NA in response to the DAD NS with non-unique tentative address. TAR-Host1 transmits a DHCP Decline message. CE-Router transmits a DHCP Reply message.
- *Part E*

  Step 23: TAR-Host1 must transmit a valid DNS request to DNS-Server1. DNS-Server1 must transmit a valid DNS response.
- *Part F*

Step 27: TAR-Host1 must transmit a valid DNS request to DNS-Server1. DNS-Server1 must transmit a valid DNS response.

- *Part G*

  Step 31: CE-Router transmits a DHCP Advertise message containing the status code 2. TAR-Host1 must ignore the DHCP Advertise message from CE-Router and transmit a DHCP Request message.

Possible Problems:

- The NUT may not support a DHCP server capable of assigning addresses. The NUT must support a DHCP Server supports Information Request if this is the case.
- It might not be possible to configure the address pool on the CE-Router device, Parts D and G may be omitted.

Test CPEInterop.3.6: Prefix Change

Purpose: Verify an IPv6 CE Router properly advertises a prefix change.

References:

- [ipv6-cpe-router] – L-13
- [ipv6-cpe-router] – L-14

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Prefix Timeout

1. Configure DHCP-Server1 to have assigned Prefix X with a preferred and valid lifetime of 1 minute.
2. CE-Router enables DHCPv6-PD. Allow time for CE-Router to distribute the Prefix X on LAN interfaces.
3. REF-Host1 transmits ICMPv6 Echo Request to TAR-Host1's Prefix X global address.
4. Observe the packets transmitted on LAN1.
5. Configure DHCP-Server1 to assign a new Prefix Y to CE-Router after the Prefix X lifetime expires.
6. Observe the packets transmitted on WAN1 and LAN1.
7. REF-Host1 transmits ICMPv6 Echo Request to TAR-Host1's Prefix X global address from Step 3.
8. Observe the packets transmitted on LAN1.
9. REF-Host1 transmits ICMPv6 Echo Request to TAR-Host1's Prefix Y global address acquired in Step 5.
10. Observe the packets transmitted on LAN1.

Part B: Reconfigure

11. CE-Router enables DHCPv6-PD. Allow time for CE-Router to distribute Prefix X on LAN interfaces.
12. REF-Host1 transmits ICMPv6 Echo Request to TAR-Host1's Prefix X global address.
13. Observe the packets transmitted on LAN1.
14. Configure DHCP-Server1 to delegate new Prefix Y to CE-Router using DHCPv6 Reconfigure. Allow time for CE-Router to distribute the prefix on LAN interfaces.
15. Observe the packets transmitted on LAN1.
16. REF-Host1 transmits ICMPv6 Echo Request to TAR-Host1's Prefix X global address as in Step 12.
17. Observe the packets transmitted on LAN1.
18. REF-Host1 transmits ICMPv6 Echo Request to TAR-Host1's Prefix Y global address acquired in Step 14.
19. Observe the packets transmitted on LAN1.

Observable Results:

- *Part A*

Step 4: TAR-Host1 must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
Step 6: CE-Router transmits a valid DHCPv6 Renew message. DHCP-Server1 transmits a valid DHCP Reply message with a new IPv6 prefix from Step 5 on WAN1. CE-Router must transmit Router Advertisements with a Prefix lifetimes of zero for all prefixes previous delegated on LAN1.
Step 8: TAR-Host1 must not respond to ICMPv6 Echo Requests from REF-Host1.
Step 10: TAR-Host1 must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.

- *Part B*

  Step 13: TAR-Host1 must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
  Step 15: DHCP-Server1 transmits a DHCPv6 Reconfigure to CE-Router on WAN1. CE-Router transmits DHCPv6 Renew message to DHCP-Server1. DHCP-Server1 transmits a DHCPv6 Reply with Prefix X having a preferred lifetime of 0 and Prefix Y with a valid preferred lifetime.
  Step 17: TAR-Host1 must not respond to ICMPv6 Echo Requests from REF-Host1. CE-Router must transmit an ICMP Destination Unreachable Message with a code 5 to REF-Host1.
  Step 19: TAR-Host1 must respond to ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.

Possible Problems:

- None.

Test CPEInterop.3.7: Link MTU

Purpose: Verify an IPv6 CE Router properly handles transmitting Packet Too Big messages and fragmented packet

References:

- [ipv6-cpe-router] – G-1

Test Setup: The network is setup according to Common Topology. Common Test Setup is performed at the beginning of this test part. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Sending Packet Too Big

1. Configure CE-Router's WAN1 to have an MTU of 1280.
2. TAR-Host1 transmits ICMPv6 Echo Request that is 1500 to REF-Host1.
3. Observe the packets transmitted on LAN1.

Part B: Forwarding Fragmented Packets

4. Configure Network 1 to have an MTU of 1280.
5. REF-Host1 transmits ICMPv6 Echo Request of size 1500 to TAR-Host1.
6. Observe the packets transmitted on LAN1.

Observable Results:

- *Part A*

  Step 4: CE-Router must transmit an ICMPv6 Packet Too Big Message to TAR-Host1. TAR-Host1 should fragment the ICMPv6 Echo Replies to REF-Host1 after receiving the Packet Too Big message.
- *Part B*

  Step 6: CE-Router should forward fragmented ICMPv6 Echo Request packets from the WAN1 network to the LAN1 network.

Possible Problems:

- Part A may be omitted if the CE-Router doesn't allow the MTU size to be configured on WAN1.

Appendix-A Required Data

When you apply for an IPv6 Ready Logo Phase-2 (CPE) you need to submit test logs. In this appendix the detail requirement for the test log is described.

1.1 Required Data

As "IPv6 Ready Logo Phase-2" the following interoperability test result data are required.

A) Topology Map

Network topology figures or address list, with IPv6 addresses and MAC address of each attached interfaces, are required. Fig.1 is an example of topology figure.

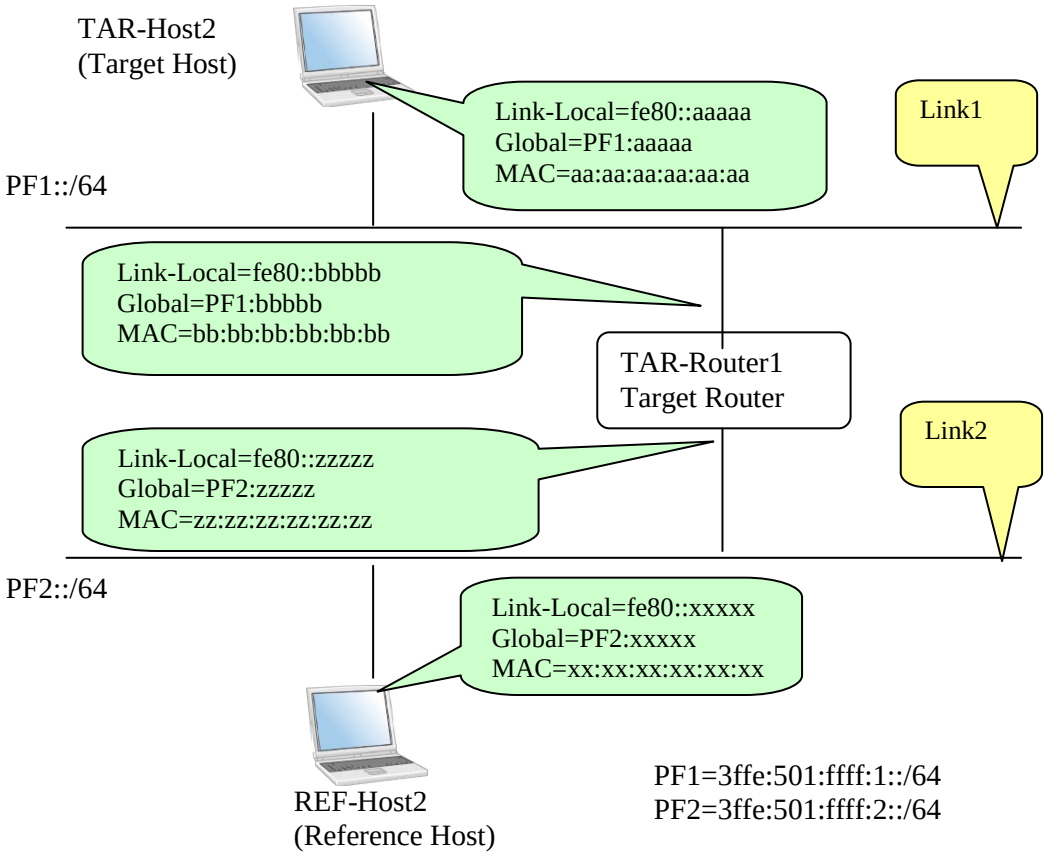


Fig. 1 Topology map example

Fig.2 is an example of address list.

```
TGT_HOST1:
        Link-Local=fe80::aaaa
        Global=PF1::aaaa
        MAC=aa:aa:aa:aa:aa:aa

REF_ROUTER1 [Link0]:
        Link-Local=fe80::bbbb
        Global=PF1::bbbb
        MAC=bb:bb:bb:bb:bb:bb

REF_ROUTER1 [Link1]:
        Link-Local=fe80::yyyy
        Global=PF2::yyyy
        MAC=yy:yy:yy:yy:yy:yy

TGT_HOST2:
        Link-Local=fe80::zzzz
        Global=PF2::zzzz
        MAC=zz:zz:zz:zz:zz:zz
```

Fig. 2 Address List example

B) Command Log

Ping (ICMP Echo Request) is used as a default application. When you run tests with the ping application, please save the command log into individual files. The naming syntax for these files is described below. We also allow using other protocols other than ICMP Echo Request and Reply. Even if you use another kind of application, please save the command log.

C) Packet Capture File

Capture all packets on each link during the test with a device that is not included in the test scenario. Make individual tcpdump(pcap) format files for each test and link or put the packet dump in a readable HTML file. The naming syntax for these files is described below.

If you run tcpdump, please specify packet size as 4096.

e.g.,) tcpdump -i if0 -s 4096 –w 5.1.A.VendorA.Link0.dump

D) Test Result Table

Collect all test result tables in a file and fill the tables as required. This file must contain a table where all passes are clearly marked.

1.2. Data file name syntax

Please use following syntax in the file name.

A) Topology Map

(IPv6 Ready Logo requires 4 different vendors for Interoperability requirements)
You'll need two topology files as indicated below:

Syntax:*CPE_Interop.ON(host).ON(router).topology*

For "ON", use the Node's vendor name which behaved as the target Node (ON).
e.g.,)
ON: Target-Host1 [vendor: VendorA, model: host1, version: 1.0]
ON: Target-Router1 [vendor: VendorB, model: router1, version: 1.0]

CPE_Interop.VendorA.VendorB.topology

ON: Target-Host1 [vendor: VendorC, model: host1, version: 1.0]
ON: Target-Router1 [vendor: VendorD, model: router1, version: 1.0]

CPE_Interop.VendorC.VendorD.topology

B) Command Results

Chapter.Section.Part.SRC.DSTs.result

For "*SRC*", use the vendor name of the node on which the commands were run. If SRC is a Reference Host, just specify as REF as SRC. For "*DSTs*", use the vendor name of the node to which the commands were run, in other words, destination of ping command.
e.g.,)
Typical Naming sample are hereafter.

1.1. ICMPv6
1.1.A.*[Tar-Host1].[CPE].*result

1.2. Default Address Selection
1.2.A.*[CPE].[Tar-Router1].*result

C) Captured packet file

Syntax:*Chapter.Section.Part.Target_Node,.Target_Node.Link.dump*

For "*Link*", use the captured link name.
For "*Target_Node*", use Vendor Name of Target Device. Vendor name for

Host must be prior to the Vendor name of Router.

1.1. ICMPv6

1.1.A.*[Tar-Host1].[Tar-Router1].*Network1.dump

1.2. Default Address Selection

1.2.A.*[Tar-Host1].[Tar-Router1*.Network1.dump

D) Test Result Table

Syntax: *Device_name_and_version.table*
Tar-Host1: Vendor A, Vendor B
Tar-Router1: Vendor D, Vendor E

1.1

	VendorA	VendorB	VendorC	VendorD
CPE				

1.2

	VendorA	VendorB	VendorC	VendorD
CPE				

1.3

	VendorA	VendorB	VendorC	VendorD
CPE				

1.4

	VendorA	VendorB	VendorC	VendorD
CPE				

2.1

	VendorA	VendorB	VendorC	VendorD
CPE				

2.2

	VendorA	VendorB	VendorC	VendorD
CPE				

2.3

	VendorA	VendorB	VendorC	VendorD

CPE				

2.4

	VendorA	VendorB	VendorC	VendorD
CPE				

2.5

	VendorA	VendorB	VendorC	VendorD
CPE				

2.6

	VendorA	VendorB	VendorC	VendorD
CPE				

2.7

	VendorA	VendorB	VendorC	VendorD
CPE				

3.1

	VendorA	VendorB	VendorC	VendorD
CPE				

3.2

	VendorA	VendorB	VendorC	VendorD
CPE				

3.3

	VendorA	VendorB	VendorC	VendorD
CPE				

3.4

	VendorA	VendorB	VendorC	VendorD
CPE				

3.5

	VendorA	VendorB	VendorC	VendorD
CPE				

3.6

	VendorA	VendorB	VendorC	VendorD
CPE				

3.7

	VendorA	VendorB	VendorC	VendorD
CPE				

1.3. Interoperability Requirements

Each applicant must be tested against other devices according to the following,
(All Vendors MUST be different)

- Must be tested against 2 Hosts and 2 Routers
  * (4 different vendors are required. The vendor in each device type must be different)

1.4. Data Archive

Please organize your data as following directory structure.

$Your_Device_ver/
    Conformance/
    Interoperability /

Put all interoperability data file in "Interoperability" directory.
Put all Conformance Self-Test results or Conformance Lab test results in "Conformance" directory.
Make a tar.gz format archive file, and put files under "$Your_Device_ver" in it.