

IPv6 READY

Interoperability Test Scenario
CE Router

Technical Document

Revision 1.0.2

IPv6 Forum
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MODIFICATION RECORD

Version 1.0.2	January 13, 2016	T. Winters	<ul style="list-style-type: none"> • Added Appendix A. • Added Possible Problem to 1.4F for Link Technologies DAD issues. • Added a Possible Problem to 1.7 to allow changing the SOL_MAX_RT value. • Added 2.9A to Advanced Functionality.
Version 1.0.1	August 21, 2015	T. Winters	<ul style="list-style-type: none"> • Clarified using DHCPv6 Address in CERouterInterop.1.2. • Updated CERouterInterop.1.1&2.1 to clear the neighbor cache of REF-Host. • Clarified that CERouterInterop.2.6B should wait the preferred lifetime to allow for Prefix X to timeout. • Updated CERouterInterop.2.6 to check the valid lifetime is less then or equal to the valid lifetime in the IA_PD. • Updated CERouterInterop.1.7 to observe the DHCPv6 Server sending Advertises to every Solicit. • Added a Possible Problem to CERouterInterop.1.1 to allow Neighbor Discovery Proxies. • Updated CERouterInterop.1.7 to allow a range of times for retransmission. • Added a Possible Problem for TAR-Router's the don't support link-local ping for CERouterInterop.3.1C.
Version 1.0.0	February 10, 2015	T. Winters	<ul style="list-style-type: none"> • Initial Release of Finalized Test Plan.



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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: Customer Edge Router (Device Under Test)
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



ADVANCED FUNCTIONALITY TEST

The following test may be omitted if the NUT does not support the advanced functionalities.

Mandatory Features on LAN (Must select at least one)

- Supporting DNS Configuration by Stateless DHCPv6 (CERouterInterop.2.4)
- Supporting Address Assignment and DNS Configuration by DHCPv6 (CERouterInterop.2.5)

General Advanced Features

- Transmitting Echo Requests (CERouterInterop.1.4 G, H)
- Supporting MTU configuration (CERouterInterop.2.7 A)

Advanced Features on WAN

- Supporting Stateless Address Autoconfiguration (CERouterInterop.1.3 A, B)
- Supporting DHCPv6 Release Message (CERouterInterop.1.4 D, CERouterInterop.1.5 D)
- Supporting DHCPv6 Confirm Message (CERouterInterop.1.4 E)
- Supporting DHCPv6 Domain Search List Option (CERouterInterop.1.4 H)
- Configurable DHCPv6 Prefix Hint (CERouterInterop.1.5 E)
- Support DHCPv6 only WAN Addressing (CERouterInterop.1.6)

Advanced Features on LAN

- Supporting Ingress Filtering (CERouterInterop.2.9A)
- Supporting Unique Local Address (CERouterInterop.4.1, CERouterInterop.4.2)



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 DUT'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.



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TABLE OF CONTENTS

MODIFICATION RECORD	2
ACKNOWLEDGEMENTS	2
INTRODUCTION	3
ADVANCED FUNCTIONALITY TEST	4
TEST ORGANIZATION	5
REFERENCES	6
TABLE OF CONTENTS	8
Common Topology	10
Common Test Setup	11
Common Test Cleanup	11
General Node Requirements	12
Section 1: WAN Side Configuration	13
TEST CEROUTERINTEROP.1.1: DUPLICATE ADDRESS DETECTION	14
TEST CEROUTERINTEROP.1.2: ROUTER DISCOVERY	16
TEST CEROUTERINTEROP.1.3: ADDRESS LIFETIME	17
TEST CEROUTERINTEROP.1.4: DHCPV6	19
TEST CEROUTERINTEROP.1.5: DHCPV6 PREFIX DELEGATION	23
TEST CEROUTERINTEROP.1.6: UNNUMBERED WAN	26
TEST CEROUTERINTEROP.1.7: DHCPV6 SOL_MAX_RT	27
TEST CEROUTERINTEROP.1.8: L FLAG PROCESSING	28
Section 2: LAN Side Configuration	29
TEST CEROUTERINTEROP.2.1: DUPLICATE ADDRESS DETECTION AND NEIGHBOR DISCOVERY ..	30
TEST CEROUTERINTEROP.2.2: ASSIGNING PREFIXES TO LAN INTERFACES	32
TEST CEROUTERINTEROP.2.3: ROUTER ADVERTISEMENT	34
TEST CEROUTERINTEROP.2.4: STATELESS DHCP SERVER	36
TEST CEROUTERINTEROP.2.5: DHCP SERVER	38
TEST CEROUTERINTEROP.2.6: PREFIX CHANGE	40
TEST CEROUTERINTEROP.2.7: LINK MTU	43
TEST CEROUTERINTEROP.2.8: DNS INFORMATION IN ROUTER ADVERTISEMENT	44
TEST CEROUTERINTEROP.2.9: INGRESS FILTERING	46

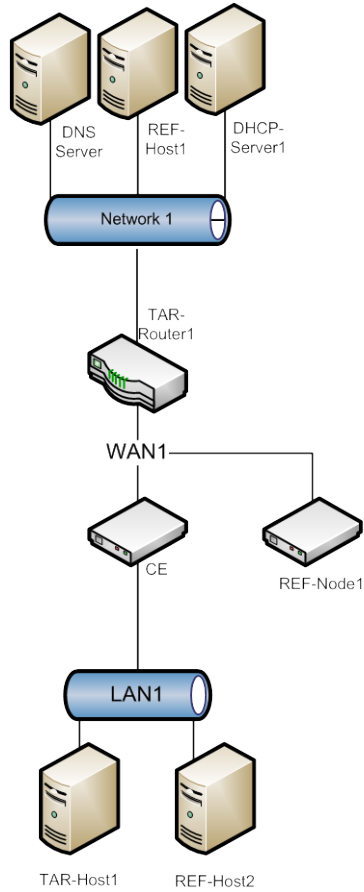


Section 3: General Requirements	47
TEST CEROUTERINTEROP.3.1: ICMPV6	48
TEST CEROUTERINTEROP.3.2: IPV6 FORWARDING BEFORE ADDRESS ACQUISITION	50
TEST CEROUTERINTEROP.3.3: NO DEFAULT ROUTE	51
TEST CEROUTERINTEROP.3.4: FORWARDING LOOPS	53
Section 4: Unique Local Addresses	54
TEST CEROUTERINTEROP.4.1: ULA PREFIX GENERATION	55
TEST CEROUTERINTEROP.4.2: ULA SITE BORDER	57
Appendix-A Required Data	58
1.1 INTEROPERABILITY TARGET DEVICE REQUIREMENTS	58
1.2 REQUIRED DATA	58
A. Topology Map.....	58
B. Command Log.....	60
C. Packet Capture File	61
D. Test Result Table	61
1.3 DATA ARCHIVE	61
A. File List for CE Router.....	62



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. The setting of DHCP-Server1 will be indicated in the individual test cases.
3. DNS-Server1 is configured with an entry for “dhcpv6.test.example.com” or equivalent.
4. TAR-Router1 is a DHCPv6 Relay Agent for DHCPv6 Server.
5. TAR-Router1 assigns global address to CE-Router on WAN1 using DHCPv6 or CE-Router forms its global address via SLAAC.
6. TAR-Router1 transmits valid Router Advertisement with the O and M flag set to 1 on the WAN interface.
7. TAR-Router1 has valid routes to LAN1.

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.



General Node Requirements

- **Host**
 - Ability to configure a global address and default router by receipt of Router Advertisement.
 - A DHCPv6 Client must be available.
 - Ability to use traceroute6.
 - Ability to configure a link-local IPv6 address.
- **Router**
 - Ability to transmit Router Advertisements with a positive AdvValidLifetime.
 - Ability to transmit Router Advertisements with a positive AdvDefaultLifetime.
 - Ability to configure the L-flag in the Prefix Information Options included in Router Advertisements.
 - Ability to be a DHCPv6 Relay Agent.
- **Host and Router**
 - Ability to use a ping6 application and print out results indicating the receipt of an ICMPv6 Echo Reply.



Section 1: 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 CERouterInterop.1.1: Duplicate Address Detection

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

References:

- [RFC 7084] – W-1
- [RFC 7084] – W-2
- [RFC 7084] – WAA-1

Test Setup: The network is setup according to [Common Topology](#). 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 TAR-Router1 before CE-Router.
3. Allow time for all devices on WAN1 for all devices to perform Duplicate Address Detection on its link-local address. Enable REF-Node1 making sure it has cleared its neighbor cache.
4. Transmit ICMPv6 Echo Request from REF-Node1 to the link-local address of CE-Router's WAN interface.
5. Observe the packets transmitted on WAN1.
6. Repeat Steps 1 thru 5, but in Step 2 enable CE-Router before TAR-Router1.
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. Enable REF-Node1 making sure it has cleared its neighbor cache.
12. Transmit ICMPv6 Echo Request from REF-Node1 to the link-local address of CE-Router WAN1 interface.
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 WAN interface.
18. 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. CE-Router must not respond to any neighbor solicitations or ICMPv6 Echo Request for the duplicated address.

Step 18: CE-Router must respond to all ICMPv6 Echo Requests from REF-Node1 with ICMPv6 Echo Replies.

Possible Problems:

- Access Technologies that require TAR-Router1 be initiated before CE-Router may omit steps 6 thru 7 and steps 15 thru 18.
- Access Technologies that deploy Neighbor Discovery Proxy may omit the link-local ping (Step 4, 12 and 17) and replace it with waiting 60 seconds and determining that no link-local IPv6 traffic originates from a device's link-local address that failed duplicate address detection.



Test CERouterInterop.1.2: Router Discovery

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

References:

- [RFC 7084] – W-2
- [RFC 7084] – W-3
- [RFC 4861] – Section 6.1.1

Test Setup: The network is setup according to [Common Topology](#). The [Common Test Cleanup](#) procedure is performed after each part. Assign global address to CE-Router on WAN1 using DHCP.

Procedure:

1. Reboot CE-Router.
2. Observe the packets transmitted on WAN1.
3. Wait for CE-Router to perform duplicate address detection for a global address thru either DHCP.
4. REF-Host1 transmits an ICMPv6 Echo Request to CE-Router's DHCPv6 global address on WAN interface.
5. Observe the packets transmitted on WAN1.

Observable Results:

Step 2: CE-Router must complete Duplicate Address Detection on link-local addresses before transmitting Router Solicitations. Router Solicitations must be transmitted with a link-local source address and the all-routers multicast address (ff02::2).

Step 5: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies using a global source address.

Possible Problems:

- None.



Test CERouterInterop.1.3: Address Lifetime

Purpose: Verify an IPv6 CE Router properly processes Router Advertisements Prefix Information Options lifetimes

References:

- [RFC 7084] – WAA-1

Test Setup: The network is setup according to [Common Topology](#). The [Common Test Cleanup](#) procedure is performed after each part.

Procedure:

Part A: Lifetime expires

1. Configure TAR-Router1 to transmit Router Advertisements with one prefix (valid lifetime = 30 sec) on WAN1 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. Allow 35 seconds to pass.
5. Transmit an ICMPv6 Echo Request from REF-Host1 to the global address of the CE-Router acquired thru the Router Advertisement on the WAN interface.
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 on the WAN interface.
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 on the WAN interface.
11. 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 timeout Prefix1. CE-Router must not respond to ICMPv6 Echo Requests or Neighbor Solicitations from REF-Host1 with the address associated with Prefix1.
- *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.



Possible Problems:

- Part A and B may be omitted if a CE Router explicitly configured to only obtain its WAN IPv6 address via DHCPv6.
- Some access technologies will prevent the routing of deprecated addresses therefore parts A and B may be omitted.



Test CERouterInterop.1.4: DHCPv6

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

References:

- [RFC 7084] – W-5
- [RFC 7084] – WAA-3
- [RFC 7084] – WAA-4
- [RFC 7084] – WAA-6
- [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 Router on WAN1.
- Configure TAR-Router1 to transmit Router Advertisements with the M-flag and O-flag set to 1 before each part.
- Perform Common Test Cleanup after each part.

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 DHCPv6 global address.
4. Observe the packets transmitted on WAN1.

Part B: Renew message

5. Enable CE-Router on WAN1.
6. 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).
7. After time T1 observe the messages transmitted on WAN1.
8. REF-Host1 transmits an ICMPv6 Echo Request to CE-Router DHCPv6 global address.
9. Observe the packets transmitted on WAN1.

Part C: Rebind message

10. Enable CE-Router on WAN1.
11. Allow enough time for the CE-Router to receive IPv6 address information from DHCP-Server1. The DHCP-Server1 assigns the T1 and T2 parameters to CE-Router IA_NA (the TAR-Router1 set T1 to 50s and T2 to 80s).
12. Disable DHCP-Server1.
13. After time T2 (80s after the Reply message), observe the messages transmitted on WAN1.
14. Enable DHCP-Server1 and confirm that CE-Router address is renewed on the next rebind.
15. REF-Host1 transmits an ICMPv6 Echo Request to the CE-Router DHCPv6 global address.
16. Observe the packets transmitted on WAN1.

Part D: Release Message



17. Enable CE-Router on WAN1. Allow enough time for CE-Router to receive IPv6 address information from DHCP-Server1.
18. TAR-Router1 transmits an ICMPv6 Echo Request to the CE-Router DHCPv6 global address.
19. Observe the packets transmitted on WAN1.
20. Configure CE-Router to release the IPv6 global address.
21. Observe the packets transmitted on WAN1.
22. TAR-Router1 transmits an ICMPv6 Echo Request to the CE-Router DHCPv6 global address.
23. Observe the packets transmitted on WAN1.

Part E: Confirm messages

24. Enable CE-Router on WAN1.
25. Observe the packets transmitted on WAN1.
26. REF-Host1 transmits ICMPv6 Echo Request to CE-Router DHCPv6 global address.
27. Observe the packets transmitted on WAN1.
28. Physically disconnect and reconnect the WAN interface.
29. Observe the packets transmitted on WAN1.
30. REF-Host1 transmits ICMPv6 Echo Request to CE-Router DHCPv6 global address.
31. Observe the packets transmitted on WAN1.

Part F: Decline Message

32. Configure REF-Node1 to have the same address that the DHCP-Server1 assigns to the CE Router.
33. Enable CE-Router on WAN1. Allow enough time for CE-Router to receive IPv6 address information from REF-Node1.
34. Observe the packets transmitted on WAN1.

Part G: DNS Recursive Name Server Option

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

Part H: Domain Search List Option

39. 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”.
40. Enable CE-Router on WAN1. Allow enough time for CE-Router to receive IPv6 address information from DHCP-Server1.
41. CE-Router transmits an ICMPv6 Echo Request to “dhcpv6”.
42. Observe the packets transmitted on WAN1.

Part I: Timeout

43. Enable CE-Router on WAN1.
44. Allow enough time for the CE-Router to receive IPv6 address information thru DHCP.
45. Disable DHCP-Server1.
46. TAR-Router1 transmits an ICMPv6 Echo Request to the CE-Router DHCPv6 global address.
47. Observe the packets transmitted on WAN1.
48. Wait valid lifetime, provided by the DHCP IA_NA in Step 44.
49. TAR-Router1 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, IA_NA Option, and Option Request Option. The option request option must include Requested Option code containing DNS_SERVERS 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 7:** CE-Router transmits its first DHCPv6 Renew message T1 (50) seconds after the reception of the DHCPv6 Reply message from DHCP-Server1. DHCP-Server1 transmits a properly formatted Reply message in response to the DHCP Renew message.
 - Step 9:** CE-Router must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
- *Part C*
 - Step 13:** CE-Router transmits a DHCPv6 Rebind Message.
 - Step 16:** CE-Router must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
- *Part D*
 - Step 19:** CE-Router must respond to all ICMPv6 Echo Requests from TAR-Router1 with ICMPv6 Echo Replies.
 - Step 21:** CE-Router transmits a DHCPv6 Release Message.
 - Step 23:** CE-Router must timeout Prefix1. CE-Router must not respond to ICMPv6 Echo Requests or Neighbor Solicitations from TAR-Router1 with the address associated with Prefix1.
- *Part E*
 - Step 25:** 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 27:** CE-Router must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
 - Step 29:** 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 or IA_PD Option.
 - Step 31:** CE-Router must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.
- *Part F*
 - Step 34:** CE-Router transmits a DAD NS for its global address. REF-Node1 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 38:** CE-Router must transmit a valid DNS request to DNS-Server1. DNS-Server1 must transmit a valid DNS response.



- *Part H*
Step 42: CE-Router must transmit a valid DNS request to DNS-Server1. DNS-Server1 must transmit a valid DNS response.
- *Part I*
Step 47: CE-Router must respond to all ICMPv6 Echo Requests from TAR-Router1 with ICMPv6 Echo Replies.
Step 50: CE-Router must timeout Prefix1. CE-Router must not respond to ICMPv6 Echo Requests or Neighbor Solicitations from TAR-Router1 with the address associated with Prefix1.

Possible Problems:

- DHCP Confirm and Release messages may not be triggered by the methods specified in the procedure. Other methods such as unplugging the interfaces can be used or rebooting may be used.
- A passive CE-Router does not implement an application for sending Echo Request therefore Parts G and H may be omitted.
- Part H may be omitted if the CE-Router doesn't support DHCPv6 Domain Search List Option.
- Some access technologies do not allow REF-Node1 to defend its address. In this case, Configure TAR-Router1 to have the same address as DHCP-Server1 assigns CE-Router in Part F.



Test CERouterInterop.1.5: DHCPv6 Prefix Delegation

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

References:

- [RFC 7084] – W-4
- [RFC 7084] – WPD-1
- [RFC 7084] – WPD-2
- [RFC 7084] – WPD-3
- [RFC 7084] – WPD-4

Test Setup: The network is setup according to [Common Topology](#).

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

- Disable CE Router on WAN1.
- Configure TAR-Router1 to transmit Router Advertisements with the M-flag and O-flag set to 1 before each part.
- Perform Common Test Cleanup after each part.

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. After time T2 (80s after the Reply message), observe the messages transmitted on WAN1.
17. Enable DHCP-Server1 and confirm that CE-Router address is renewed on the next rebind
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. Configure DHCP-Server1 to assign a different prefix length than the prefix hint supplied in the DHCPv6 Solicit message from the CE-Router.
30. Wait for timer T1 (50s) to expire.
31. Observe the packets transmitted on WAN1.

Part F: M Flag

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

Part G: O Flag

35. Configure TAR-Router1 to transmit Router Advertisement with the M flag set to zero and O flag set to one.
36. Configure CE-Router to enable DHCPv6-PD.
37. 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 including IA_PD option and IA_PD Prefix option and the value within these two options must be the same 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 including IA_PD option and IA_PD Prefix option and the value within these two options must be the same as given in the DHCPv6 Reply message in step 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 16: 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 Renew 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 including IA_PD option and IA_PD prefix option and the value within these two options must be the same as given in the DHCPv6 Reply message from Step 21.

Step 26: CE-Router must not transmit any more Client-Initiated Configuration messages for the IA_PD that was released.

- *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 including IA_PD option and IA_PD prefix option and the value within these two options must be the same as given in the DHCPv6 Reply message in step 28.

- *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 37: 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.

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 CERouterInterop.1.6: Unnumbered WAN

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

References:

- [RFC 7084] – WAA-9

Test Setup: The network is setup according to [Common Topology](#). [Common Test Setup](#) is performed at the beginning of this test part with the exception that no global IPv6 address is assigned to the WAN interface of the CE-Router. The [Common Test Cleanup](#) procedure is performed after each part.

Procedure:

1. Configure TAR-Router1 to transmit a Router Advertisement with the M flag set to zero and the O flag set to 1.
2. Observe the packets transmitted on WAN1.
3. Using an application, such as traceroute6, REF-Host1 transmits an IPv6 packet to TAR-Host1 with a hop-limit of 2.
4. Observe the packets transmitted on WAN1.

Observable Results:

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 Reply message to CE-Router.

Step 4: CE-Router must transmit an ICMPv6 Time Exceeded message using the global source address acquired on the LAN interface to REF-Host1.

Possible Problems:

- May be omitted if a CE Router is explicitly configured to only obtain its WAN IPv6 address via DHCPv6.
- If the CE-Router request an IA_NA and the DHCPv6 Server doesn't support sending an IA_NA option containing Status Code of Address Unavailable this test case may be omitted.



Test CERouterInterop.1.7: DHCPv6 SOL_MAX_RT

Purpose: Verify an IPv6 CE Router properly processes the SOL_MAX_RT option from the DHCP server.

References:

- [RFC 7084] – WAA-8
- [RFC 7083]

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 include the SOL_MAX_RT option in response to DHCPv6 Advertise message. Set the MAX_SOL_RT to 180 seconds. Configure the DHCP server to not assign IPv6 addresses or prefixes.
2. Enable the CE-Router.
3. Observe the packets transmitted on WAN1.
4. Wait 600 seconds.
5. Observe the packets transmitted on WAN1.

Observable Results:

Step 3: DHCP-Server1 transmits a valid DHCPv6 Advertise Message containing SOL_MAX_RT option set to 180 for every Solicit Message from CE-Router. CE Router must not send Request messages to DHCP-Server1.

Step 5: The last two DHCPv6 Solicit Messages transmitted by the CE Router must be between 162 and 198 seconds apart.

Possible Problems:

- If the SOL_MAX_RT value of 180 can't be used, it may be substituted with a value not equal to the default SOL_MAX_RT. The values in Steps 4 & 5 should be recalculated per RFC 7083 in this case.



Test CERouterInterop.1.8: L Flag Processing

Purpose: Verify an IPv6 CE Router properly processes the L flag in the Prefix Information Option.

References:

- [RFC 7084] – WAA-2
- [RFC 5942]

Test Setup: The network is setup according to [Common Topology](#). [Common Test Setup](#) is performed with the exception that no global IPv6 address is assigned to the WAN interface of the CE-Router through SLAAC. The [Common Test Cleanup](#) procedure is performed after each part.

Procedure:

1. Configure TAR-Router1 to transmit Router Advertisements with one prefix (valid lifetime = 30 sec) on WAN1 and the L-flag clear. The Prefix should match the prefix that the DHCP Server is serving for the WAN interface.
2. Allow time for CE-Router to obtain an IPv6 address thru DHCPv6.
3. Transmit an ICMPv6 Echo Request from REF-Node1 to the DHCPv6 global address of CE-Router.
4. Observe the packets transmitted on WAN1.

Observable Results:

Step 4: CE-Router must respond to all ICMPv6 Echo Requests from REF-Node1 using TAR-Router1 as the next hop.

Possible Problems:

- A TAR-Router1 may transmit ICMPv6 Redirect messages. It is recommended that this behavior be disabled if possible, but if not all subsequent packets might be sent directly to the REF-Node1.



Section 2: 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 CERouterInterop.2.1: 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:

- [RFC 7084] – G-1
- [RFC 7084] – 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. Enable REF-Host2 making sure it has cleared its neighbor cache.
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 TAR-Host1 before CE-Router.
11. Allow time for all devices on LAN1 to perform Duplicate Address Detection on their link-local address. Enable REF-Host2 making sure it has cleared its neighbor cache
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 CE-Router before TAR-Host1.
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.

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: TAR-Host1 must respond to all ICMPv6 Echo Requests from REF-Host2 with ICMPv6 Echo Replies. CE-Router must not respond to any neighbor solicitations or ICMPv6 Echo Request for the duplicated address.

Step 19: CE-Router must respond to all ICMPv6 Echo Requests from REF-Host2 with ICMPv6 Echo Replies.

Possible Problems:

- A host may not bind the new link-local address if it has its pre-configured link-local address to fall back on. For this reason, the original link-local address should be removed from the testing interface. If the original cannot be removed then the global addresses may be used.



Test CERouterInterop.2.2: Assigning Prefixes to LAN Interfaces

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

References:

- [RFC 7084] – 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-Host1 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-Host1 transmits ICMPv6 Echo Request to REF-Host1.
18. Observe the packets transmitted on LAN1 and WAN1.

Part C: Prefix Length of /56

19. Configure DHCP-Server1 to assign a /56 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-Host1 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 a Prefix Information Option with a /64 prefix assigned in Step 1. The preferred and valid lifetimes in the Prefix Information Option must not be more than the preferred and valid lifetimes from the IA_PD.

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 a Prefix Information Option containing a /64 prefix from the /60 prefix assigned in Step 10. The preferred and valid lifetimes in the Prefix Information Option must not be more than the preferred and valid lifetimes from the IA_PD.

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 a Prefix Information Option containing a /64 prefix from the /56 prefix assigned in Step 19. The preferred and valid lifetimes in the Prefix Information Option must not be more than the preferred and valid lifetimes from the IA_PD.

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 CERouterInterop.2.3: Router Advertisement

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

References:

- [RFC 7084] – L-3
- [RFC 7084] – L-4
- [RFC 7084] – L-5
- [RFC 7084] – L-6
- [RFC 4191]

Test Setup: The network is setup according to [Common Topology](#). [Common Test Setup](#) is performed at the beginning of this test part with the exception in Part B that no global IPv6 address is assigned to the WAN interface of the CE-Router. The [Common Test Cleanup](#) procedure is performed after each part.

Procedure:

Part A: Route Information Option

1. Configure DHCP-Server1 to assign a /60 prefix thru Prefix Delegation.
2. CE-Router enables DHCPv6-PD.
3. Observe the packets transmitted on WAN1.
4. Observe the packets transmitted on LAN1.
5. REF-Host1 transmits an ICMPv6 Echo Request to TAR-Host1's global address.
6. Observe the packets transmitted on LAN1 and WAN1.

Part B: No Prefixes

7. Disable CE-Router on WAN1.
8. Configure DHCP-Server1 to not assign IA_PD.
9. Enable CE-Router on WAN1.
10. Observe the packets transmitted on LAN1 and WAN1.

Part C: Advertising Interface

11. Disable TAR-Host1 on LAN1.
12. Enable TAR-Host1 on LAN1.
13. Observe the packets transmitted on LAN1 and WAN1.

Observable Results:

- *Part A*
 - Step 3:** 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 4:** 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 6:** TAR-Host1 must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.



- *Part B*
Step 10: CE-Router must not transmit Router Advertisements with a router lifetime greater than zero on LAN1.
- *Part C*
Step 13: 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 CERouterInterop.2.4: Stateless DHCP Server

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

References:

- [RFC 7084] – 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-Host1 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 CERouterInterop.2.5: DHCP Server

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

References:

- [RFC 7084] – L-8
- [RFC 7084] – L-10
- [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 DHCPv6 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.
7. After time T1 observe the messages transmitted on LAN1.
8. REF-Host1 transmits an ICMPv6 Echo Request to TAR-Host1 DHCPv6 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.
12. Disable the LAN1 interface on CE-Router.
13. After time T2 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 DHCPv6 address.
16. Observe the packets transmitted on LAN1.

Part D: Decline Message

17. Configure REF-Host2 to have the same global address that the CE-Router will assign to TAR-Host1.
18. Enable TAR-Host1 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.

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 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. REF-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.

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.



Test CERouterInterop.2.6: Prefix Change

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

References:

- [RFC 7084] – L-3
- [RFC 7084] – L-13
- [RFC 7084] – 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 and WAN1.
5. Configure DHCP-Server1 to remove Prefix X from the available Prefixes. Configure Prefix Y to be available for CE-Router.
6. Wait for CE-Router to transmit a DHCPv6 Renew for Prefix X.
7. Observe the packets transmitted on LAN1 and WAN1.
8. Wait for the valid lifetime of Prefix X to timeout.
9. Assign REF-Host2 a global address using Prefix X from Step 2.
10. REF-Host1 transmits ICMPv6 Echo Request to Prefix Y global address of TAR-Host1.
11. Observe the packets transmitted on LAN1 and WAN1.
12. REF-Host2 transmits ICMPv6 Echo Request from Prefix X global address to TAR-Host1 Prefix X global address.
13. Observe the packets transmitted on LAN1 and WAN1.
14. REF-Host2 transmits ICMPv6 Echo Request from Prefix X global address from Step 9 to REF-Host1.
15. Observe the packets transmitted on LAN1 and WAN1.

Part B: Reconfigure

16. CE-Router enables DHCPv6-PD. Allow time for CE-Router to distribute Prefix X, with a preferred and valid lifetime of 1 minute, on LAN interfaces.
17. REF-Host1 transmits ICMPv6 Echo Request to TAR-Host1's Prefix X global address.
18. Observe the packets transmitted on LAN1 and WAN1.
19. Configure DHCP-Server1 to delegate new Prefix Y to CE-Router using DHCPv6 Reconfigure. Allow time for CE-Router to timeout the valid lifetime of Prefix X and distribute the prefix on LAN interfaces.
20. Observe the packets transmitted on WAN1 and LAN1.
21. Assign REF-Host2 a global address using Prefix X from Step 16.
22. REF-Host1 transmits ICMPv6 Echo Request to Prefix Y global address of TAR-Host1.



23. Observe the packets transmitted on LAN1 and WAN1.
24. REF-Host2 transmits ICMPv6 Echo Request from Prefix X global address to TAR-Host1 Prefix X global address.
25. Observe the packets transmitted on LAN1 and WAN1.
26. REF-Host2 transmits ICMPv6 Echo Request from Prefix X global address from Step 21 to REF-Host1.
27. Observe the packets transmitted on LAN1 and WAN1.

Observable Results:

- *Part A*

Step 4: TAR-Host1 must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.

Step 7: 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 Information Option containing a preferred lifetime of zero for all prefixes previous delegated on LAN1. The valid lifetime of the Prefix Option must not be greater than the value advertised in the IA_PD. Future DHCPv6 Renew messages from the CE-Router must NOT include the old IPv6 prefix.

Step 11: TAR-Host1 must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.

Step 13: TAR-Host1 must timeout Prefix1. TAR-Host1 must not respond to ICMPv6 Echo Requests or Neighbor Solicitations from REF-Host2 with the address associated with Prefix X.

Step 15: CE-Router must not forward ICMPv6 Echo Request from REF-Host2. CE-Router must transmit an ICMPv6 Destination Unreachable message with a code 5 to REF-Host2.

- *Part B*

Step 18: TAR-Host1 must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.

Step 20: 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. CE-Router must transmit Router Advertisements with a Prefix Information Option containing a preferred lifetime of zero for all prefixes previous delegated on LAN1. The valid lifetime of the Prefix Option must not be greater than the value advertised in the IA_PD. Future DHCPv6 Renew messages from the CE-Router must NOT include the old IPv6 prefix.

Step 23: TAR-Host1 must respond to all ICMPv6 Echo Requests from REF-Host1 with ICMPv6 Echo Replies.

Step 25: TAR-Host1 must timeout Prefix1. TAR-Host1 must not respond to ICMPv6 Echo Requests or Neighbor Solicitations from REF-Host2 with the address associated with Prefix X.

Step 27: CE-Router must not forward ICMPv6 Echo Request from REF-Host2. CE-Router must transmit an ICMPv6 Destination Unreachable message with a code 5 to REF-Host2.

Possible Problems:

- None.





Test CERouterInterop.2.7: Link MTU

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

References:

- [RFC 7084] – 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.

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 and WAN1.

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 and WAN1.

Observable Results:

- *Part A*
Step 4: CE-Router must transmit a valid ICMPv6 Packet Too Big Message to TAR-Host1. TAR-Host1 should fragment the ICMPv6 Echo Request 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.
- Part A may be omitted if the CE-Router uses the same MTU learned on WAN1 as the MTU on the LAN interface.



Test CERouterInterop.2.8: DNS Information in Router Advertisement

Purpose: Verify an IPv6 CE Router properly transmits Router Advertisements containing DNS Server and DNS Search List.

References:

- [RFC 7084] – L-11
- [RFC 6106]

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: Recursive DNS Server

1. Disable the DHCPv6 Client on TAR-Host1.
2. Configure CE-Router to include a DNS Recursive Name Server option that includes DNS-Server global IPv6 address as the name server.
3. Enable TAR-Host1 on LAN1.
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: DNS Search List

7. Disable the DHCPv6 Client on TAR-Host1.
8. 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 “dhcpv6”.
9. Enable TAR-Host1 on LAN1.
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:** The CE-Router must transmit a Router Advertisement containing Recursive DNS Server Option.
 - 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:** The CE-Router must transmit a Router Advertisement containing a Recursive DNS Server Option and DNS Search List Option.
 - Step 12:** TAR-Host1 must transmit a valid DNS request to DNS-Server1. DNS-Server1 must transmit a valid DNS response.

Possible Problems:



- The TAR-Host1 may not process DNS information in Router Advertisement or support the ability to disable the DHCPv6 Client. Omit steps 5, 6, 11, 12 when this happens.



Test CERouterInterop.2.9: Ingress Filtering

Purpose: Verify an IPv6 CE Router properly supports ingress filtering in accordance with BCP 38.

References:

- [RFC 7084] – L-14
- [RFC 7084] – S-2
- [RFC 2827]

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: Manually configured address

1. Configure TAR-Host1 with a global IPv6 address using a prefix not delegated to the CE-Router.
2. TAR-Host1 to transmits an ICMPv6 Echo Requests to REF-Host1 using the configured address in Step 1.
3. Observe the packets transmitted on LAN1 and WAN1.

Part B: Previous Address

4. Configure DHCP-Server1 to use address lifetime for Prefix X to last the entire test.
5. TAR-Host1 to transmits an ICMPv6 Echo Requests to REF-Host1.
6. Observe the packets transmitted on LAN1 and WAN1.
7. Power off the CE-Router.
8. Configure the DHCP-Server1 to delegate a new Prefix Y to the CE Router.
9. Power on the CE-Router. Allow time for TAR-Host1 to obtain a Prefix Y.
10. Configure TAR-Host1 to transmit an ICMPv6 Echo Request using an address from Prefix X to REF-Host1.
11. Observe the packets transmitted on LAN1 and WAN1.

Observable Results:

- *Part A*
Step 3: The CE-Router must not forward the ICMPv6 Echo Request from TAR-Host1 to REF-Host1. The CE-Router must send an ICMPv6 Destination Unreachable message with code 5 to TAR-Host1.
- *Part B*
Step 6: REF-Host1 must respond to all ICMPv6 Echo Requests from TAR-Host1 with ICMPv6 Echo Replies.
Step 11: The CE-Router must not forward the ICMPv6 Echo Request from TAR-Host1 to REF-Host1. The CE-Router must send an ICMPv6 Destination Unreachable message with code 5 to TAR-Host1.

Possible Problems:

- None.



Section 3: 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 CERouterInterop.3.1: ICMPv6

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

References:

- [RFC 4294]
- [RFC 4443]
- [RFC 4291]
- [RFC 7084] – 4.1
- [RFC 7084] – G-1
- [RFC 7084] – 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 LAN interface.
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 DHCPv6 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 LAN1 and 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 RequestThe 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 CE-Router does not implement an application for sending Echo Request.
- The TAR-Router may not support the ability to transmit a link-local Echo Request, if so Step 9 thru 10 may be omitted.



Test CERouterInterop.3.2: 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:

- [RFC 7084] – 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.

Procedure:

Part A: LAN to WAN

1. Configure a global address on TAR-Host1 thru either SLAAC or DHCP.
2. TAR-Host1 transmits an ICMPv6 Echo Request to REF-Host1 continuously.
3. Power cycle the CE-Router.
4. Observe the packets transmitted by the NUT.

Part B: WAN to LAN

5. Configure a global address on TAR-Host1 thru either SLAAC or DHCP.
6. REF-Host1 transmits an ICMPv6 Echo Request to TAR-Host1 continuously.
7. Power cycle the CE Router.
8. Observe the packets transmitted by the NUT.

Observable Results:

- *Part A*
Step 4: CE-Router must not forward the ICMPv6 Echo Request to TAR-Router1 until the CE Router has acquired an address and prefixes.
- *Part B*
Step 8: CE-Router must not forward the ICMPv6 Echo Request to TAR-Router1 until the CE Router has acquired an address and prefixes.

Possible Problems:

- None.



Test CERouterInterop.3.3: 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:

- [RFC 7084] – G-4
- [RFC 7084] – 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 to transmit a Router Advertisement with a Router Lifetime of 0.
2. Observe the packets transmitted on LAN1.
3. REF-Host1 transmits ICMPv6 Echo Request to CE-Router.
4. Observe the packets transmitted on WAN1.
5. TAR-Router1 transmits ICMPv6 Echo Request to TAR-Host1.
6. Observe the packets transmitted on LAN1.

Part B: Loses Default Route

7. Configure TAR-Router1 to transmit Router Advertisement with a Router Lifetime of 600.
8. Observe the packets transmitted on LAN1.
9. REF-Host1 transmits ICMPv6 Echo Request to TAR-Host1.
10. Observe the packets transmitted on LAN1.
11. Configure TAR-Router1 to transmit Router Advertisement with a Router Lifetime of 0.
12. Observe the packets transmitted on LAN1.
13. REF-Host1 transmits ICMPv6 Echo Request to CE-Router.
14. Observe the packets transmitted on WAN1.
15. TAR-Router1 transmits ICMPv6 Echo Request to TAR-Host1.
16. Observe the packet transmitted on LAN1.

Observable Results:

- *Part A*
 - Step 2:** CE-Router must not transmit Router Advertisements with a Router Lifetime greater than zero.
 - Step 4:** CE-Router must not transmit an ICMPv6 Echo Reply to REF-Host1.
 - Step 6:** TAR-Host1 must not transmit an ICMPv6 Echo Reply to TAR-Router1.
- *Part B*
 - Step 8:** CE-Router must transmit a Router Advertisements with a Router Lifetime greater than zero.
 - Step 10:** TAR-Host1 must transmit an ICMPv6 Echo Replies to REF-Host1.
 - Step 12:** CE-Router must immediately transmit Router Advertisements with a Router Lifetime with a lifetime of zero.



Step 14: CE-Router must not transmit an ICMPv6 Echo Reply to REF-Host1.

Step 16: TAR-Host1 must not transmit an ICMPv6 Echo Reply to TAR-Router1.

Possible Problems:

- A CE-Router may not allow for forwarding Echo Requests when no default lifetime is available. These tests may require the reverse communication directions. In this case, transmit the ICMPv6 Echo Request from TAR-Host1.



Test CERouterInterop.3.4: Forwarding Loops

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

References:

- [RFC 7084] – WPD-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:

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.
6. TAR-Router1 transmits ICMPv6 Echo Request to an address that was not assigned to a LAN interface on the CE-Router.
7. 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.

Step 7: CE-Router should not transmit any ICMPv6 Echo Request to LAN1. CE-Router should transmit an ICMPv6 Destination Unreachable message to TAR-Router1.

Possible Problems:

- The ICMPv6 Destination Unreachable may be omitted if the RUT does not support transmission of the error message.



Section 4: Unique Local Addresses

Scope

The following tests cover IPv6 CE Router support of Unique Local Addresses.

Overview

The tests in this group verify that a Customer Edge Router that supports Unique Local Addresses (ULA) properly supports the use of the ULAs.



Test CERouterInterop.4.1: ULA Prefix Generation

Purpose: Verify an IPv6 CE Router properly generates and maintains ULA prefixes.

References:

- [RFC 7084] – ULA-1
- [RFC 7084] – ULA-2
- [RFC 7084] – ULA-3
- [RFC 7084] – ULA-5

Test Setup: The network is setup according to [Common Topology](#). [Common Test Setup](#) is performed at the beginning of this test part with the exception in Part D that no global IPv6 address is assigned to the WAN interface of the CE-Router. The [Common Test Cleanup](#) procedure is performed after each part.

Procedure:

Part A: Prefix Generation

1. Configure CE-Router to generate ULA prefix.
2. Observe the packets transmitted on LAN1.
3. Allow time for all devices on LAN1 for to perform Duplicate Address Detection on its ULA address.
4. REF-Host2 transmits ICMPv6 Echo Request to the ULA address of TAR-Host1.
5. Observe the packets transmitted on LAN1.

Part B: Reboot

6. Configure CE-Router to generate ULA prefix.
7. Observe the packets transmitted on LAN1.
8. Allow time for all devices on LAN1 to perform Duplicate Address Detection on its ULA address.
9. REF-Host2 transmits ICMPv6 Echo Request to the ULA address of TAR-Host1.
10. Observe the packets transmitted on LAN1.
11. Power cycle the CE-Router.
12. Observe the packets transmitted on LAN1.
13. Allow time for all devices on LAN1 to perform Duplicate Address Detection on its ULA address.
14. REF-Host2 transmits ICMPv6 Echo Request to the ULA address of TAR-Host1.
15. Observe the packets transmitted on LAN1.

Part C: User Configuration

16. Configure CE-Router with a valid ULA address to advertise.
17. Observe the packets transmitted on LAN1.
18. Allow time for all devices on LAN1 to perform Duplicate Address Detection on it's ULA address.
19. REF-Host2 transmits ICMPv6 Echo Request to the ULA address of TAR-Host1.
20. Observe the packets transmitted on LAN1.

Part D: Only Advertise Unique Local Address

21. Configure CE-Router to only advertise Unique Local Prefix in Router Advertisements.
22. Observe the packets transmitted on LAN1.

Observable Results:



- *Part A*
 - Step 2:** CE-Router must transmit Router Advertisement with a Prefix Information Option with a valid ULA prefix. The Router Advertisement must also contain the Router Information Option for the prefix that is advertised.
 - Step 5:** TAR-Host1 must receive all the ICMPv6 Echo Request sent from REF-Host2 and respond with ICMPv6 Echo Replies.
- *Part B*
 - Step 7:** CE-Router must transmit Router Advertisement with a Prefix Information Option with a valid ULA prefix.
 - Step 10:** TAR-Host1 must receive all the ICMPv6 Echo Request sent from REF-Host2 and respond with ICMPv6 Echo Replies.
 - Step 12:** CE-Router must transmit Router Advertisements with a same prefix advertised in Step 7.
 - Step 15:** TAR-Host1 must receive all the ICMPv6 Echo Request sent from REF-Host2 and respond with ICMPv6 Echo Replies.
- *Part C*
 - Step 17:** CE-Router must transmit Router Advertisement with a Prefix Information Option with the ULA prefix configured in Step 16. The Router Advertisement must also contain the Router Information Option for the prefix that is advertised.
 - Step 20:** TAR-Host1 must receive all the ICMPv6 Echo Request sent from REF-Host2 and respond with ICMPv6 Echo Replies.
- *Part D*
 - Step 22:** CE-Router must transmit Router Advertisements with a router lifetime of zero on LAN1.

Possible Problems:

- This test may be omitted if the CE-Router may not be able to generate ULA address.
- Part C may be omitted if the CE-Router doesn't support user-configurable Unique Local Address.



Test CERouterInterop.4.2: ULA Site Border

Purpose: Verify an IPv6 CE Router properly routes ULA prefixes as a site border router.

References:

- [RFC 7084] – ULA-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.

Procedure:

1. Configure CE-Router to generate ULA prefix.
2. Observe the packets transmitted on LAN1.
3. Allow time for all devices on LAN1 for to perform Duplicate Address Detection on its ULA address.
4. TAR-Host1 transmits ICMPv6 Echo Request to REF-Host1 using the ULA source address.
5. Observe the packets transmitted on LAN1 and WAN1.

Observable Results:

Step 2: CE-Router must transmit a Router Advertisement with a Prefix Information Option with a valid ULA prefix.

Step 5: TAR-Host1 transmits an ICMPv6 Echo Request using a ULA as a source address to the global address of REF-Host1. CE-Router must not forward the Echo Request to WAN1.

Possible Problems:

- This test may be omitted if the CE-Router may not be able to generate ULA addresses.



Appendix-A Required Data

When you apply for an IPv6 Ready CE Router Logo Phase-2 you need to submit test logs. In this appendix detailed requirement for the test logs are described.

1.1 Interoperability Target Device Requirements

Each applicant must be tested against 2 Target Routers and 2 Target Hosts. All Vendors MUST have different IPv6 stacks.

1.2 Required Data

The following interoperability test result data are required for IPv6 Ready CE Router Logo Phase-2.

The CE-Router, TAR-Host1 and TAR-Router1 in each round of interoperability will be referred to here as follows:

CE-Router	VendorX DeviceName DeviceVersion	Vendor name of CE-Router Device name of CE-Router Device version of CE-Router
TAR-Host1	VendorA Vendor B	Vendor names of TAR-Host1
TAR-Router1	VendorC VendorD	Vendor names of TAR-Router1

A. Topology Map

Network topology figures or address list, with IPv6 addresses and MAC address of each attached interface, are required. Fig. 1 is an example of topology figure. Fig. 2 is an example of an address list.

Naming Syntax

TAR-Host1.TAR-Router1.topology

e.g. *VendorA.VendorC.topology*

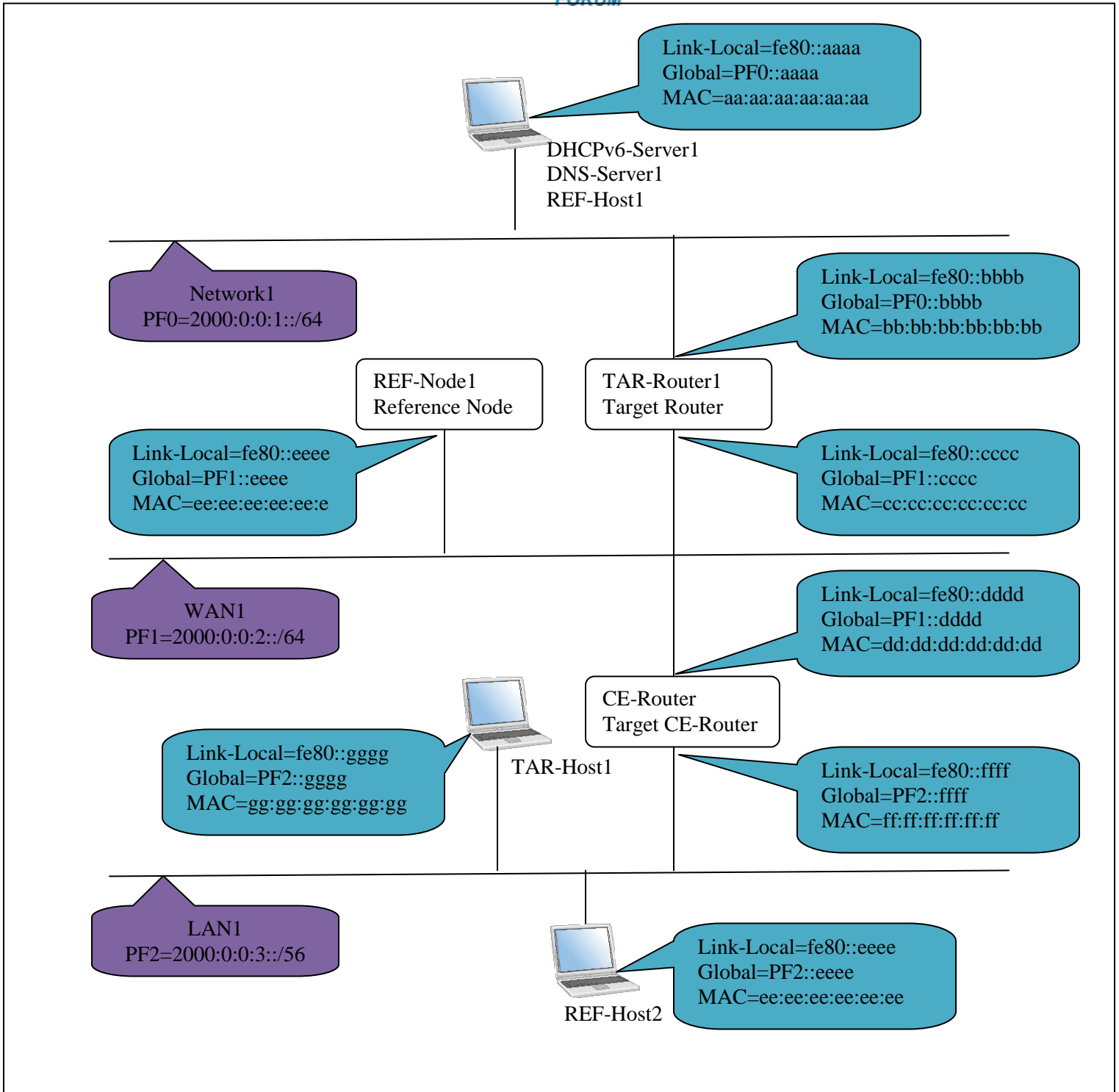


Figure 1 - Topology Figure Example



Network1	WAN1 PF1=2000:0:0:2::/64	LAN1 PF2=2000:0:0:3/56
PF0=2000:0:0:1::/64	TAR-ROUTER1 [WAN1]:	CE-ROUTER [LAN1]:
DHCPv6-SERVER1:	Link-Local=fe80::cccc	Link-Local=fe80::ffff
Link-Local=fe80::aaaa	Global=PF1::cccc	Global=PF2::ffff
Global=PF0::aaaa	MAC=cc:cc:cc:cc:cc:cc	MAC=ff:ff:ff:ff:ff:ff
MAC=aa:aa:aa:aa:aa:aa		
	CE-ROUTER1 [WAN1]:	TAR-HOST1:
DNS-SERVER1:	Link-Local=fe80::dddd	Link-Local=fe80::gggg
Link-Local=fe80::aaaa	Global=PF1::dddd	Global=PF2::gggg
Global=PF0::aaaa	MAC=dd:dd:dd:dd:dd:dd	MAC=gg:gg:gg:gg:gg:gg
MAC=aa:aa:aa:aa:aa:aa		
	REF-NODE1:	REF-HOST2:
REF-HOST1:	Link-Local=fe80::eeee	Link-Local=fe80::eeee
Link-Local=fe80::aaaa	Global=PF1::eeee	Global=PF2::eeee
Global=PF0::aaaa	MAC=ee:ee:ee:ee:ee:ee	MAC=ee:ee:ee:ee:ee:ee
MAC=aa:aa:aa:aa:aa:aa		
TAR-ROUTER1 [Network1]:		
Link-Local=fe80::bbbb		
Global=PF0::bbbb		
MAC=bb:bb:bb:bb:bb:bb		

Figure 2 - Address List Example

B. Command Log

Ping6 and traceroute are used as default applications. When you run a test with ping6 or traceroute application, please save the command and command output into individual files. Alternate applications are allowed. Save the command log regardless of what application was used. Save a command files for each test on each node.

Naming Syntax

Chapter.Section.Part.SRC.DST.result

SRC – the vendor name of the node on which the commands were run.

DST – the vendor name of the destination of the command.

If either nodes are Reference Hosts or the DST is not a host in the topology, they are represented as REF.

e.g. CERouterInterop.3.1A ICMPv6 Link-Local Address (LAN)

3.1.A.REF.VendorX.result

3.1.A.VendorX.REF.result

NOTE: Reference files for CERouterInterop.1.1B and CERouterInterop.2.1.B should be named as follows:

Chapter.Section.Part.SRC.DST1.DST2.result

Where DST1 is the Target Device that was enabled first and DST2 is the Target Device that was enabled second.



e.g. CERouter.1.1.B Duplicate Address Detection Tentative Address Duplicated (Link-Local)

1.1.B.REF.VendorC.VendorX.result – includes command from step 12.

1.1.B.REF.VendorX.VendorC.result – includes command from step17.

C. Packet Capture File

Capture all packets on each link during the test with a device that is not part of the test. Make individual tcpdump(pcap) format file for each test and link or put the packet dump in a readable HTML file.

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

e.g. tcpdump -i if0 -s 4096 -w 1.1.A.VendorX.VendorC.WAN.pcap

Naming Syntax

Chapter.Section.Part.CE-Router.TargetNode.Link.pcap

For "*Link*", use the captured link name.

For "*TargetNode*", use Vendor Name of Target Device on the link.

e.g. CERouterInterop.3.1.A ICMPv6 Link-Local Address (LAN)

3.1.A.VendorX.VendorA.LAN.pcap

e.g. CERouterInterop.3.1.C ICMPv6 Link-Local Address (WAN)

1.2.VendorX.VendorC.WAN.pcap

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.

For each test part, include the following information:

	VendorA VendorC	VendorB VendorD
VendorX	PASS or N/S	PASS or N/S

Naming Syntax

VendorX.DeviceName.DeviceVersion.table

1.3 Data Archive

- Conformance Self-Test results or Conformance Lab test results in are placed in the Conformance directory.
- Interoperability data files described above are placed in the Interoperability directory.
- Make a tar.gz format archive file named *VendorX.DeviceName.Version*

Please organize your data as following directory structure:

*VendorX.DeviceName.DeviceVersion/
Conformance/*



Interoperability/
VendorA.VendorC/
Results/
Captures/
VendorB.VendorD/
Results/
Captures/

A. File List for CE Router

NOTE: Some files may be named differently or missing due to lack of support for Advanced Functionality or use of possible problems

/Interoperability
VendorX.DeviceName.DeviceVersion.table
VendorA.VendorC/
VendorA.VendorC.topology
Results/
1.1.A.REF.VendorX.result
1.1.B.REF.VendorC.VendorX.result
1.1.B.REF.VendorX.VendorC.result
1.2.REF.VendorX.result
1.3.A.REF.VendorX.result
1.3.B.REF.VendorX.result
1.4.A.REF.VendorX.result
1.4.B.REF.VendorX.result
1.4.C.REF.VendorX.result
1.4.D.VendorC.VendorX.result
1.4.E.REF.VendorX.result
1.4.G.VendorX.REF.result
1.4.H.VendorX.REF.result
1.4.I.VendorC.VendorX.result
1.6.REF.VendorX.result
1.8.REF.VendorX.result
2.1.A.REF.VendorX.result
2.1.B.REF.VendorA.VendorX.result
2.1.B.REF.VendorX.VendorA.result
2.2.A.VendorA.VendorX.result
2.2.A.VendorA.REF.result
2.2.B.VendorA.VendorX.result
2.2.B.VendorA.REF.result
2.2.C.VendorA.VendorX.result
2.2.C.VendorA.REF.result
2.3.A.REF.VendorA.result
2.4.A.VendorA.REF.result
2.4.B.VendorA.REF.result
2.5.A.REF.VendorA.result
2.5.B.REF.VendorA.result
2.5.C.REF.VendorA.result



2.5.E.VendorA.REF.result
2.5.F.VendorA.REF.result
2.6.A.REF1.VendorA.result
2.6.A.REF2.VendorA.result
2.6.A.REF2.REF1.result
2.6.B.REF1.VendorA.result
2.6.B.REF2.VendorA.result
2.6.B.REF2.REF1.result
2.7.A.VendorA.REF.result
2.7.B.REF.VendorA.result
2.8.A.VendorA.REF.result
2.8.B.VendorA.REF.result
2.9.A.VendorA.REF.result
2.9.B.VendorA.REF.result
3.1.A.VendorA.VendorX.result
3.1.A.VendorX.VendorA.result
3.1.B.VendorA.VendorX.result
3.1.B.VendorX.VendorA.result
3.1.C.VendorC.VendorX.result
3.1.C.VendorX.VendorC.result
3.1.D.VendorC.VendorX.result
3.1.D.VendorX.VendorC.result
3.1.E.VendorA.REF.result
3.2.A.VendorA.REF.result
3.2.B.REF.VendorA.result
3.3.A.REF.VendorX.result
3.3.A.VendorC.VendorA.result
3.3.B.REF.VendorX.result
3.3.B.REF.VendorA.result
3.3.B.VendorC.VendorA.result
3.4.VendorA.REF.result
3.4.VendorC.REF.result
4.1.A.REF.VendorA.result
4.1.B.REF.VendorA.result
4.1.C.REF.VendorA.result
4.2.VendorA.REF.result

/Captures

1.1.A.VendorX.VendorC.WAN.pcap
1.1.B.VendorX.VendorC.WAN.pcap
1.2.VendorX.VendorC.WAN.pcap
1.3.A.VendorX.VendorC.WAN.pcap
1.3.B.VendorX.VendorC.WAN.pcap
1.4.A.VendorX.VendorC.WAN.pcap
1.4.B.VendorX.VendorC.WAN.pcap
1.4.C.VendorX.VendorC.WAN.pcap
1.4.D.VendorX.VendorC.WAN.pcap
1.4.E.VendorX.VendorC.WAN.pcap
1.4.F.VendorX.VendorC.WAN.pcap



- 1.4.G.VendorX.VendorC.WAN.pcap
- 1.4.H.VendorX.VendorC.WAN.pcap
- 1.4.I.VendorX.VendorC.WAN.pcap
- 1.5.A.VendorX.VendorC.WAN.pcap
- 1.5.B.VendorX.VendorC.WAN.pcap
- 1.5.D.VendorX.VendorC.WAN.pcap
- 1.5.F.VendorX.VendorC.WAN.pcap
- 1.6.VendorX.VendorC.WAN.pcap
- 1.7.VendorX.VendorC.WAN.pcap
- 1.8.VendorX.VendorC.WAN.pcap
- 2.1.A.VendorX.VendorA.LAN.pcap
- 2.2.A.VendorX.VendorA.LAN.pcap
- 2.2.B.VendorX.VendorA.LAN.pcap
- 2.2.C.VendorX.VendorA.LAN.pcap
- 2.3.A.VendorX.VendorA.LAN.pcap
- 2.3.B.VendorX.VendorA.LAN.pcap
- 2.3.C.VendorX.VendorA.LAN.pcap
- 2.3.C.VendorX.VendorC.WAN.pcap
- 2.4.B.VendorX.VendorA.LAN.pcap
- 2.5.B.VendorX.VendorA.LAN.pcap
- 2.5.D.VendorX.VendorA.LAN.pcap
- 2.5.F.VendorX.VendorA.LAN.pcap
- 2.6.A.VendorX.VendorC.WAN.pcap
- 2.6.B.VendorX.VendorC.WAN.pcap
- 2.7.A.VendorX.VendorC.WAN.pcap
- 2.7.B.VendorX.VendorC.WAN.pcap
- 2.8.B.VendorX.VendorA.LAN.pcap
- 2.9.A.VendorX.VendorC.WAN.pcap
- 2.9.B.VendorX.VendorC.WAN.pcap
- 3.1.B.VendorX.VendorA.LAN.pcap
- 3.1.D.VendorX.VendorC.WAN.pcap
- 3.1.E.VendorX.VendorC.WAN.pcap
- 3.2.A.VendorX.VendorC.WAN.pcap
- 3.2.B.VendorX.VendorC.WAN.pcap
- 3.3.A.VendorX.VendorC.WAN.pcap
- 3.3.B.VendorX.VendorC.LAN.pcap
- 3.4.VendorX.VendorA.LAN.pcap
- 3.4.VendorX.VendorC.WAN.pcap
- 4.1.A.VendorX.VendorA.LAN.pcap
- 4.1.C.VendorX.VendorA.LAN.pcap
- 4.2.VendorX.VendorA.LAN.pcap
- 4.2.VendorX.VendorC.WAN.pcap
- 1.5.C.VendorX.VendorC.WAN.pcap
- 1.5.E.VendorX.VendorC.WAN.pcap
- 1.5.G.VendorX.VendorC.WAN.pcap
- 2.1.B.VendorX.VendorA.LAN.pcap
- 2.2.A.VendorX.VendorC.WAN.pcap
- 2.2.B.VendorX.VendorC.WAN.pcap
- 2.2.C.VendorX.VendorC.WAN.pcap
- 2.3.A.VendorX.VendorC.WAN.pcap
- 2.3.B.VendorX.VendorC.WAN.pcap
- 2.4.A.VendorX.VendorA.LAN.pcap
- 2.5.A.VendorX.VendorA.LAN.pcap
- 2.5.C.VendorX.VendorA.LAN.pcap
- 2.5.E.VendorX.VendorA.LAN.pcap
- 2.6.A.VendorX.VendorA.LAN.pcap
- 2.6.B.VendorX.VendorA.LAN.pcap
- 2.7.A.VendorX.VendorA.LAN.pcap
- 2.7.B.VendorX.VendorA.LAN.pcap
- 2.8.A.VendorX.VendorA.LAN.pcap
- 2.9.A.VendorX.VendorA.LAN.pcap
- 2.9.B.VendorX.VendorA.LAN.pcap
- 3.1.A.VendorX.VendorA.LAN.pcap
- 3.1.C.VendorX.VendorC.WAN.pcap
- 3.1.E.VendorX.VendorA.LAN.pcap
- 3.2.A.VendorX.VendorA.LAN.pcap
- 3.2.B.VendorX.VendorA.LAN.pcap
- 3.3.A.VendorX.VendorA.LAN.pcap
- 3.3.B.VendorX.VendorA.LAN.pcap
- 4.1.B.VendorX.VendorA.LAN.pcap
- 4.1.D.VendorX.VendorA.LAN.pcap

/VendorB.VendorD

VendorB.VendorD.topology

/Results

- 1.1.A.REF.VendorX.result
- 1.1.B.REF.VendorD.VendorX.result
- 1.1.B.REF.VendorX.VendorD.result



1.2.REF.VendorX.result
1.3.A.REF.VendorX.result
1.3.B.REF.VendorX.result
1.4.A.REF.VendorX.result
1.4.B.REF.VendorX.result
1.4.C.REF.VendorX.result
1.4.D.VendorD.VendorX.result
1.4.E.REF.VendorX.result
1.4.G.VendorX.REF.result
1.4.H.VendorX.REF.result
1.4.I.VendorD.VendorX.result
1.6.REF.VendorX.result
1.8.REF.VendorX.result
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2.1.B.REF.VendorB.VendorX.result
2.1.B.REF.VendorX.VendorB.result
2.2.A.VendorB.VendorX.result
2.2.A.VendorB.REF.result
2.2.B.VendorB.VendorX.result
2.2.B.VendorB.REF.result
2.2.C.VendorB.VendorX.result
2.2.C.VendorB.REF.result
2.3.A.REF.VendorB.result
2.4.A.VendorB.REF.result
2.4.B.VendorB.REF.result
2.5.A.REF.VendorB.result
2.5.B.REF.VendorB.result
2.5.C.REF.VendorB.result
2.5.E.VendorB.REF.result
2.5.F.VendorB.REF.result
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2.6.A.REF2.VendorB.result
2.6.A.REF2.REF1.result
2.6.B.REF1.VendorB.result
2.6.B.REF2.VendorB.result
2.6.B.REF2.REF1.result
2.7.A.VendorB.REF.result
2.7.B.REF.VendorB.result
2.8.A.VendorB.REF.result
2.8.B.VendorB.REF.result
2.9.A.VendorB.REF.result
2.9.B.VendorB.REF.result
3.1.A.VendorB.VendorX.result
3.1.A.VendorX.VendorB.result
3.1.B.VendorB.VendorX.result
3.1.B.VendorX.VendorB.result
3.1.C.VendorD.VendorX.result
3.1.C.VendorX.VendorD.result



3.1.D.VendorD.VendorX.result
3.1.D.VendorX.VendorD.result
3.1.E.VendorB.REF.result
3.2.A.VendorB.REF.result
3.2.B.REF.VendorB.result
3.3.A.REF.VendorX.result
3.3.A.VendorD.VendorB.result
3.3.B.REF.VendorX.result
3.3.B.REF.VendorB.result
3.3.B.VendorD.VendorB.result
3.4.VendorB.REF.result
3.4.VendorD.REF.result
4.1.A.REF.VendorB.result
4.1.B.REF.VendorB.result
4.1.C.REF.VendorB.result
4.2.VendorB.REF.result

/Captures

1.1.A.VendorX.VendorD.WAN.pcap
1.1.B.VendorX.VendorD.WAN.pcap
1.2.VendorX.VendorD.WAN.pcap
1.3.A.VendorX.VendorD.WAN.pcap
1.3.B.VendorX.VendorD.WAN.pcap
1.4.A.VendorX.VendorD.WAN.pcap
1.4.B.VendorX.VendorD.WAN.pcap
1.4.C.VendorX.VendorD.WAN.pcap
1.4.D.VendorX.VendorD.WAN.pcap
1.4.E.VendorX.VendorD.WAN.pcap
1.4.F.VendorX.VendorD.WAN.pcap
1.4.G.VendorX.VendorD.WAN.pcap
1.4.H.VendorX.VendorD.WAN.pcap
1.4.I.VendorX.VendorD.WAN.pcap
1.5.A.VendorX.VendorD.WAN.pcap
1.5.B.VendorX.VendorD.WAN.pcap
1.5.C.VendorX.VendorD.WAN.pcap
1.5.D.VendorX.VendorD.WAN.pcap
1.5.E.VendorX.VendorD.WAN.pcap
1.5.F.VendorX.VendorD.WAN.pcap
1.5.G.VendorX.VendorD.WAN.pcap
1.6.VendorX.VendorD.WAN.pcap
1.7.VendorX.VendorD.WAN.pcap
1.8.VendorX.VendorD.WAN.pcap
2.1.A.VendorX.VendorB.LAN.pcap
2.1.B.VendorX.VendorB.LAN.pcap
2.2.A.VendorX.VendorB.LAN.pcap
2.2.A.VendorX.VendorD.WAN.pcap
2.2.B.VendorX.VendorB.LAN.pcap
2.2.B.VendorX.VendorD.WAN.pcap
2.2.C.VendorX.VendorB.LAN.pcap



2.2.C.VendorX.VendorD.WAN.pcap
2.3.A.VendorX.VendorB.LAN.pcap
2.3.A.VendorX.VendorD.WAN.pcap
2.3.B.VendorX.VendorB.LAN.pcap
2.3.B.VendorX.VendorD.WAN.pcap
2.3.C.VendorX.VendorB.LAN.pcap
2.3.C.VendorX.VendorD.WAN.pcap
2.4.A.VendorX.VendorB.LAN.pcap
2.4.B.VendorX.VendorB.LAN.pcap
2.5.A.VendorX.VendorB.LAN.pcap
2.5.B.VendorX.VendorB.LAN.pcap
2.5.C.VendorX.VendorB.LAN.pcap
2.5.D.VendorX.VendorB.LAN.pcap
2.5.E.VendorX.VendorB.LAN.pcap
2.5.F.VendorX.VendorB.LAN.pcap
2.6.A.VendorX.VendorB.LAN.pcap
2.6.A.VendorX.VendorD.WAN.pcap
2.6.B.VendorX.VendorB.LAN.pcap
2.6.B.VendorX.VendorD.WAN.pcap
2.7.A.VendorX.VendorB.LAN.pcap
2.7.A.VendorX.VendorD.WAN.pcap
2.7.B.VendorX.VendorB.LAN.pcap
2.7.B.VendorX.VendorD.WAN.pcap
2.8.A.VendorX.VendorB.LAN.pcap
2.8.B.VendorX.VendorB.LAN.pcap
2.9.A.VendorX.VendorB.LAN.pcap
2.9.A.VendorX.VendorD.WAN.pcap
2.9.B.VendorX.VendorB.LAN.pcap
2.9.B.VendorX.VendorD.WAN.pcap
3.1.A.VendorX.VendorB.LAN.pcap
3.1.B.VendorX.VendorB.LAN.pcap
3.1.C.VendorX.VendorD.WAN.pcap
3.1.D.VendorX.VendorD.WAN.pcap
3.1.E.VendorX.VendorB.LAN.pcap
3.1.E.VendorX.VendorD.WAN.pcap
3.2.A.VendorX.VendorB.LAN.pcap
3.2.A.VendorX.VendorD.WAN.pcap
3.2.B.VendorX.VendorB.LAN.pcap
3.2.B.VendorX.VendorD.WAN.pcap
3.3.A.VendorX.VendorB.LAN.pcap
3.3.A.VendorX.VendorD.WAN.pcap
3.3.B.VendorX.VendorB.LAN.pcap
3.3.B.VendorX.VendorD.LAN.pcap
3.4.VendorX.VendorB.LAN.pcap
3.4.VendorX.VendorD.WAN.pcap
4.1.A.VendorX.VendorB.LAN.pcap
4.1.B.VendorX.VendorB.LAN.pcap
4.1.C.VendorX.VendorB.LAN.pcap



4.1.D.VendorX.VendorB.LAN.pcap
4.2.VendorX.VendorB.LAN.pcap
4.2.VendorX.VendorD.WAN.pcap