

# **IPv6 READY**

Conformance Test Scenario  
CE Router

**Technical Document**

Revision 1.0.1

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*IPv6 Forum*

*<http://www.ipv6forum.org>  
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## MODIFICATION RECORD

Version 1.0.1	July 11, 2016	T. Winters	<ul style="list-style-type: none"><li>• Removed 1.1.3E from Advanced Functionality – DNS Search List.</li><li>• Updated 1.29D to allow sending a Prefix Information Option with a preferred lifetime of zero. Matches 2.7.5B.</li></ul>
Version 1.0.0	January 14, 2016	T. Winters	<ul style="list-style-type: none"><li>• Initial Release of Finalized Test Plan.</li></ul>



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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  
NA: Neighbor Advertisement  
ND: Neighbor Discovery  
NS: Neighbor Solicitation  
NCE: Neighbor Cache Entry  
PD: Prefix Delegation  
RA: Router Advertisement  
RS: Router Solicitation  
TAR: Targeted Device  
REF: Reference Device  
ULA: Unique Local Address



## ADVANCED FUNCTIONALITY TEST

The following test may be omitted if the CE-Router does not support the advanced functionalities.

### Mandatory Features on LAN (Must select at least one)

- Supporting DNS Configuration by Stateless DHCPv6 (CERouter Section 2 Group 1)
- Supporting Address Assignment and DNS Configuration by DHCPv6 (CERouter Section 2 Group 2)

### General Advanced Features

- Transmitting Echo Requests (CERouter.1.1.17, CERouter.1.1.10 E - F)
- Supporting MTU configuration (CERouter.3.1.8, CERouter.1.5.8)

### Advanced Features on WAN

- Supporting Stateless Address Autoconfiguration (CERouter.1.4.6, CERouter.1.4.7, CERouter.1.4.8, CERouter.1.4.9, CERouter.1.4.10)
- Supporting DHCPv6 Release Message (CERouter.1.1.1E, CERouter.1.1.5F, CERouter.1.1.13, CERouter.1.1.16O, CERouter.1.2.2D, CERouter.1.2.7, CERouter.1.2.9O)
- Supporting DHCPv6 Confirm Message (CERouter.1.1.1B, CERouter.1.1.5C, CERouter.1.1.10, 1.1.16I, 1.1.16J)
- Supporting DHCPv6 Domain Search List Option (CERouter.1.1.3F, CERouter.1.1.17B, CERouter.1.1.17D, CERouter.1.1.17F)
- Configurable DHCPv6 Prefix Hint (CERouter.1.6.5)

### Advanced Features on LAN

- Supporting Unique Local Address (2.7.7, 3.2.4)



## 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 CE-Router'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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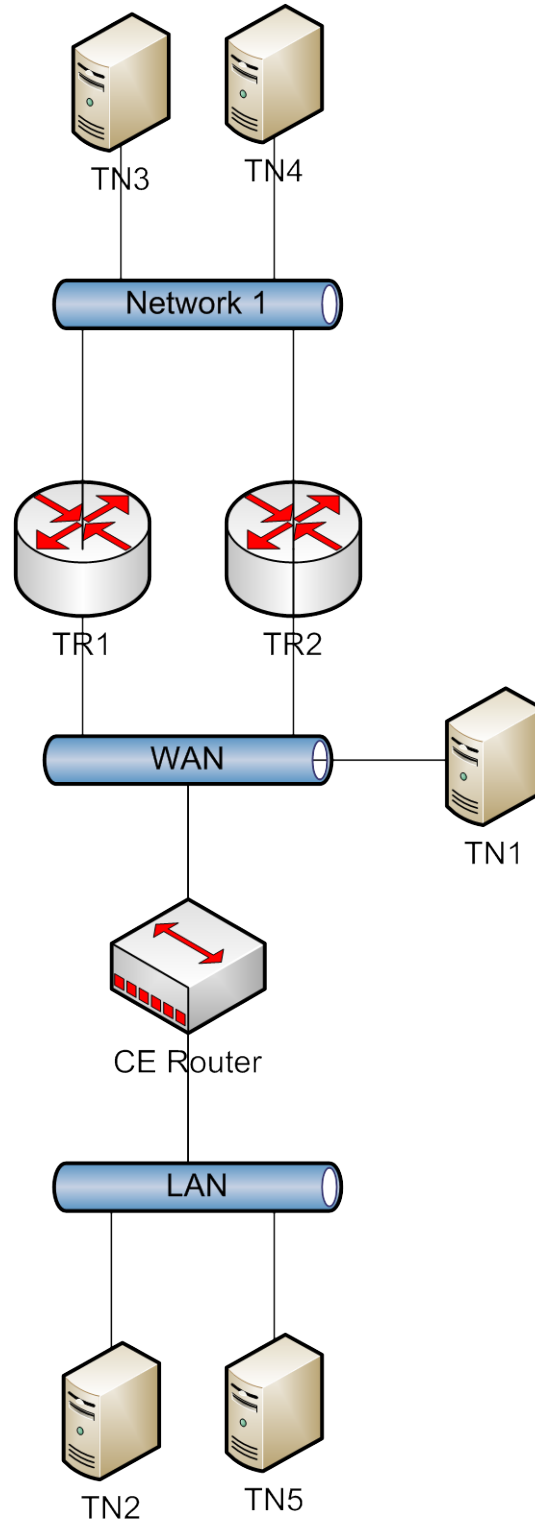
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## Common Topology

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







## Common Test Setup

Tests in this test suite may refer to a common test setup procedure defined for this section. Unless otherwise stated in the test case, each TR or TN will respond to Neighbor Solicitations with standard Neighbor Advertisements.

### Common Test Setup 1.1

Summary: This minimal setup procedure provides the CE-Router with a default route, a global address, DNS information, and prefix delegation purposes.

1. TR1 transmits a Router Advertisement to the all-nodes multicast address with the M and O Flag set. The Router Advertisement sets the current hop limit to 64. The Router Advertisement includes a Prefix Advertisement with a global prefix and the L bit set and the B bits clear. This should cause the CE-Router to add TR1 to its Default Router List and compute Reachable Time. The Router Lifetimes are long enough such that they do not expire during the test.
2. TR1 transmits an Echo Request to the NUT and responds to Neighbor Solicitations from the NUT. Wait for an Echo Reply from the NUT. This should cause the NUT to resolve the address of TR1 and create a Neighbor Cache entry for TR1 in state REACHABLE.
3. CE-Router transmits a DHCPv6 Solcit message to “All DHCP\_Relay\_Agents\_and\_Servers” multicast address (FF02::1:2). TN1 responds with a DHCPv6 Advertise message. The CE Router then sends a DHCPv6 Request message to TN1 asking for confirmed addresses and configuration. TN1 responds with a Reply message that contains the confirmed address and configuration. The DHCPv6 Reply message contains an IA\_NA and IA\_PD options with T1 set to 50 seconds and T2 set to 80 seconds. The DHCPv6 Reply also contains a DNS Recursive Name Server Option that includes TN3’s global address and a Domain Search List option that includes “test.example.com”.

### Common Test Setup 1.2

Summary: This minimal setup procedure provides the CE-Router with a global address, DNS information, and prefix delegation purposes.

1. TR1 transmits a Router Advertisement to the all-nodes multicast address with the M and O Flag set. This should cause the CE-Router to add TR1 to its Default Router List and compute Reachable Time. The Router Lifetimes are long enough such that they do not expire during the test.
2. CE-Router transmits a DHCPv6 Solcit message to “All DHCP\_Relay\_Agents\_and\_Servers” multicast address (FF02::1:2). TN1 responds with an DHCPv6 Advertise message. The CE Router then sends a DHCPv6 Request message to TN1 asking for confirmed addresses and configuration. TN1 responds with a Reply message that contains the confirmed address and configuration. The DHCPv6 Reply message contains an IA\_NA and IA\_PD options with T1 set to 50 seconds and T2 set to 80 seconds. The DHCPv6 Reply also contains a DNS Recursive Name Server Option that includes TN3’s global address and a Domain Search List option that includes “test.example.com”.



### Common Test Setup 1.3

Summary: This minimal setup procedure provides the CE-Router with two default routers TR1 and TR2, a global address, DNS information, and prefix delegation purposes.

1. TR1 and TR2 transmits a Router Advertisement to the all-nodes multicast address with the M and O Flag set. The Router Advertisement includes a Prefix Advertisement with a global prefix and the L bit set and the B bits clear. This should cause the CE-Router to add TR1 to its Default Router List and compute Reachable Time. The Router Lifetimes are long enough such that they do not expire during the test.
2. CE-Router transmits a DHCPv6 Solicit message to “All DHCP\_Relay\_Agents\_and\_Servers” multicast address (FF02::1:2). TN1 responds with an DHCPv6 Advertise message. The CE Router then sends a DHCPv6 Request message to TN1 asking for confirmed addresses and configuration. TN1 responds with a Reply message that contains the confirmed address and configuration. The DHCPv6 Reply message contains an IA\_NA and IA\_PD options with T1 set to 50 seconds and T2 set to 80 seconds. The DHCPv6 Reply also contains a DNS Recursive Name Server Option that includes TN3’s global address and a Domain Search List option that includes “test.example.com”.

### Common Test Cleanup

1. Any information learned 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: WAN Interface**

### **Scope**

The following tests cover IPv6 CE Router WAN Interface.

### **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.



## **Group 1: RFC 3315 and 3646 – Client Specification**

### **Scope**

The following tests cover specifications for the client implementation of the Dynamic Host Configuration Protocol for IPv6 (DHCPv6), Request For Comments 3315 and DNS Configuration options for Dynamic Host Configuration Protocol for IPv6 (DHCPv6), Request For Comments 3646.

The scope of the tests includes major functionality groups such as client behavior in client-initiated configuration exchange, client behavior in server-initiated configuration exchange, client behavior in server solicitation, and message validation by client. The section provides test cases to verify the operation of DHCPv6 clients' functionality most commonly implemented in practice.

The section is structured mainly with regard to the above functionality groups. The organization of this section however will tend to depart from the organization of RFC 3315 when grouping based on considerations of test setup and procedure is applied.

These tests also verify the process for receiving a list of available DNS recursive name servers and a domain search list from a server in parallel with Address Assignment.

### **Overview**

These tests are designed to verify the readiness of a DHCPv6 client implementation vis-à-vis the base specifications of the Dynamic Host Configuration Protocol for IPv6.



## Test CERouter.1.1.1: Basic Message Exchange

**Purpose:** Verify an IPv6 CE Router properly handles the reception of Reply message during a basic message exchange.

### References:

- [RFC 7084] – WAA-4,
- [RFC 3315] - Sections 17.1.4,18.1.8 and 19.4.5

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of each test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Valid Reply message in response to Request*

1. Observe the packets transmitted by the CE-Router.
2. TN1 transmits an Echo Request to CE-Router's Global Address.
3. Observe the packets transmitted by the CE-Router.

#### *Part B: Valid Reply message in response to Confirm message*

4. Physically disconnect the CE-Router from the link on the proper interface. (Disabling and re-enabling the network interface can also achieve this).
5. Allow enough time elapses in which the CE-Router recognizes a link down situation (5 seconds) and reconnect the CE-Router.
6. Upon reception of a DHCPv6 Confirm message from the CE-Router at the time T1, TN1 transmits a properly formatted Reply message.
7. Allow time for the CE-Router to perform Duplicate Address Detection (DAD).
8. TN1 transmit an ICMPv6 Echo Request to the CE-Router's Global Address.
9. Observe the packets transmitted by the CE-Router.

#### *Part C: Valid Reply message in response to a Renew message*

10. Wait T1 timer (50 seconds).
11. Upon reception of a DHCPv6 Renew message from the CE-Router at the time T1, TN1 transmits a properly formatted DHCPv6 Reply message.
12. TN1 transmits an ICMPv6 Echo Request to the CE-Router's Global Address.
13. Observe the packets transmitted by the CE-Router.

#### *Part D: Valid Reply message in response to a Rebind message*

14. Wait T2 timer (80 seconds).
15. Upon reception of a DHCPv6 Rebind message from the CE-Router at the time T2, TN1 transmits a properly formatted Reply message.
16. TN1 transmits an ICMPv6 Echo Request to the CE-Router's Global Address.
17. Observe the packets transmitted by the CE-Router.

#### *Part E: Valid Reply message in response to a Release message*

18. Configure the CE-Router to release the IPv6 address on the WAN interface.
19. Upon reception of a DHCPv6 Release message from the CE-Router TN1 transmits a properly formatted DHCPv6 Reply message.
20. TN1 transmits an ICMPv6 Echo Request to the CE-Router's released address.
21. Observe the packets transmitted by the CE-Router.

#### *Part F: Valid Reply message in response to a Decline message*



22. After receiving a DAD NS from the CE-Router, TN1 transmits a solicited NA for that tentative address.
23. Upon reception of a DHCPv6 Decline message from the CE-Router TN1 transmits a properly formatted DHCPv6 Reply message.
24. TN1 transmits an ICMPv6 Echo Request to the CE-Router's declined address.
25. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 1:** The CE-Router performs duplicate address detection on each of the addresses in any IAs it receives in the DHCPv6 Reply message from TN1 before using that address for traffic. The CE-Router transmitted DAD NS for each of its addresses.  
**Step 3:** The CE-Router must transmit an ICMPv6 Echo Reply to TN1.
- *Part B*  
**Step 9:** The CE-Router must transmit an ICMPv6 Echo Reply to TN1.
- *Part C*  
**Step 13:** The CE-Router must transmit an ICMPv6 Echo Reply to TN1.
- *Part D*  
**Step 17:** The CE-Router must transmit an ICMPv6 Echo Reply to TN1.
- *Part E*  
**Step 21:** Upon reception of the ICMPv6 Echo Request message from TN1 to the released address, the CE-Router did not send an Echo Reply message.
- *Part F*  
**Step 25:** Upon reception of the ICMPv6 Echo Request message from TN1 to the declined IPv6 address, the CE-Router did not send an ICMPv6 Echo Reply message.

### Possible Problems:

- None.



## Test CERouter.1.1.2: Implementation of DHCP constants

**Purpose:** Verify an IPv6 CE Router properly listens on the correct UDP port and transmits messages to the correct DHCP constant address.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 5.1, 5.2 and 13

**Test Setup:** The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Multicast Address*

1. Enable DHCPv6 on the CE-Router.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Valid UDP port*

3. Enable DHCPv6 on the CE-Router.
4. Observe the packets transmitted by the CE-Router.
5. Upon reception of a DHCPv6 Solicit message from the CE-Router, TN1 transmits an DHCPv6 Advertise message to UDP port 546.
6. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** The CE-Router must transmit a DHCPv6 Solicit message with a destination address set to the “ALL\_DHCP\_Relay\_Agents\_and\_Servers” multicast address (FF02::1:2).
- *Part B*  
**Step 4:** The CE-Router must transmit a DHCPv6 Solicit message with a destination UDP port set to 547.  
**Step 6:** The CE-Router must process the correct DHCPv6 Advertise message and transmit a DHCPv6 Request message to TN1.

### Possible Problems:

- None.



### Test CERouter.1.1.3: DHCPv6 Option Format

**Purpose:** Verify an IPv6 CE Router properly transmits the correct DHCPv6 Option formats.

#### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 22.2
- [RFC 3315] – Section 17.1.1 and 22.4
- [RFC 3315] – Section 22.3
- [RFC 3646] – Section 3 and 4

**Test Setup:** The [Common Test Cleanup](#) procedure is performed after each part.

#### Procedure:

##### *Part A: Client Identifier Option format*

1. Enable DHCPv6 on the CE-Router.
2. Observe the packets transmitted by the CE-Router.

##### *Part B: IA\_NA Option Format*

3. Enable DHCPv6 on the CE-Router.
4. Observe the packets transmitted by the CE-Router.

##### *Part C: Server Identifier Option format*

5. Enable DHCPv6 on the CE-Router.
6. Observe the packets transmitted by the CE-Router.
7. Upon the reception of a DHCPv6 Solicit message from the CE-Router, TN1 transmits a valid DHCPv6 Advertise message including a Server Identifier Option.
8. Observe the packets transmitted by the CE-Router.

##### *Part D: IA Address Option Format*

9. Execute [Common Test Setup 1.1](#).
10. Wait T1 (50) seconds.
11. Observe the packets transmitted by the CE-Router.

##### *Part E: Option Request Option Format (DNS Recursive Name Server option)*

12. Enable DHCPv6 on the CE-Router.
13. Observe the packets transmitted by the CE-Router.

##### *Part F: Option Request Option Format (Domain Search List Option)*

14. Enable the packets transmitted by the CE-Router.
15. Observe the packets transmitted by the CE-Router.

#### Observable Results:

- *Part A*
  - Step 2:** The CE-Router transmits a properly formatted DHCPv6 Solicit message containing the following Client Identifier option values:
    - An option-code set to OPTION\_CLIENTID (1)
    - An option-length set to length of DUID in octets
    - DUID Field set to any non-zero number





- *Part B*

**Step 4:** The CE-Router transmits a properly formatted DHCPv6 Solicit message containing the following IA\_NA option values:

  - An option-code set to OPTION\_IA\_NA (3)
  - An option-length set to 12 + length of IA\_NA options field
  - An IAID value set to a number
  - Time T1 set to a number
  - Time T2 set to a number
- *Part C*

**Step 6:** The CE-Router transmits a properly formatted DHCPv6 Solicit message.  
**Step 8:** The CE-Router transmits a properly formatted DHCPv6 Request message containing the following Server Identifier option values:

  - An option-code set to OPTION\_SERVERID (2)
  - An option-length set to length of DUID in octets
  - DUID Field set to DUID for the Server
- *Part D*

**Step 11:** The CE-Router transmits a properly formatted DHCPv6 Renew message containing the following IA Address option values:

  - An option-code set to OPTION\_IAADDR (5)
  - An option-length set to 24 + length of IAaddr-options field
  - Any Valid IPv6 Address
  - A preferred lifetime
  - A valid lifetime
- *Part E*

**Step 13:** The CE-Router transmits a properly formatted Solicit message containing the following Option Request Option values:

  - An option-code set to OPTION\_\_ORO (6)
  - An option-length set to 2 \* number of requested options
  - A requested-option-code-n set to DNS Recursive Name Server Option (23)
- *Part F*

**Step 15:** The CE-Router transmits a properly formatted Solicit message containing the following Option Request Option values:

  - An option-code set to OPTION\_\_ORO (6)
  - An option-length set to 2 \* number of requested options
  - A requested-option-code-n set to Domain Search List option (24)

**Possible Problems:**

- None.



## Test CERouter.1.1.4: Client DHCP Unique Identifier Contents

**Purpose:** Verify an IPv6 CE Router properly format of the DHCP Client's DUID-LLT, DUID-EN, and DUID-LL option.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Sections 9.2, 9.3 and 9.4

**Test Setup:** No 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: DUID Format*

1. Enable DHCPv6 on the CE-Router.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: DUID Consistency*

3. Enable DHCPv6 on the CE-Router.
4. Observe the packets transmitted by the CE-Router.
5. Reboot the CE-Router.
6. Enable DHCPv6 on the CE-Router.
7. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*

**Step 2:** The CE-Router transmits a properly formatted DHCPv6 Solicit message containing one of the following DUID options:

#### **DUID-LLT**

- An option-code set to OPTION\_CLIENTID(1)
- An option-length set to the length of DUID in octets
- The type field was set to the value of 0x01
- A hardware type set to the IANA-assigned value
- A time value of DUID
- A link-layer address

#### **DUID-EN**

- An option-code set to OPTION\_CLIENTID(1)
- An option-length set to the length of DUID in octets
- The type field was set to the value of 0x02
- An Enterprise Number of DUID, IANA value
- A non-zero identifier number of the DUID

#### **DUID-LL**

- An option-code set to OPTION\_CLIENTID(1)
- An option-length set to the length of DUID in octets
- The type field was set to the value of 0x03



- A hardware type set to the IANA-assigned value
- A link-layer address of DUID
- *Part B*
  - Step 4:** The CE-Router transmits a properly formatted DHCPv6 Solicit message containing the following DUID-LLT option:
    - DUID-LLT**
      - An option-code set to OPTION\_CLIENTID(1)
      - An option-length set to the length of DUID in octets
      - The type field was set to the value of 0x01
      - A hardware type set to the IANA-assigned value
      - A time value of DUID
      - A link-layer address
    - DUID-EN**
      - An option-code set to OPTION\_CLIENTID(1)
      - An option-length set to the length of DUID in octets
      - The type field was set to the value of 0x02
      - An Enterprise Number of DUID, IANA value
      - A non-zero identifier number of the DUID
    - DUID-LL**
      - An option-code set to OPTION\_CLIENTID(1)
      - An option-length set to the length of DUID in octets
      - The type field was set to the value of 0x03
      - A hardware type set to the IANA-assigned value
      - A link-layer address of DUID
  - Step 7:** The CE-Router transmits a properly formatted DHCPv6 Solicit message with the DUID option containing the same values as in Step 4.

**Possible Problems:**

- None.



## Test CERouter.1.1.5: Elapsed Time Option Format

**Purpose:** Verify an IPv6 CE Router properly transmits an Elapsed Time Option format.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 22.9, 5.5 and 14.

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part with the exception of Part A and B. Part H uses a T1=50 seconds and T2= 2500 seconds, the preferred lifetime and valid lifetime. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

*Part A: Elapsed Time Option in Solicit message*

1. Enable DHCPv6 on the CE-Router.
2. Observe the packets transmitted by the CE-Router.

*Part B: Elapsed Time Option in Request message*

3. Enable DHCPv6 on the CE-Router.
4. Upon the reception of a DHCPv6 Solicit message from the CE-Router, TN1 transmits a properly formatted Advertise message.
5. Observe the packets transmitted by the CE-Router.

*Part C: Elapsed Time Option in Confirm message*

6. Physically disconnect the CE-Router from the link on the proper interface. (Disabling and re-enabling the network interface can also achieve this).
7. Allow enough time elapses in which the CE-Router recognizes a link down situation (5 seconds) and reconnect the CE-Router.
8. Observe the packets transmitted by the CE-Router.

*Part D: Elapsed Time Option in Renew message*

9. Wait T1 timer (50 seconds).
10. Observe the packets transmitted by the CE-Router.

*Part E: Elapsed Time Option in Rebind message*

11. Wait T2 timer (80 seconds).
12. Observe the packets transmitted by the CE-Router.

*Part F: Elapsed Time Option in Release message*

13. Configure the CE-Router to release the IPv6 address on the WAN interface.
14. Observe the packets transmitted by the CE-Router.

*Part G: Elapsed Time option in Decline message*

15. After receiving a DAD NS from the CE-Router, TN1 transmits a solicited NA for that tentative address.
16. Observe the packets transmitted by the CE-Router.

*Part H: Maximum Elapsed Time in elapsed-time field*

17. After the T1 timer (50 seconds) the CE-Router to transmits 8 DHCPv6 Renew message or 1256 (0xffff + REN\_MAX\_RT) seconds elapsed since the first Renew message was received.
18. Observe the packets transmitted by the CE-Router.

### Observable Results:



- *Part A*

**Step 2:** The CE-Router transmits properly formatted DHCPv6 Solicit messages containing the following Elapsed Time option values:

  - An option-code set to OPTION\_ELAPSED\_TIME (8)
  - An option-length set to 2
  - An elapsed time set to a number
- *Part B*

**Step 5:** The CE-Router transmits properly formatted DHCPv6 Request messages containing the following Elapsed Time option values:

  - An option-code set to OPTION\_ELAPSED\_TIME (8)
  - An option-length set to 2
  - An elapsed time set to a number
- *Part C*

**Step 8:** The CE-Router transmits properly formatted DHCPv6 Confirm messages containing the following Elapsed Time option values:

  - An option-code set to OPTION\_ELAPSED\_TIME (8)
  - An option-length set to 2
  - An elapsed time set to a number
- *Part D*

**Step 10:** The CE-Router transmits properly formatted DHCPv6 Renew messages containing the following Elapsed Time option values:

  - An option-code set to OPTION\_ELAPSED\_TIME (8)
  - An option-length set to 2
  - An elapsed time set to a number
- *Part E*

**Step 12:** The CE-Router transmits properly formatted DHCPv6 Rebind messages containing the following Elapsed Time option values:

  - An option-code set to OPTION\_ELAPSED\_TIME (8)
  - An option-length set to 2
  - An elapsed time set to a number
- *Part F*

**Step 14:** The CE-Router transmits properly formatted DHCPv6 Release messages containing the following Elapsed Time option values:

  - An option-code set to OPTION\_ELAPSED\_TIME (8)
  - An option-length set to 2
  - An elapsed time set to a number
- *Part G*

**Step 16:** The CE-Router transmits properly formatted DHCPv6 Decline messages containing the following Elapsed Time option values:

  - An option-code set to OPTION\_ELAPSED\_TIME (8)
  - An option-length set to 2
  - An elapsed time set to a number
- *Part H*

**Step 18:** The CE-Router transmits a first DHCPv6 Renew message containing an Elapsed Time option with its elapsed-time value set to 0. The CE-Router must retransmit the



DHCPv6 Renew messages containing an Elapsed Time option with its elapsed-time value set to the time elapsed since the first DHCPv6 Renew message unless the time since the first Renew message is greater than or equal to 0xffff.

**Possible Problems:**

- None.



## Test CERouter.1.1.6: Identity Association Consistency

**Purpose:** Verify an IPv6 CE Router properly maintains the IAID for the IA is consistent across all restarts.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 10

**Test Setup:** The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. Enable DHCPv6 on the CE-Router.
2. Observe the packets transmitted by the CE-Router.
3. Reboot the CE-Router.
4. Enable DHCPv6 on the CE-Router.
5. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** The CE-Router transmits a properly formatted DHCPv6 Solicit message contacting the following IA\_NA option values:

- An option-code set to OPTION\_IA\_NA (3)
- An option-length set to 12 + length of IA\_NA options field
- An IAID value set to a number

**Step 5:** The CE-Router transmits a properly formatted DHCPv6 Solicit message containing the same IAID value as in Step 2.

### Possible Problems:

- None.



## Test CERouter.1.1.7: Transmission of Solicit Messages

**Purpose:** Verify an IPv6 CE Router transmits properly formatted Solicit messages and properly follows the retransmission algorithm for Solicit messages.

### References:

- [RFC 7084] – W-1
- [RFC 7084] – WAA- 8
- [RFC 3315] – Sections 5.5, 14, 15.1, 16, 17.1, 17.1.1, 17.1.2, and 22.9
- [RFC 3346] – Sections 3 and 4
- [RFC 7083] – Section 3

**Test Setup:** The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Solicit message format*

1. Enable DHCPv6 on the CE-Router.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Retransmission Time of Solicit Message*

3. Enable DHCPv6 on the CE-Router.
4. Wait  $RT_{prev} = MRT + MRT * RAND$  ( $108 \leq RT_{prev} \leq 132$ ).
5. Observe the packets transmitted by the CE-Router.
6. Wait  $0xffff + SOL\_MAX\_RT$  seconds after the first DHCPv6 Solicit message.
7. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*

**Step 2:** The CE-Router transmits a properly formatted DHCPv6 Solicit message containing the following elements:

  - Src Address is a link-local for that interface
  - The msg-type field was set to the value of 1 (Solicit)
  - A header containing a Transaction ID
  - A Client Identifier Option (containing DUID)
  - An Elapsed Time Option
  - IA\_NA Option
  - DNS Recursive Server Option
- *Part B*

**Step 5:** The CE-Router should properly transmit Solicit messages according to the chart below. The transaction ID is the same for all retransmitted messages.

Solicit Message	Minimum Delay	Maximum Delay
First message	-	-
Second message	$RT$ (greater than 1.0 sec)= $IRT + RAND * IRT$	$RT(1.1 \text{ sec}) =$ $IRT + RAND * IRT$





	Where IRT=1, RAND>0	Where IRT=1, RAND= +.1
X message	3240 seconds =.9*MRT where MRT=3600	3960 seconds =1.1*MRT where MRT = 3600
X+1 message	3240 seconds =.9*MRT where MRT=3600	3960 seconds =1.1*MRT where MRT=3600

**Step 7:** The first Solicit message containing an Elapsed Time option with its elapsed-time value set to 0, and the followed retransmit Solicit messages' elapsed-time value set to the time elapsed since the first Solicit message was received. The elapsed-time value is set to 0xffff when the time elapsed of 0xffff or longer since the first Solicit message was received. The elapsed-time value of these Solicit messages should be in the range of the follow chart:

Solicit message	Minimum of Elapsed-time value	Maximum of Elapsed-time value
First message	0	0
Second message	Value=1000ms =IRT+RAND*IRT Where IRT=1s, RAND=0	Value=1100ms = IRT+RAND*IRT Where IRT=1s, RAND=0.1
Third message	Value=2900ms =Valueprev+ RT RT=2*RTprev+RAND*RTprev Where RAND=-0.1	Value=3410ms =Valueprev+ RT RT=2*RTprev+RAND*RTprev Where RAND=0.1
	Value>Valueprev	Value>Valueprev
Y message	Value=0xffff	Value=0xffff
	Value=0xffff	Value=0xffff

**Possible Problems:**

- The CE-Router may define other values for Transmission and Retransmission Parameters in RFC3315. These values can be used for Part B.



## Test CERouter.1.1.8: Message Exchange Termination for Solicit messages

**Purpose:** Verify an IPv6 CE Router properly implements the mechanism for message exchange termination for Solicit message.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 14 and 17.1.2

**Test Setup:** The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

*Part A: Receives Advertise message without Preference Option before first RT elapse.*

1. Enable DHCPv6 on the CE-Router.
2. Observe the packets transmitted by the CE-Router.
3. TN1 immediately transmits a DHCPv6 Advertise message that does not include a Preference Option.
4. Observe the packets transmitted by the CE-Router.

*Part B: Receives Advertise message without Preference Option after first RT elapse*

5. Enable DHCPv6 on the CE-Router.
6. Wait for two DHCPv6 Solicit messages from the CE-Router.
7. TN1 transmits an DHCPv6 Advertise message that does not include a Preference Option.
8. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** The CE-Router transmits a Solicit message.  
**Step 4:** The CE-Router must wait  $IRT + RAND * IRT$  (greater than 1.0) seconds before transmitting a DHCPv6 Request message. The CE-Router must not transmit a DHCPv6 Request message immediately after receiving the Advertise message from the TN1.
- *Part B*  
**Step 8:** The CE-Router transmits a DHCPv6 Request message immediately after receiving the Advertise message from TN1.

### Possible Problems:

- If the CE-Router is configured with either MRC or MRD set to a value other than 0, the CE-Router will terminate the message exchange according to section 14 of RFC 3315; therefore the above test cases would not apply.



## Test CERouter.1.1.9: Transmission of Request message

**Purpose:** Verify an IPv6 CE Router transmits properly formatted Request messages and properly implements the mechanisms for message exchange termination for Request message.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 5.5, 14, 18.1.1 and 22.9
- [DHCP 3646] – Sections 3 and 4

**Test Setup:** The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Request message format*

1. Enable DHCPv6 on the CE-Router.
2. TN1 transmits a DHCPv6 Advertise message in response to the DHCPv6 Solicit message from the CE-Router.
3. Observe the packets transmitted by the CE-Router.

#### *Part B: Maximum Retransmission Time of Request Message*

4. Enable DHCPv6 on the CE-Router.
5. TN1 transmits a DHCPv6 Advertise message in response to the DHCPv6 Solicit message from the CE-Router.
6. Wait  $RT_{prev} = MRT + MRT * RAND$  ( $27 \leq RT_{prev} \leq 33$ ).
7. Observe the packets transmitted by the CE-Router.

#### *Part C: Maximum Retransmission Count of Request messages*

8. Enable DHCPv6 on the CE-Router.
9. TN1 transmits a DHCPv6 Advertise message in response to the DHCPv6 Solicit message from the CE-Router.
10. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 3:** The CE-Router transmits a properly formatted DHCPv6 Request message to TN1 containing:
  - The msg-type field was set to the value of 3 (Request)
  - A header containing a Transaction ID
  - A Client Identifier Option (containing a DUID)
  - A Server Identifier Option (containing a DUID)
  - An Elapsed Time Option
  - DNS Recursive Name Server Option
- *Part B*  
**Step 7:** The CE-Router transmits a properly formatted DHCPv6 Request message according to the Second message in the char below:

Request Message	Minimum Delay	Maximum Delay
-----------------	---------------	---------------



First message	-	-
Second message	0.9 = IRT + RAND*IRT Where IRT=1, RAND=-.1	1.1 = IRT + RAND*IRT Where IRT=1, RAND=+.1

The elapsed-time value of these Request messages should be in the range of the follow chart:

Request message	Minimum of Elapsed-time value	Maximum of Elapsed-time value
First message	0	0
Second message	Value=900ms=RT+0 RT=IRT+RAND*IRT Where IRT=1s, RAND=-0.1	Value=1100ms=RT+0 RT= IRT+RAND*IRT Where IRT=1s, RAND=0.1
Third message	Value=2610ms=Valueprev+ RT RT=2*RTprev+RAND*RTprev Where RAND=-0.1	Value=3410ms=Valueprev+ RT RT=2*RTprev+RAND*RTprev Where RAND=0.1
	Value>Valueprev	Value>Valueprev
10th message	Value>Valueprev	Value>Valueprev

- *Part C.*

**Step 10:** The CE-Router must terminate the message exchange after the transmission of REQ\_MAX\_RC (10) DHCPv6 Request messages. The CE-Router must not transmit any more DHCPv6 Request messages.

**Possible Problems:**

- If REQ\_MAX\_RC means the max Retransmission count in RFC 3315, maybe the observable results of Part D in Step 9 is: The CE-Router totally sent 11 Request messages including 1 transmission and REQ\_MAX\_RC (10) Retransmissions.
- The CE-Router may define other values for Transmission and Retransmission Parameters in RFC3315. These values can be used for Part B and C.



## Test CERouter.1.1.10: Transmission of Confirm messages

**Purpose:** Verify an IPv6 CE Router transmits properly formatted DHCPv6 Confirm message and properly implements the mechanism for message exchange termination for Confirm messages.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 5.5 and 18.1.2
- [RFC 3646] – Section 3, 4 and 5

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Confirm message format*

1. Physically disconnect the CE-Router from the link on the proper interface. (Disabling and re-enabling the network interface can also achieve this).
2. Allow enough time elapses in which the CE-Router recognizes a link down situation (5 seconds) and reconnect the CE-Router.
3. Observe the packets transmitted by the CE-Router.

#### *Part B: Maximum Retransmission Time of Confirm message*

4. Physically disconnect the CE-Router from the link on the proper interface. (Disabling and re-enabling the network interface can also achieve this).
5. Allow enough time elapses in which the CE-Router recognizes a link down situation (5 seconds) and reconnect the CE-Router.
6. Wait  $RT_{prev} = MRT + MRT * RAND$  ( $3.6 \leq RT_{prev} \leq 4.4$ ) seconds after the first DHCPv6 Confirm message.
7. Observe the packets transmitted by the CE-Router.

#### *Part C: Maximum Retransmission Count of Confirm messages*

8. Physically disconnect the CE-Router from the link on the proper interface. (Disabling and re-enabling the network interface can also achieve this).
9. Allow enough time elapses in which the CE-Router recognizes a link down situation (5 seconds) and reconnect the CE-Router.
10. Observe the packets transmitted by the CE-Router.

#### *Part D: Reserved Address Information*

11. Physically disconnect the CE-Router from the link on the proper interface. (Disabling and re-enabling the network interface can also achieve this).
12. Allow enough time elapses in which the CE-Router recognizes a link down situation (5 seconds) and reconnect the CE-Router.
13. TN1 transmits an ICMPv6 Echo Request to the CE-Router's Global Address obtained in Step 14 after CNF\_MAX\_RD elapsed after the first DHCPv6 Confirm message.
14. Observe the packets transmitted by the CE-Router.

#### *Part E: DNS Recursive Name Server option*

15. CE-Router transmits an Echo Request to "DHCPv6.TEST.EXAMPLE.COM".
16. Observe the packets transmitted by the CE-Router.



17. Physically disconnect the CE-Router from the link on the proper interface. (Disabling and re-enabling the network interface can also achieve this).
18. Allow enough time elapses in which the CE-Router recognizes a link down situation (5 seconds) and reconnect the CE-Router.
19. CE-Router transmits an Echo Request to “DHCPv6.TEST.EXAMPLE.COM”.
20. Observe the packets transmitted by the CE-Router.

*Part F: DNS Search List Option*

21. CE-Router transmits an Echo Request to “DHCPv6”.
22. Observe the packets transmitted by the CE-Router.
23. Physically disconnect the CE-Router from the link on the proper interface. (Disabling and re-enabling the network interface can also achieve this).
24. Allow enough time elapses in which the CE-Router recognizes a link down situation (5 seconds) and reconnect the CE-Router.
25. CE-Router transmits an Echo Request to “DHCPv6”.
26. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*

**Step 3:** The CE-Router transmits a DAD NS for its Link-Local address and then transmits a properly formatted Confirm Message between 0 and CONF\_MAX\_DELAY (1 second) after DAD processing to TN1 containing:

- The “msg-type” field was set to the value of 4 (Confirm)
- A header containing a Transaction ID
- A Client Identifier Option (containing a DUID)
- An IA Address Option with the proper IPv6 address associated with the IA and the preferred-lifetime and valid-lifetime fields was set to 0.
- An Elapsed Time Option

- *Part B*

**Step 7:** The CE-Router should properly transmit DHCPv6 Confirm messages according to the chart below. The transaction ID is the same for all retransmitted messages.

Confirm Message	Minimum Delay	Maximum Delay
First message	-	-
Second message	0.9 = IRT + RAND*IRT Where IRT=1, RAND= -.1	1.1 = IRT + RAND*IRT Where IRT=1, RAND= +.1
X message	3.6 seconds =.9*MRT where MRT=4	4.4 seconds =1.1*MRT where MRT=4
X+1 message	3.6 seconds =.9*MRT where MRT=4	4.4 seconds =1.1*MRT where MRT=4

X+1 message that after CNF\_MAX\_RD (10 seconds) is not observed.

The elapsed-time value of these Confirm messages should be in the range of the follow chart:

Confirm message	Minimum of Elapsed-time value	Maximum of Elapsed-time value
-----------------	-------------------------------	-------------------------------



First message	0	0
Second message	Value=900ms=RT+0 RT=IRT+RAND*IRT Where IRT=1s, RAND=-0.1	Value=1100ms=RT+0 RT= IRT+RAND*IRT Where IRT=1s, RAND=0.1
Third message	Value=2610ms=Valueprev+ RT RT=2*RTprev+RAND*RTprev Where RAND=-0.1	Value=3410ms=Valueprev+ RT RT=2*RTprev+RAND*RTprev Where RAND=0.1
	Value>Valueprev	Value>Valueprev
Last message	Value>Valueprev	Value =10000ms

- *Part C*  
**Step 10:** The CE-Router must terminate the message transmission of DHCPv6 Confirm message after CNF\_MAX\_RD (10 seconds). The CE-Router must not transmit a DHCPv6 Confirm messages.
- *Part D*  
**Step 14:** The CE-Router should continue using its IP address and transmit an ICMPv6 Echo Reply to TN1.
- *Part E*  
**Step 16:** The CE-Router transmitted a DNS Standard Query to TN3.  
**Step 20:** The CE-Router transmitted a DNS Standard Query to TN3.
- *Part F*  
**Step 22:** The CE-Router transmitted a DNS Standard Query containing QNAME is “DHPCv6.TEST.EXAMPLE.COM” to TN3.  
**Step 26:** The CE-Router transmitted a DNS Standard Query containing QNAME is “DHPCv6.TEST.EXAMPLE.COM” to TN3.

**Possible Problems:**

- The CE-Router may define other values for Transmission and Retransmission Parameters in RFC3315. These values can be used for Part B and C.



## Test CERouter.1.1.11: Transmission of Renew messages

**Purpose:** Verify an IPv6 CE Router properly transmits DHCPv6 Renew messages.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 5.5, 14 and 18.1.3
- [RFC 3646] – Section 3, 4 and 5

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. Part B has a T1=40s and T2=3000s. Part C has a T1=100s and T2=200s. The Preferred lifetime must be longer than T2. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Renew message format*

1. Wait T1 timer (50 seconds).
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Maximum Retransmission of Renew message*

3. Wait T1 timer (50 seconds). TN1 does not transmit a DHCPv6 Reply messages in response to the first DHCPv6 Renew messages.
4. Observe the packets transmitted by the CE-Router.

#### *Part C: Duration of Renew messages*

5. Wait T1 timer (50 seconds). No DHCPv6 Reply messages are transmitted in response to DHCPv6 Renew messages.
6. Observe the packets transmitted by the CE-Router.

### Observable Results:

#### • *Part A*

**Step 2:** The CE-Router must send its first DHCPv6 Renew message T1 (50) seconds after the reception of the DHCPv6 Reply message from TN1. The CE-Router transmits a properly formatted Renew message to TN1 containing:

- A “msg-type” field set to the value of RENEW (5)
- A header containing a Transaction ID
- A Server Identifier Option (containing a server DUID)
- A Client Identifier Option (containing a client DUID)
- An IA Address Option with the proper IPv6 address associated with the IA.
- An Elapsed Time Option
- DNS Recursive Name Server Option

#### • *Part B*

**Step 4:** The CE Router should properly transmit DHCPv6 Renew messages according to the chart below. The transaction ID is the same for all retransmitted messages.

Renew Message	Minimum Delay	Maximum Delay
First message	-	-
Second message	9 =	11 =





	IRT + RAND*IRT Where IRT=10, RAND= -.1	IRT + RAND*IRT Where IRT=10, RAND= +.1
X message	540 seconds =.9*MRT where MRT=600	660 seconds =1.1*MRT where MRT=600
X+1 message	540 seconds =.9*MRT where MRT=600	660 seconds =1.1*MRT where MRT=600

X+1 message that after T2 (2000 seconds) is not observed.

The first Renew message contains an Elapsed Time option with its elapsed-time value set to 0, and CE-Router retransmitted the Renew messages containing an Elapsed Time option with its elapsed-time value set to the time elapsed since the first Renew message was received, but elapsed-time value set to 0xffff when the time elapsed 0xffff since the first Renew message was received. The elapsed-time value of these Renew messages should be in the range of the follow chart:

Renew message	Minimum of Elapsed-time value	Maximum of Elapsed-time value
First message	0	0
Second message	Value=9000ms =IRT+RAND*IRT Where IRT=10s, RAND=-0.1	Value=11000ms = IRT+RAND*IRT Where IRT=10s, RAND=0.1
Third message	Value=26100ms =Valueprev+ RT RT=2*RTprev+RAND*RTprev Where RAND=-0.1	Value=34100ms =Valueprev+ RT RT=2*RTprev+RAND*RTpre v Where RAND=0.1
	Value>Valueprev	Value>Valueprev
Y message	Value=0xffff	Value=0xffff
	Value=0xffff	Value=0xffff

- *Part C*

**Step 6:** The CE-Router must terminate the message transmission of Renew message after MRD (Remaining time until T2). The CE-Router must not transmit any more Renew messages.

The transaction ID is the same for all retransmitted messages.

**Possible Problems:**

- The CE-Router may define other values for Transmission and Retransmission Parameters in RFC3315. These values can be used for Part B and C.



## Test CERouter.1.1.12: Transmission of Rebind message

**Purpose:** Verify an IPv6 CE Router properly transmits Rebind messages.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 5.5, 14 and 18.1.4
- [RFC 3646] – Section 3, 4 and 5

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. Part B has a valid address lifetime of 3000s. Part C has a valid address lifetime of 300s. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### Part A: Rebind message format

1. Wait T2 timer (80 seconds). TN1 doesn't respond to any DHCPv6 Renew message during this period.
2. Observe the packets transmitted by the CE-Router.

#### Part B: Maximum Retransmission Time of Rebind messages, T1 and T2 (Valid lifetime=3000s)

3. Wait T2 timer (80 seconds). TN1 doesn't respond to any DHCPv6 Renew message during this period.
4. Observe the packets transmitted by the CE-Router.

#### Part C: Maximum Retransmission Count of Rebind messages, T1 and T2 (Valid Lifetime = 300s)

5. Wait T2 timer (80 seconds). TN1 doesn't respond to any DHCPv6 Renew message during this period.
6. Observe the packets transmitted by the CE-Router.

### Observable Results:

#### • Part A

**Step 2:** The CE-Router must send its first DHCPv6 Rebind message T2 (80) seconds after the reception of the DHCPv6 Reply message from TN1. The CE-Router transmits a properly formatted Rebind message to TN1 containing:

- A "msg-type" field set to the value of REBIND (6).
- A header containing a Transaction ID
- A Client Identifier Option (containing a DUID)
- An IA Address Option with the proper IPv6 address associated with the IA
- An Elapsed Time Option
- DNS Recursive Name Server Option

#### • Part B

**Step 4:** The CE-Router must properly transmit DHCPv6 Rebind messages according to the chart below. The transaction ID is the same for all retransmitted messages.

Rebind Message	Minimum Delay	Maximum Delay
First message	-	-
Second message	9 =	11 =



	IRT + RAND*IRT Where IRT=10, RAND= -.1	IRT + RAND*IRT Where IRT=10, RAND= +.1
X message	540 seconds =.9*MRT where MRT=600	660 seconds =1.1*MRT where MRT=600
X+1 message	540 seconds =.9*MRT where MRT=600	660 seconds =1.1*MRT where MRT=600

X+1 message that after valid lifetime (3000 seconds) is not observed.

The first Rebind message contains an Elapsed Time option with its elapsed-time value set to 0, and CE-Router retransmitted the Rebind messages containing an Elapsed Time option with its elapsed-time value set to the time elapsed since the first Rebind message was received, but elapsed-time value set to 0xffff when the time elapsed 0xffff since the first Rebind message was received. The elapsed-time value of these Rebind messages should be in the range of the follow chart:

Rebind message	Minimum of Elapsed-time value	Maximum of Elapsed-time value
First message	0	0
Second message	Value=9000ms =IRT+RAND*IRT Where IRT=10s, RAND=-0.1	Value=11000ms = IRT+RAND*IRT Where IRT=10s, RAND=0.1
Third message	Value=26100ms =Valueprev+ RT RT=2*RTprev+RAND*RTprev Where RAND=-0.1	Value=34100ms =Valueprev+ RT RT=2*RTprev+RAND*RTprev Where RAND=0.1
	Value>Valueprev	Value>Valueprev
Y message	Value=0xffff	Value=0xffff
	Value=0xffff	Value=0xffff

- *Part C*

**Step 6:** The CE-Router must terminate the message transmission of DHCPv6 Rebind message after MRD (Remaining time until valid lifetimes of all addresses have expired). The CE-Router must not transmit any more Rebind messages.

**Possible Problems:**

- The CE-Router may define other values for Transmission and Retransmission Parameters in RFC3315. These values can be used for Part B and C.



## Test CERouter.1.1.13: Transmission of Release messages

**Purpose:** Verify an IPv6 CE Router properly transmits Release messages.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 5.5, 14 and 18.1.6
- [RFC 3646] – Section 3, 4 and 5

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Release message format*

1. Configure the CE-Router to release the IPv6 address on the WAN interface.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Release of Received Address*

3. Configure the CE-Router to release the IPv6 address on the WAN interface.
4. Observe the packets transmitted by the CE-Router.
5. TN1 transmits an ICMPv6 Echo Request to the CE-Router's released address.
6. Observe the packets transmitted by the CE-Router.

#### *Part C: Retransmission of Release message*

7. Configure the CE-Router to release the IPv6 address on the WAN interface. TN1 does not transmit a DHCPv6 Reply messages in response to the first DHCPv6 Release messages.
8. Observe the packets transmitted by the CE-Router.

#### *Part D: Maximum Retransmission Count of Release message, no Reply message from Server*

9. Configure the CE-Router to release the IPv6 address on the WAN interface. TN1 does not transmit a DHCPv6 Reply messages in response to the first DHCPv6 Release messages.
10. Observe the packets transmitted by the CE-Router.

#### *Part E: Retransmission and message exchange termination, Server responds with Reply message*

11. Configure the CE-Router to release the IPv6 address on the WAN interface.
12. Wait for the CE-Router to transmit two DHCPv6 Release messages.
13. TN1 transmits a DHCPv6 Reply message to the CE-Router that includes a Status Code option with the value NoBinding for each IA in the CE-Router for each IA in the CE-Router's DHCPv6 Release message.
14. Observe the packets transmitted by the CE-Router.

#### *Part F: Elapsed-time value of the retransmit Release message*

15. Configure the CE-Router to release the IPv6 address on the WAN interface.
16. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** The CE-Router transmit a properly formatted DHCPv6 Release message to TN1 containing:
  - A “msg-type” field set to the value of 8 (RELEASE).



- A header containing a Transaction ID.
- A Client Identifier Option (containing a DUID)
- A Server Identifier Option
- An IA Address Option with the proper IPv6 address associated with the IA
- An Elapsed Time Option

• *Part B*

**Step 4:** The CE-Router transmits a properly formatted DHCPv6 Release message to TN1.

**Step 6:** The CE-Router must not transmit an ICMPv6 Echo Reply.

• *Part C*

**Step 8:** The CE-Router transmits a properly formatted DHCPv6 Release Message according to the Second Message in the chart below.

Release Message	Minimum Delay	Maximum Delay
First message	-	-
Second message	0.9 seconds = IRT + RAND*IRT Where IRT=1, RAND= -.1	1.1 seconds = IRT + RAND*IRT Where IRT=1, RAND= +.1

• *Part D*

**Step 10:** The CE-Router must terminate the message exchange after the transmission of REL\_MAX\_RC (5) Release messages. The CE-Router must not transmit any more Release messages. The transaction ID is the same for all retransmitted messages.

• *Part E*

**Step 14:** The CE-Router ceases the transmission of Release messages upon reception of the Reply message from TN1.

• *Part F*

**Step 16:** The CE-Router transmits the first DHCPv6 Release message contains an Elapsed Time option with its elapsed-time value set to 0, and CE-Router retransmitted the DHCPv6 Release messages containing an Elapsed Time option with its elapsed-time value set to the time elapsed since the first DHCPv6 Release message was received, The elapsed-time value of these DHCPv6 Release messages should be in the range of the follow chart:

Release message	Minimum of Elapsed-time value	Maximum of Elapsed-time value
First message	0	0
Second message	Value=900ms =IRT+RAND*IRT Where IRT=1s, RAND=-0.1	Value=1100ms = IRT+RAND*IRT Where IRT=1s, RAND=0.1
Third message	Value=2610ms =Valueprev+ RT RT=2*RTprev+RAND*Rtprev Where RAND=-0.1	Value=3410ms =Valueprev+ RT RT=2*Rtprev+RAND*Rtprev Where RAND=0.1
4 <sup>th</sup> message	Value=5859ms =Valueprev+ RT RT=2*Rtprev+RAND*Rtprev Where RAND=-0.1	Value=8261ms =Valueprev+ RT RT=2*Rtprev+RAND*Rtprev Where RAND=0.1
5 <sup>th</sup> message	Value=12032ms =Valueprev+ RT RT=2*Rtprev+RAND*Rtprev	Value=18448ms =Valueprev+ RT RT=2*Rtprev+RAND*Rtprev



	Where RAND=-0.1	Where RAND=0.1
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**Possible Problems:**

- None.



## Test CERouter.1.1.14: Transmission of Decline messages

**Purpose:** Verify an IPv6 CE Router properly creates and transmits Decline messages.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 5.5, 14, 18.1.7 and 18.1.8
- [RFC 3646] – Section 3, 4 and 5

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Decline message format*

1. After receiving a DAD NS from the CE-Router, TN1 transmits a solicited NA for that tentative address.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Decline of received address*

3. After receiving a DAD NS from the CE-Router, TN1 transmits a solicited NA for that tentative address.
4. Observe the packets transmitted by the CE-Router.
5. TN1 transmits an ICMPv6 Echo request to the same IPv6 address in the DHCPv6 Reply message from TN1.
6. Observe the packets transmitted by the CE-Router.

#### *Part C: Retransmission of Decline message*

7. After receiving a DAD NS from the CE-Router, TN1 transmits a solicited NA for that tentative address.
8. Observe the packets transmitted by the CE-Router.

#### *Part D: Maximum Retransmission Count of Decline message, no Reply message from Server*

9. After receiving a DAD NS from the CE-Router, TN1 transmits a solicited NA for that tentative address.
10. Observe the packets transmitted by the CE-Router.

#### *Part E: Retransmission and message exchange termination, Server responds*

11. After receiving a DAD NS from the CE-Router, TN1 transmits a solicited NA for that tentative address.
12. TN1 transmits a DHCPv6 Reply message to the CE-Router that includes a Status Code option with the value NoBinding.
13. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 2:** The CE-Router transmits a properly formatted Decline message to TN1 containing:
    - A link-local source address, not the tentative address in Step 1
    - A “msg-type” field set to the value of 9 (DECLINE)
    - A header containing a Transaction ID



- A Client Identifier Option (containing a DUID)
  - A Server Identifier Option
  - An IA Address Option with the IPv6 address acquired in Step 1 and the proper IA association
  - An Elapsed Time Option
- *Part B*
    - Step 4:** The CE-Router transmits a properly formatted Decline message to TN1.
    - Step 6:** The CE-Router must not reply to the ICMPv6 Echo Request transmitted from TN1.
  - *Part C*
    - Step 8:** The CE-Router transmits a properly formatted DHCPv6 Decline Message according to the Second Message in the chart below.

Decline Message	Minimum Delay	Maximum Delay
First message	-	-
Second message	0.9 seconds = IRT + RAND*IRT Where IRT=1, RAND= -.1	1.2 seconds = IRT + RAND*IRT Where IRT=1, RAND= +.1

- *Part D*
  - Step 10:** The CE-Router must terminate the message exchange after the transmission of DEC\_MAX\_RC (5) Decline messages. Then the CE-Router must not transmit any more DHCPv6 Decline messages. The transaction ID is the same for all retransmitted messages. The first DHCPv6 Decline message contains an Elapsed Time option with its elapsed-time value set to 0, and CE-Router retransmitted the DHCPv6 Decline messages containing an Elapsed Time option with its elapsed-time value set to the time elapsed since the first Decline message was received, The elapsed-time value of these DHCPv6 Decline messages should be in the range of the follow chart:

Decline message	Minimum of Elapsed-time value	Maximum of Elapsed-time value
First message	0	0
Second message	Value=900ms =IRT+RAND*IRT Where IRT=1s, RAND=-0.1	Value=1100ms = IRT+RAND*IRT Where IRT=1s, RAND=0.1
Third message	Value=2610ms =Valueprev+ RT RT=2*Rtprev+RAND*Rtprev Where RAND=-0.1	Value=3410ms =Valueprev+ RT RT=2*Rtprev+RAND*Rtprev Where RAND=0.1
4 <sup>th</sup> message	Value=5859ms =Valueprev+ RT RT=2*Rtprev+RAND*Rtprev Where RAND=-0.1	Value=8261ms =Valueprev+ RT RT=2*Rtprev+RAND*Rtprev Where RAND=0.1
5 <sup>th</sup> message	Value=12032ms =Valueprev+ RT RT=2*Rtprev+RAND*Rtprev Where RAND=-0.1	Value=18448ms =Valueprev+ RT RT=2*Rtprev+RAND*Rtprev Where RAND=0.1

- *Part E*
  - Step 13:** The CE-Router ceases the transmission of DHCPv6 Decline messages upon reception of the DHCPv6 Reply message.





**Possible Problems:**

- If DEC\_MAX\_RC means the max Retransmission count in RFC 3315, the observable results of Part D in Step are: The CE-Router must transmit 6 DHCPv6 message including 1 transmission and DEC\_MAX\_RC (5) Retransmission.
- The CE-Router may define other values for Transmission and Retransmission Parameters in RFC3315. These values can be used for Part C and D.



## Test CERouter.1.1.15: Reception of Advertise messages

**Purpose:** Verify an IPv6 CE Router properly handles the reception of DHCPv6 Advertise messages.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 17.1.3

**Test Setup:** The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. Enable DHCPv6 on the CE-Router.
2. Upon reception of a DHCPv6 Solicit message TN1 transmits properly formatted DHCPv6 Advertise message containing a Status Code of NoAddrsAvail (code 2). No IA\_PD is included in the Advertise message.
3. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 5:** The CE-Router must silently discard the DHCPv6 Advertise message. The CE-Router must continue to transmit DHCPv6 Solicit messages.

### Possible Problems:

- None.



## Test CERouter.1.1.16: Client Initiated Exchange – Reception of a Reply message

**Purpose:** Verify an IPv6 CE Router properly handles the reception of DHCPv6 Reply message after initiating an exchange.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 18.1.8

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of each part using a valid lifetime of 200 with the exception of Part A, B, F, G, H. Allow the IA\_PD T1/T2 and lifetimes to be long enough such that they do not expire during the test. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: T1 and T2 Times Recorded*

1. Enable DHCPv6 on the CE-Router.
2. Upon reception of a DHCPv6 Solicit message TN1 transmits a properly formatted DHCPv6 Advertise message.
3. Upon reception of a DHCPv6 Request message TN1 transmits a properly formatted DHCPv6 Reply message with an IA\_NA containing a values of T1=50 and T2 = 80.
4. Wait T1 (50) seconds.
5. Observe the packets transmitted by the CE-Router.
6. Wait 30 seconds.
7. Observe the packets transmitted by the CE-Router.

#### *Part B: New Address in IA Option*

8. Enable DHCPv6 on the CE-Router.
9. Upon reception of a DHCPv6 Solicit message TN1 transmits a properly formatted DHCPv6 Advertise message.
10. Upon reception of a DHCPv6 Request message TN1 transmits a properly formatted DHCPv6 Reply message with an IA\_NA with Address1 containing a values of T1=50 and T2 = 80.
11. Upon reception of a DHCPv6 Renew message TN1 transmits a properly formatted DHCPv6 Reply message with IA\_NA option including two IA address options containing Address1 and Address2 respectively.
12. Wait T1 (50) seconds.
13. Observe the packets transmitted by the CE-Router.

#### *Part C: Update Lifetimes*

14. Upon reception of a DHCPv6 Renew message TN1 transmits a properly formatted DHCPv6 Reply message with an IA\_NA with a valid lifetime of 100.
15. TN1 transmits an ICMPv6 Echo Request to the CE-Router's global address.
16. Observe the packets transmitted by the CE-Router.
17. Wait 110 seconds.
18. TN1 transmits an ICMPv6 Echo Request to the CE-Router's global address.
19. Observe the packets transmitted by the CE-Router.

#### *Part D: IA Address option – Valid Lifetime set to zero*



20. Upon reception of a DHCPv6 Renew message TN1 transmits a properly formatted DHCPv6 Reply message with an IA\_NA with a valid lifetime of 0.
21. TN1 transmits an Echo Request to CE-Router's Global Address.
22. Observe the packets transmitted by the CE-Router.

*Part E: IA Address option not included in IA from Server*

23. Upon reception of a DHCPv6 Renew message TN1 transmits a properly formatted DHCPv6 Reply message containing an IA\_NA without an IA Address.
24. TN1 transmits an Echo Request to CE-Router's Global Address.
25. Observe the packets transmitted by the CE-Router.

*Part F: Reply message contains UnspecFail*

26. Enable DHCPv6 on the CE-Router.
27. Upon reception of a DHCPv6 Solicit message TN1 transmits a properly formatted DHCPv6 Advertise message.
28. Upon reception of a DHCPv6 Request message TN1 transmits a properly formatted DHCPv6 Reply message containing a Status Code option with a value of UnspecFail.
29. Observe the packets transmitted by the CE-Router.

*Part G: Reply message contains UseMulticast*

30. Enable DHCPv6 on the CE-Router.
31. Upon reception of a DHCPv6 Solicit message TN1 transmits a properly formatted DHCPv6 Advertise message.
32. Upon reception of a DHCPv6 Request message TN1 transmits a properly formatted DHCPv6 Reply message containing a Status Code option with a value of UseMulticast.
33. Observe the packets transmitted by the CE-Router.

*Part H: Reply messages contains NotOnLink in response to a Request message.*

34. Enable DHCPv6 on the CE-Router.
35. Upon reception of a DHCPv6 Solicit message TN1 transmits a properly formatted DHCPv6 Advertise message.
36. Upon reception of a DHCPv6 Request message TN1 transmits a properly formatted DHCPv6 Reply message containing a Status Code option with a value of NotOnLink.
37. Observe the packets transmitted by the CE-Router.

*Part I: Reply message contains NotOnLink in response to a Confirm message*

38. Physically disconnect the CE-Router from the link on the proper interface. (Disabling and re-enabling the network interface can also achieve this).
39. Allow enough time elapses in which the CE-Router recognizes a link down situation (5 seconds) and reconnect the CE-Router.
40. Upon reception of a DHCPv6 Confirm message TN1 transmits a properly formatted DHCPv6 Reply message containing a valid IA\_NA with a Status Code option with a value of NotOnLink.
41. Observe the packets transmitted by the CE-Router.

*Part J: Reply message in response to a Confirm message*

42. Physically disconnect the CE-Router from the link on the proper interface. (Disabling and re-enabling the network interface can also achieve this).
43. Allow enough time elapses in which the CE-Router recognizes a link down situation (5 seconds) and reconnect the CE-Router.
44. Upon reception of a DHCPv6 Confirm message TN1 transmits a properly formatted DHCPv6 Reply message.
45. TN1 transmits an Echo Request to CE-Router's Global Address.
46. Observe the packets transmitted by the CE-Router.

*Part K: Reply message contains NoBinding in response to a Renew message*



47. Wait T1 timer (50 seconds).
48. Upon reception of a DHCPv6 Renew message TN1 transmits a properly formatted DHCPv6 Reply message containing a Status Code option with a value of NoBinding for the IA\_NA for which the CE-Router requested configuration.
49. Observe the packets transmitted by the CE-Router.

*Part L: Reply message contains NoBinding in response to a Rebind message*

50. Wait T2 timer (80 seconds).
51. Upon reception of a DHCPv6 Rebind message TN1 transmits a properly formatted DHCPv6 Reply message containing a Status Code option with a value of NoBinding for the IA\_NA for which the CE-Router requested configuration.
52. Observe the packets transmitted by the CE-Router.

*Part M: Reply message contains no IA\_NA response to a Renew message*

53. Wait T1 timer (50 seconds).
54. Upon reception of a DHCPv6 Renew message TN1 transmits a properly formatted DHCPv6 Reply message without an IA\_NA option.
55. Observe the packets transmitted by the CE-Router.

*Part N: Reply message contains no IA\_NA in response to a Rebind message*

56. Wait T2 timer (80 seconds).
57. Upon reception of a DHCPv6 Rebind message TN1 transmits a properly formatted DHCPv6 Reply message without an IA\_NA option.
58. Observe the packets transmitted by the CE-Router.

*Part O: Reply message contains NoBinding in response to a Release message*

59. Configure the CE-Router to release the IPv6 address on the WAN interface.
60. Upon reception of a DHCPv6 Release message TN1 transmits a properly formatted DHCPv6 Reply message containing a Status Code option with a value of NoBinding for the IA\_NA for which the CE-Router requested configuration.
61. Observe the packets transmitted by the CE-Router.
62. TN1 transmits an ICMPv6 Echo Request to the CE-Router's released address.
63. Observe the packets transmitted by the CE-Router.

*Part P: Reply message contains NoBinding in response to a Decline message*

64. After receiving a DAD NS from the CE-Router, TN1 transmits a solicited NA for that tentative address.
65. Upon reception of a DHCPv6 Decline message TN1 transmits a properly formatted DHCPv6 Reply message containing a Status Code option with a value of NoBinding for the IA\_NA for which the CE-Router requested configuration.
66. Observe the packets transmitted by the CE-Router.
67. TN1 transmits an ICMPv6 Echo Request to the CE-Router's for the declined address.
68. Observe the packets transmitted by the CE-Router.

#### **Observable Results:**

- *Part A*
  - Step 5:** The CE-Router transmitted a DHCPv6 Renew message to TN1.
  - Step 7:** The CE-Router transmitted a DHCPv6 Rebind message to TN1.
- *Part B*
  - Step 13:** The CE-Router must transmit a DHCPv6 Renew message to TN1 containing an IA\_NA for both Address1 and Address2.
- *Part C*



**Step 16:** The CE-Router must transmit an ICMPv6 Echo Reply to TN1.

**Step 19:** The CE-Router must not transmit an ICMPv6 Echo Reply to TN1.

- *Part D*  
**Step 22:** The CE-Router must not transmit an ICMPv6 Echo Reply to TN1.
- *Part E*  
**Step 25:** The CE-Router must transmit an ICMPv6 Echo Reply to TN1.
- *Part F*  
**Step 29:** The CE-Router must continue transmitting its Request message. The CE-Router must limit the rate at which it retransmits the message and limit the duration of the time during which it retransmits the message.
- *Part G*  
**Step 33:** The CE-Router must retransmit the original DHCPv6 Request message to the TN1 using multicast through the interface on which the DHCPv6 Reply message from TN1 was received.
- *Part H*  
**Step 37:** The CE-Router must transmit a DHCPv6 Solicit message to the multicast address of FF02::1:2 or retransmit the DHCPv6 Request message using the same transaction ID without specifying any addresses.
- *Part I*  
**Step 41:** The CE-Router must transmit a DHCPv6 Solicit message to the multicast address of FF02::1:2.
- *Part J*  
**Step 46:** The CE-Router must transmit an ICMPv6 Echo Reply to TN1.
- *Part K*  
**Step 49:** The CE-Router must transmit a DHCPv6 Request message with a Server ID option identify TN1 for each of IA\_NA that the CE-router included in the DHCPv6 Renew message. The CE-Router must not transmit any additional DHCPv6 Renew messages.
- *Part L*  
**Step 52:** The CE-Router must transmit DHCPv6 Request message after receiving the DHCPv6 Reply message.
- *Part M*  
**Step 55:** The CE-Router must transmit a DHCPv6 Renew message before T1 seconds after receiving the DHCPv6 Reply message.
- *Part N*  
**Step 58:** The CE-Router must transmit a DHCPv6 Rebind message after receiving the DHCPv6 Reply message.
- *Part O*  
**Step 61:** Upon reception of the DHCPv6 Reply message from TN1, the CE-Router did not send any additional Release messages.  
**Step 63:** The CE-Router must not transmit an ICMPv6 Echo Reply to TN1.
- *Part P*  
**Step 66:** Upon reception of the DHCPv6 Reply message from TN1, the CE-Router did not send any additional Decline messages.  
**Step 68:** The CE-Router must not transmit an ICMPv6 Echo Reply to TN1.

### Possible Problems:



- None.

### Test CERouter.1.1.17: Reception of Reply messages for DNS Configuration options

**Purpose:** Verify an IPv6 CE Router properly handles the reception of DHCPv6 Reply messages for DNS Configuration options after initiating an exchange.

#### References:

- [RFC 7084] – W-1
- [RFC 3315] – 18.1.8 and 22.7
- [RFC 3646] – Section 3 and 4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### Procedure:

##### *Part A: Using DNS Recursive Name Server option*

1. The CE-Router transmits an ICMPv6 Echo Request to “DHCPv6.TEST.EXAMPLE.COM”.
2. Observe the packets transmitted by the CE-Router.

##### *Part B: Using Domain Search List option*

3. The CE-Router transmits an ICMPv6 Echo Request to “DHCPv6”.
4. Observe the packets transmitted by the CE-Router.

##### *Part C: DNS Recursive Name Server option updated by Renew message*

5. The CE-Router transmits an ICMPv6 Echo Request to “DHCPv6.TEST.EXAMPLE.COM”.
6. Observe the packets transmitted by the CE-Router.
7. Wait T1 (50) seconds.
8. Upon reception of a DHCPv6 Renew message TN1 transmits a properly formatted DHCPv6 Reply message with a DNS Recursive Name Server option including TN4’s Global address.
9. CE-Router transmits an ICMPv6 Echo Request to “DHCPv6.TEST.EXAMPLE.COM”.
10. Observe the packets transmitted by the CE-Router.

##### *Part D: Domain Search List option updated by Renew message*

11. The CE-Router transmits an ICMPv6 Echo Request to “DHCPv6”.
12. Observe the packets transmitted by the CE-Router.
13. Wait T1 (50) seconds.
14. Upon reception of a DHCPv6 Renew message TN1 transmits a properly formatted DHCPv6 Reply message with a DNS Recursive Name Server option including TN3’s Global address and Domain Search List option including “TEST.COM”.
15. CE-Router transmits an ICMPv6 Echo Request to “DHCPv6”.
16. Observe the packets transmitted by the CE-Router.

##### *Part E: DNS Recursive Name Server option updated by Rebind message*

17. The CE-Router transmits an ICMPv6 Echo Request to “DHCPv6.TEST.EXAMPLE.COM”.
18. Observe the packets transmitted by the CE-Router.
19. Wait T2 (80) seconds.
20. Upon reception of a DHCPv6 Rebind message TN1 transmits a properly formatted DHCPv6 Reply message with a DNS Recursive Name Server option including TN4’s Global address.
21. CE-Router transmits an ICMPv6 Echo Request to “DHCPv6.TEST.EXAMPLE.COM”.
22. Observe the packets transmitted by the CE-Router.



*Part F: Domain Search List option updated by Rebind message*

23. The CE-Router transmits an ICMPv6 Echo Request to “DHCPv6”.
24. Observe the packets transmitted by the CE-Router.
25. Wait T2 (80) seconds.
26. Upon reception of a DHCPv6 Rebind message TN1 transmits a properly formatted DHCPv6 Reply message with a DNS Recursive Name Server option including TN3’s Global address and Domain Search List option including “TEST.COM”.
27. CE-Router transmits an ICMPv6 Echo Request to “DHCPv6”.
28. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*  
**Step 2:** The CE-Router transmits a DNS Standard Query to TN3.
- *Part B*  
**Step 4:** The CE-Router transmits a DNS Standard Query whose QNAME is “DHCPv6.TEST.EXAMPLE.COM” to TN3.
- *Part C*  
**Step 6:** The CE-Router transmits a DNS Standard Query to TN3.  
**Step 10:** The CE-Router transmits a DNS Standard Query to TN4.
- *Part D*  
**Step 12:** The CE-Router transmits a DNS Standard Query whose QNAME is “DHCPv6.TEST.EXAMPLE.COM” to TN3.  
**Step 16:** The CE-Router transmits a DNS Standard Query whose QNAME is “DHCPv6.TEST.COM” to TN3.
- *Part E*  
**Step 18:** The CE-Router transmits a DNS Standard Query to TN3.  
**Step 22:** The CE-Router transmits a DNS Standard Query to TN4.
- *Part F*  
**Step 24:** The CE-Router transmits a DNS Standard Query whose QNAME is “DHCPv6.TEST.EXAMPLE.COM” to TN3.  
**Step 28:** The CE-Router transmits a DNS Standard Query whose QNAME is “DHCPv6.TEST.COM” to TN3.

**Possible Problems:**

- If the NUT is a “passive node”, it does not need to send an ICMPv6 Echo Request and may omit this test.a





## Test CERouter.1.1.18: Reception of Invalid Advertise message

**Purpose:** Verify an IPv6 CE Router properly handles the reception of invalid Advertise messages.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 15, 15.3, and 17.1.3

**Test Setup:** The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: No Server Identifier option*

1. Enable DHCPv6 on the CE-Router.
2. Upon reception of a DHCPv6 Solicit message TN1 transmits DHCPv6 Advertise message that does not contain a Server Identifier option.
3. Observe the packets transmitted by the CE-Router.

#### *Part B: No Client Identifier option*

4. Enable DHCPv6 on the CE-Router.
5. Upon reception of a DHCPv6 Solicit message TN1 transmits DHCPv6 Advertise message that does not contain a Client Identifier option.
6. Observe the packets transmitted by the CE-Router.

#### *Part C: Client Identifier that does not match the DUID of the client*

7. Enable DHCPv6 on the CE-Router.
8. Upon reception of a DHCPv6 Solicit message TN1 transmits properly formatted DHCPv6 Advertise message containing a Client Identifier option whose value does not the client's DUID.
9. Observe the packets transmitted by the CE-Router.

#### *Part D: Transaction ID Mismatch*

10. Enable DHCPv6 on the CE-Router.
11. Upon reception of a DHCPv6 Solicit message TN1 transmits properly formatted DHCPv6 Advertise message containing a transaction-id field value that does not match the value the client used in its Solicit message.
12. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** The CE-Router must silently discard the DHCPv6 Advertise message and not send a DHCPv6 Request message. The CE-Router must continue to transmit DHCPv6 Solicit messages.
- *Part B*  
**Step 4:** The CE-Router must silently discard the DHCPv6 Advertise message and not send a DHCPv6 Request message. The CE-Router must continue to transmit DHCPv6 Solicit messages.
- *Part C*



**Step 6:** The CE-Router must silently discard the DHCPv6 Advertise message. The CE-Router must not send a DHCPv6 Request message based on the received DHCPv6 Advertise message but must continue to transmit Solicit messages.

- *Part D*

**Step 8:** The CE-Router must silently discard the Advertise message. The CE-Router must not send a DHCPv6 Request message based on the received DHCPv6 Advertise message but must continue to transmit Solicit messages.

**Possible Problems:**

- None.



## Test CERouter.1.1.19: Reception of Invalid Reply message

**Purpose:** Verify an IPv6 CE Router properly handles the reception of invalid DHCPv6 Reply messages.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 15, 15.10, 22.4 and 22.6

**Test Setup:** No Common Test Setup. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: No Server Identifier Option*

1. Enable DHCPv6 on the CE-Router.
2. Upon reception of a DHCPv6 Solicit message TN1 transmits a properly formatted DHCPv6 Advertise message.
3. Upon reception of a DHCPv6 Request message TN1 transmits a DHCPv6 Reply message that does not contain a Server Identifier option.
4. Observe the packets transmitted by the CE-Router.

#### *Part B: Transaction ID Mismatch*

5. Enable DHCPv6 on the CE-Router.
6. Upon reception of a DHCPv6 Solicit message TN1 transmits a properly formatted DHCPv6 Advertise message.
7. Upon reception of a DHCPv6 Request message TN1 transmits a DHCPv6 Reply message contains a transaction-id field that does not match the value in the DHCPv6 Request message.
8. Observe the packets transmitted by the CE-Router.

#### *Part C: Contains invalid IA\_NA option T1 > T2*

9. Enable DHCPv6 on the CE-Router.
10. Upon reception of a DHCPv6 Solicit message TN1 transmits a properly formatted DHCPv6 Advertise message.
11. Upon reception of a DHCPv6 Request message TN1 transmits a DHCPv6 Reply message that contains an IA\_NA option with T1 greater than T2.
12. TN1 transmits an Echo Request to CE-Router's Global Address.
13. Observe the packets transmitted by the CE-Router.

#### *Part D: Contains invalid IA Address (preferred lifetime > valid lifetime)*

14. Enable DHCPv6 on the CE-Router.
15. Upon reception of a DHCPv6 Solicit message TN1 transmits a properly formatted DHCPv6 Advertise message.
16. Upon reception of a DHCPv6 Request message TN1 transmits a DHCPv6 Reply message that contains an IA\_NA option with preferred lifetime greater than the valid lifetime.
17. TN1 transmits an Echo Request to CE-Router's Global Address.
18. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*



**Step 5:** The CE-Router must silently discard the invalid DHCPv6 Reply message and continues to transmit a DHCPv6 Request message.

- *Part B*

**Step 8:** The CE-Router must silently discard the invalid DHCPv6 Reply message and continues to transmit a DHCPv6 Request message.

- *Part C*

**Step 13:** The CE-Router must silently discard the invalid IA\_Address option in the DHCPv6 Reply message. The CE-Router must not transmit an ICMPv6 Echo Reply to TN1.

- *Part D*

**Step 18:** The CE-Router must silently discard the invalid IA\_Address option in the DHCPv6 Reply message. The CE-Router must not transmit an ICMPv6 Echo Reply to TN1.

**Possible Problems:**

- None.



## Test CERouter.1.1.20: Client Message Validation

**Purpose:** Verify an IPv6 CE Router properly discards all Solicit, Request, Confirm, Renew, Rebind, Decline, Release, Relay-forward, Relay-reply and Information-Request messages.

### References:

- [RFC 7084] – W-1

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Solicit message (type 1)*

1. TN1 transmits a DHCPv6 Solicit message to the CE-Router Port 546.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Request message (type 3)*

3. TN1 transmits a DHCPv6 Request message to the CE-Router port 546.
4. Observe the packets transmitted by the CE-Router.

#### *Part C: Confirm message (type 4)*

5. TN1 transmits a DHCPv6 Confirm message to the CE-Router port 546.
6. Observe the packets transmitted by the CE-Router.

#### *Part D: Renew messages (type 5)*

7. TN1 transmits a DHCPv6 Renew message to the CE-Router port 546.
8. Observe the packets transmitted by the CE-Router.

#### *Part E: Rebind messages (type 6)*

9. TN1 transmits a DHCPv6 Rebind message to the CE-Router port 546.
10. Observe the packets transmitted by the CE-Router.

#### *Part F: Decline messages (type 9)*

11. TN1 transmits a DHCPv6 Decline message to the CE-Router port 546.
12. Observe the packets transmitted by the CE-Router.

#### *Part G: Release messages (type 8)*

13. TN1 transmits a DHCPv6 Release message to the CE-Router port 546.
14. Observe the packets transmitted by the CE-Router.

#### *Part H: Relay-forward message (type 12)*

15. TN1 transmits a DHCPv6 Relay-forward message to the CE-Router port 546.
16. Observe the packets transmitted by the CE-Router.

#### *Part I: Relay-reply message (type 13)*

17. TN1 transmits a DHCPv6 Relay-reply message to the CE-Router port 546.
18. Observe the packets transmitted by the CE-Router.

#### *Part J: Information-request message (type 11)*

19. TN1 transmits an Information-request message to the CE-Router port 546.
20. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*



**Step 2:** The CE-Router discards the DHCPv6 Solicit message from TN1 and does not transmit any packets.

- *Part B*  
**Step 4:** The CE-Router discards the DHCPv6 Request message from TN1 and does not transmit any packets.
- *Part C*  
**Step 6:** The CE-Router discards the DHCPv6 Confirm message from TN1 and does not transmit any packets.
- *Part D*  
**Step 8:** The CE-Router discards the DHCPv6 Renew message from TN1 and does not transmit any packets.
- *Part E*  
**Step 10:** The CE-Router discards the DHCPv6 Rebind message from TN1 and does not transmit any packets.
- *Part F*  
**Step 12:** The CE-Router discards the DHCPv6 Decline message from TN1 and does not transmit any packets.
- *Part G*  
**Step 14:** The CE-Router discards the DHCPv6 Release message from TN1 and does not transmit any packets.
- *Part H*  
**Step 16:** The CE-Router discards the DHCPv6 Relay-forward message from TN1 and does not transmit any packets.
- *Part I*  
**Step 18:** The CE-Router discards the DHCPv6 Relay-reply message from TN1 and does not transmit any packets.
- *Part J*  
**Step 20:** The CE-Router discards the DHCPv6 Information-Request message from TN1 and does not transmit any packets.

**Possible Problems:**

- None.



## Test CERouter.1.1.21: SOL\_MAX\_RT Option

**Purpose:** Verify an IPv6 CE Router properly handles SOL\_MAX\_RT option.

### References:

- [RFC 7084] – WAA-8
- [RFC 7083] – Section 4, 6, 7

**Test Setup:** The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: SOL\_MAX\_RT Option*

1. Enable DHCPv6 on the CE-Router.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Set Value (300 seconds)*

3. Enable DHCPv6 on the CE-Router.
4. Upon reception of a DHCPv6 Solicit message TN2 transmits DHCPv6 Advertise message that contains a SOL\_MAX\_RT with a value of 300 seconds and an IA\_NA containing a status code of NoAddrsAvail (2).
5. Observe the packets transmitted by the CE-Router.

#### *Part C: Less than 60 seconds*

6. Enable DHCPv6 on the CE-Router.
7. Upon reception of a DHCPv6 Solicit message TN2 transmits DHCPv6 Advertise message that contains a SOL\_MAX\_RT with a value of 45 seconds. A IA\_NA contains a status code of NoAddrsAvail (2) and the IA\_PD contains a status code of NoPrefixAvail (6) in the Advertise message.
8. Observe the packets transmitted by the CE-Router.

#### *Part D: Greater than 86400 seconds*

9. Enable DHCPv6 on the CE-Router.
10. Upon reception of a DHCPv6 Solicit message TN2 transmits DHCPv6 Advertise message that contains a SOL\_MAX\_RT with a value of 87000 seconds. A IA\_NA contains a status code of NoAddrsAvail (2) and the IA\_PD contains a status code of NoPrefixAvail (6) in the Advertise message.
11. Observe the packets transmitted by the CE-Router.

#### *Part E: No Addresses Available – Status Code*

12. Enable DHCPv6 on the CE-Router.
13. Upon reception of a DHCPv6 Solicit message TN2 transmits DHCPv6 Advertise message that contains a SOL\_MAX\_RT with a value of 400 seconds and a Status Code option containing a status code of NoAddrsAvail (2). A IA\_NA contains a status code of NoAddrsAvail (2) and the IA\_PD contains a status code of NoPrefixAvail (6) in the Advertise message.
14. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*



**Step 2:** The CE-Router transmits a properly formatted Solicit message to TN1 containing a Option Request Options with a SOL\_MAX\_RT Option with the following:

- An option-code set to OPTION\_SOL\_MAX\_RT (82)

• *Part B*

**Step 5:** The CE-Router must process the SOL\_MAX\_RT option in the Advertise message. The CE-Router must NOT transmit a DHCPv6 Request message in response to the DHCPv6 Advertise message. The CE Router should properly transmit DHCPv6 Solicits messages according to the chart below:

Solicit Message	Minimum Delay	Maximum Delay
First message	-	-
X message	270 seconds = .9*MRT where MRT=300	330 seconds = 1.1*MRT where MRT = 300
X+1 message	270 seconds = .9*MRT where MRT=300	330 seconds = 1.1*MRT where MRT=300

• *Part C*

**Step 8:** The CE-Router must silently discard the SOL\_MAX\_RT option in DHCPv6 Advertise message. The normal Solicit retransmission timers are applied in the chart below:

Solicit Message	Minimum Delay	Maximum Delay
First message	-	-
Second message	1000 ms	1100 ms
Third message	2900 ms	3410 ms
Fourth message	6510 ms	8260 ms
Fifth message	13380 ms	18450 ms
Sixth message	26400 ms	39820 ms
Seventh message	51160 ms	84770 ms
Eighth message	98210 ms	179110 ms

• *Part D*

**Step 11:** The CE-Router must silently discard the SOL\_MAX\_RT option in DHCPv6 Advertise message. The normal Solicit retransmission timers are applied in the chart below:

Solicit Message	Minimum Delay	Maximum Delay
First message	-	-
Second message	RT (greater than 1.0 sec)= IRT + RAND*IRT Where IRT=1, RAND>0	RT(1.1 sec) = IRT + RAND*IRT Where IRT=1, RAND= +.1





X message	3240 seconds = .9*MRT where MRT=3600	3960 seconds = 1.1*MRT where MRT = 3600
X+1 message	3240 seconds = .9*MRT where MRT=3600	3960 seconds = 1.1*MRT where MRT=3600

- *Part E*

**Step 14:** The CE-Router must process the SOL\_MAX\_RT option in the Advertise message. The CE-Router must NOT transmit a DHCPv6 Request message in response to the DHCPv6 Advertise message. The CE Router should properly transmit DHCPv6 Solicits messages according to the chart below:

Solicit Message	Minimum Delay	Maximum Delay
First message	-	-
X message	360 seconds = .9*MRT where MRT=400	440 seconds = 1.1*MRT where MRT = 400
X+1 message	360 seconds = .9*MRT where MRT=400	440 seconds = 1.1*MRT where MRT=400

**Possible Problems:**

- None.



## **Group 2: RFC 3633 – Request Router**

### **Scope**

The following tests cover specifications for the requesting router (Client) implementation of IPv6 Prefix options for Dynamic Host Configuration Protocol (DHCP) version 6, Request For Comments 3633. These tests verify the process for receiving a list of available IPv6 Prefix options from a server in Dynamic Host Configuration Protocol for IPv6.

### **Overview**

These tests are designed to verify the readiness of a DHCPv6 requesting router (Client) implementation vis-à-vis the IPv6 Prefix options for Dynamic Host Configuration Protocol for IPv6 specification.



## Test CERouter.1.2.1: Prefix Options Format

**Purpose:** Verify an IPv6 CE Router properly transmits the correct DHCPv6 IA\_PD option.

### References:

- [RFC 7084] – WPD-1
- [DHCP-PD 3633] – Section 6,9, and 10

**Test Setup:** The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: IA\_PD Option Format*

1. Enable DHCPv6 on the CE-Router.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: IA\_PD Prefix Option Format*

3. Enable DHCPv6 on the CE-Router.
4. Upon the reception of a DHCPv6 Solicit message from the CE-Router, TN1 transmits a valid DHCPv6 Advertise message including an IA\_PD option with Prefix option.
5. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** The CE-Router transmits a properly formatted DHCPv6 Solicit message containing the following IA\_PD option values:
  - An option-code set to OPTION\_IA\_PD (25)
  - An option-length set to 12 + length of IA\_PD options field
  - An IAID value set to a number
  - Time T1 set to a number
  - Time T2 set to a number
- *Part B*  
**Step 13:** The CE-Router transmits a properly formatted DHCPv6 Request message containing the following IA\_PD option values:
  - An option-code set to OPTION\_IA\_PD (25)
  - An option-length set to 12 + length of IA\_PD options field
  - An IAID value set to a number
  - Time T1 set to a number
  - Time T2 set to a number
  - An IA\_PD Prefix Option containing the following values:
    - An option-code set to OPTION\_IAPREFIX (26)
    - An option-length set to 25 + length of Prefix options field
    - A preferred lifetime and a valid lifetime
    - A valid prefix length
    - An IPv6 Prefix



**Possible Problems:**

- None.



## Test CERouter.1.2.2: Basic Message Exchange

**Purpose:** Verify an IPv6 CE Router properly handles the reception of the DHCPv6 Reply message during a basic message exchange.

### References:

- [RFC 7084] – WPD-1
- [DHCP-PD 3633] – Sections 7, 9 and 12

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of each test part. Allow the IA\_NA lifetimes to be long enough such that they do not expire during the test. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

*Part A: Valid Reply message in response to DHCPv6 Request*

1. TN2 transmits a valid Router Solicitation.
2. Observe the packets transmitted by the CE-Router.

*Part B: Valid Reply message in response to a Renew message*

3. Wait T1 timer (50 seconds).
4. Upon reception of a DHCPv6 Renew message from the CE-Router at the time T1, TN1 transmits a properly formatted DHCPv6 Reply message.
5. TN2 transmits a valid Router Solicitation.
6. Observe the packets transmitted by the CE-Router.

*Part C: Valid Reply message in response to a Rebind message*

7. Wait T2 timer (80 seconds).
8. Upon reception of a DHCPv6 Rebind message from the CE-Router at the time T2, TN1 transmits a properly formatted Reply message.
9. TN2 transmits a valid Router Solicitation.
10. Observe the packets transmitted by the CE-Router.

*Part D: Valid Reply message in response to a Release message*

11. Configure the CE-Router to release the IPv6 prefix.
12. Upon reception of a DHCPv6 Release message from the CE-Router TN1 transmits a properly formatted DHCPv6 Reply message.
13. TN2 transmits a valid Router Solicitation.
14. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** The CE-Router must transmit a Router Advertisement containing a PIO with a prefix from the IA\_PD on the LAN network.
- *Part B*  
**Step 6:** The CE-Router must transmit a Router Advertisement containing a PIO with a prefix from the IA\_PD on the LAN network.
- *Part C*



**Step 10:** The CE-Router must transmit a Router Advertisement containing a PIO with a prefix from the IA\_PD on the LAN network.

- *Part D*

**Step 14:** The CE-Router must transmit a Router Advertisement that does NOT contain a PIO with a prefix from the IA\_PD on the LAN network.

**Possible Problems:**

- None.



### Test CERouter.1.2.3: Transmission of Solicit Messages for Prefix Delegation

**Purpose:** Verify an IPv6 CE Router transmits properly formatted Solicit messages for Prefix Delegation.

**References:**

- [RFC 7084] – WPD-1
- [RFC 3315] – Sections 5.5, 14, 15.1, 16, 17.1, 17.1.1, 17.1.2, and 22.9
- [DHCP 3646] – Sections 3 and 4
- [DHCP-PD 3633] – Section 6,7 and 11.1

**Test Setup:** Allow the IA\_NA lifetimes to be long enough such that they do not expire during the test. The [Common Test Cleanup](#) procedure is performed after each part.

**Procedure:**

*Part A: Solicit message format*

1. Enable DHCPv6 on the CE-Router.
2. Observe the packets transmitted by the CE-Router.

*Part B: Retransmission Time of Solicit Message*

3. Enable DHCPv6 on the CE-Router.
4. Wait  $RT_{prev} = MRT + MRT * RAND$  ( $108 \leq RT_{prev} \leq 132$ ).
5. Observe the packets transmitted by the CE-Router.
6. Wait  $0xffff + SOL\_MAX\_RT$  seconds after the first DHCPv6 Solicit message.
7. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*

**Step 2:** The CE-Router transmits a properly formatted DHCPv6 Solicit message containing the following elements:

  - Src Address is a link-local for that interface
  - The msg-type field was set to the value of 1 (Solicit)
  - A header containing a Transaction ID
  - A Client Identifier Option (containing DUID)
  - An Elapsed Time Option
  - IA\_PD Option with the proper IPv6 prefix associated with the IA.
- *Part B*

**Step 5:** The CE-Router should properly transmit Solicit messages according to the chart below. The transaction ID is the same for all retransmitted messages.

Solicit Message	Minimum Delay	Maximum Delay
First message	-	-
Second message	$RT$ (greater than 1.0 sec)= $IRT + RAND * IRT$ Where $IRT=1, RAND > 0$	$RT(1.1 \text{ sec}) =$ $IRT + RAND * IRT$ Where $IRT=1, RAND = +.1$



X message	3240 seconds = .9*MRT where MRT=3600	3960 seconds = 1.1*MRT where MRT = 3600
X+1 message	3240 seconds = .9*MRT where MRT=3600	3960 seconds = 1.1*MRT where MRT=3600

**Step 7:** The first Solicit message containing an Elapsed Time option with its elapsed-time value set to 0, and the followed retransmit Solicit messages' elapsed-time value set to the time elapsed since the first Solicit message was received, but elapsed-time value set to 0xffff when the time elapsed 0xffff since the first Solicit message was received. The elapsed-time value of these Solicit messages should be in the range of the follow chart:

Solicit message	Minimum of Elapsed-time value	Maximum of Elapsed-time value
First message	0	0
Second message	Value=1000ms =IRT+RAND*IRT Where IRT=1s, RAND=0	Value=1100ms = IRT+RAND*IRT Where IRT=1s, RAND=0.1
Third message	Value=2900ms =Valueprev+ RT RT=2*RTprev+RAND*RTprev Where RAND=-0.1	Value=3410ms =Valueprev+ RT RT=2*RTprev+RAND*RTprev Where RAND=0.1
	Value>Valueprev	Value>Valueprev
Y message	Value=0xffff	Value=0xffff
	Value=0xffff	Value=0xffff

**Possible Problems:**

- The CE-Router may define other values for Transmission and Retransmission Parameters in RFC3315. These values can be used for Part B.





## Test CERouter.1.2.4: Transmission of Request message for Prefix Delegation

**Purpose:** Verify an IPv6 CE Router transmits properly formatted Request messages and properly implements the mechanisms for message exchange termination for Request message for Prefix Delegation.

### References:

- [RFC 7084] – W-1
- [DHCP 3633] – Section 7 and 12.1
- [RFC 3315] – Section 5.5, 14, 18.1.1 and 22.9

**Test Setup:** Allow the IA\_NA lifetimes to be long enough such that they do not expire during the test. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Request message format*

1. Enable DHCPv6 on the CE-Router.
2. TN1 transmits a DHCPv6 Advertise message in response to the DHCPv6 Solicit message from the CE-Router.
3. Observe the packets transmitted by the CE-Router.

#### *Part B: Maximum Retransmission Time of Request Message*

4. Enable DHCPv6 on the CE-Router.
5. TN1 transmits a DHCPv6 Advertise message in response to the DHCPv6 Solicit message from the CE-Router.
6. Wait  $RT_{prev} = MRT + MRT * RAND$  ( $27 \leq RT_{prev} \leq 33$ ).
7. Observe the packets transmitted by the CE-Router.
8. TN2 transmits a valid Router Solicitation.
9. Observe the packets transmitted by the CE-Router.

#### *Part C: Maximum Retransmission Count of Request messages*

10. Enable DHCPv6 on the CE-Router.
11. TN1 transmits a DHCPv6 Advertise message in response to the DHCPv6 Solicit message from the CE-Router.
12. Observe the packets transmitted by the CE-Router.
13. TN2 transmits a valid Router Solicitation.
14. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 3:** The CE-Router transmits a properly formatted DHCPv6 Request message to TN1 containing:
    - The msg-type field was set to the value of 3 (Request)
    - A header containing a Transaction ID
    - A Client Identifier Option (containing a DUID)
    - A Server Identifier Option (containing a DUID)
    - An Elapsed Time Option



- IA\_PD Option with the proper IPv6 prefix associated with the IA.
- *Part B*
  - Step 7:** The CE-Router transmits a properly formatted DHCPv6 Request message according to the Second message in the chart below:

Request Message	Minimum Delay	Maximum Delay
First message	-	-
Second message	0.9 = IRT + RAND*IRT Where IRT=1, RAND=-.1	1.1 = IRT + RAND*IRT Where IRT=1, RAND=+.1

The elapsed-time value of these Request messages should be in the range of the follow chart:

Request message	Minimum of Elapsed-time value	Maximum of Elapsed-time value
First message	0	0
Second message	Value=900ms=RT+0 RT=IRT+RAND*IRT Where IRT=1s, RAND=-0.1	Value=1100ms=RT+0 RT= IRT+RAND*IRT Where IRT=1s, RAND=0.1
Third message	Value=2610ms=Valueprev+ RT RT=2*RTprev+RAND*RTprev Where RAND=-0.1	Value=3410ms=Valueprev+ RT RT=2*RTprev+RAND*RTprev Where RAND=0.1
	Value>Valueprev	Value>Valueprev
10th message	Value>Valueprev	Value>Valueprev

**Step 9:** The CE-Router must NOT transmit a Router Advertisement containing a PIO with a prefix from the IA\_PD on the LAN network.

- *Part C.*
  - Step 12:** The CE-Router must terminate the message exchange after the transmission of REQ\_MAX\_RC (10) DHCPv6 Request messages. The CE-Router must not transmit any more DHCPv6 Request messages.
  - Step 14:** The CE-Router must NOT transmit a Router Advertisement containing a PIO with a prefix from the IA\_PD on the LAN network.

### Possible Problems:

- It is possible to Interpret REQ\_MAX\_RC to mean the number of retries after the initial Request message. Therefore the observable result in Part C Step 12 can read: The CE-Router must terminate the message exchange after the transmission of (1) initial DHCPv6 Request message plus REQ\_MAX\_RC (10) DHCPv6 Request messages (total=11). The CE-Router must not transmit any more DHCPv6 Request messages.
- The CE-Router may define other values for Transmission and Retransmission Parameters in RFC3315. These values can be used for Part B and C.



## Test CERouter.1.2.5: Transmission of Renew messages for Prefix Delegation

**Purpose:** Verify an IPv6 CE Router properly transmits DHCPv6 Renew messages for Prefix Delegation.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 5.5, 14 and 18.1.3
- [DHCP 3633] – Section 12.1

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. Part B has an IA\_PD values of T1=40s and T2=3000s. Part C has an IA\_PD values of T1=100s and T2=200s. Allow the IA\_NA lifetimes to be long enough such that they do not expire during the test. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Renew message format*

1. Wait T1 timer.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a valid Router Solicitation.
4. Observe the packets transmitted by the CE-Router.

#### *Part B: Maximum Retransmission of Renew message*

5. Wait T1 timer. TN1 does not transmit a DHCPv6 Reply messages in response to the first DHCPv6 Renew messages.
6. Observe the packets transmitted by the CE-Router.

#### *Part C: Maximum Retransmission Count of Renew messages*

7. Wait T1 timer. No DHCPv6 Reply messages are transmitted in response to DHCPv6 Renew messages.
8. Observe the packets transmitted by the CE-Router.
9. TN2 transmits a valid Router Solicitation.
10. Observe the packets transmitted by the CE-Router.

### Observable Results:

#### • *Part A*

**Step 2:** The CE-Router must send its first DHCPv6 Renew message T1 (50) seconds after the reception of the DHCPv6 Reply message from TN1. The CE-Router transmits a properly formatted Renew message to TN1 containing:

- A “msg-type” field set to the value of RENEW (5)
- A header containing a Transaction ID
- A Server Identifier Option (containing a server DUID)
- A Client Identifier Option (containing a client DUID)
- An IA PD Option with the proper IPv6 prefix associated with the IA.
- An Elapsed Time Option

**Step 6:** The CE-Router must transmit a Router Advertisement containing a PIO with a prefix from the IA\_PD on the LAN network.



- Part B

**Step 6:** The CE Router should properly transmit DHCPv6 Renew messages according to the chart below. The transaction ID is the same for all retransmitted messages.

Renew Message	Minimum Delay	Maximum Delay
First message	-	-
Second message	9 = IRT + RAND*IRT Where IRT=10, RAND= -.1	11 = IRT + RAND*IRT Where IRT=10, RAND= +.1
X message	540 seconds =.9*MRT where MRT=600	660 seconds =1.1*MRT where MRT=600
X+1 message	540 seconds =.9*MRT where MRT=600	660 seconds =1.1*MRT where MRT=600

X+1 message that after T2 (2000 seconds) is not observed.

The first Renew message contains an Elapsed Time option with its elapsed-time value set to 0, and CE-Router retransmitted the Renew messages containing an Elapsed Time option with its elapsed-time value set to the time elapsed since the first Renew message was received, but elapsed-time value set to 0xffff when the time elapsed 0xffff since the first Renew message was received. The elapsed-time value of these Renew messages should be in the range of the follow chart:

Renew message	Minimum of Elapsed-time value	Maximum of Elapsed-time value
First message	0	0
Second message	Value=9000ms =IRT+RAND*IRT Where IRT=10s, RAND=-0.1	Value=11000ms = IRT+RAND*IRT Where IRT=10s, RAND=0.1
Third message	Value=26100ms =Valueprev+ RT RT=2*RTprev+RAND*RTprev Where RAND=-0.1	Value=34100ms =Valueprev+ RT RT=2*RTprev+RAND*RTpre v Where RAND=0.1
	Value>Valueprev	Value>Valueprev
Y message	Value=0xffff	Value=0xffff
	Value=0xffff	Value=0xffff

- Part C

**Step 8:** The CE-Router must terminate the message transmission of Renew message after MRD (Remaining time until T2). The CE-Router must not transmit any more Renew messages.

The transaction ID is the same for all retransmitted messages.

**Step 10:** The CE-Router must transmit a Router Advertisement containing a PIO with a prefix from the IA\_PD on the LAN network.

**Possible Problems:**



- The CE-Router may define other values for Transmission and Retransmission Parameters in RFC3315. These values can be used for Part B and C.



## Test CERouter.1.2.6: Transmission of Rebind message for Prefix Delegation

**Purpose:** Verify an IPv6 CE Router properly transmits Rebind messages for Prefix Delegation.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 5.5, 14 and 18.1.4
- [DHCP 3633] – Section 12.1

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. Part B has a valid address lifetime of 3000s. Part C has a valid address lifetime of 300s. Allow the IA\_NA lifetimes to be long enough such that they do not expire during the test. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Rebind message format*

1. Wait T2 timer (80 seconds). TN1 doesn't respond to any DHCPv6 Renew message during this period.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a valid Router Solicitation.
4. Observe the packets transmitted by the CE-Router.

#### *Part B: Maximum Retransmission Time of Rebind messages, T1 and T2 (Valid lifetime=3000s)*

5. Wait T2 timer (80 seconds).
6. Observe the packets transmitted by the CE-Router.

#### *Part C: Maximum Retransmission Count of Rebind messages, T1 and T2 (Valid Lifetime = 300s)*

7. Wait T2 timer (80 seconds).
8. Observe the packets transmitted by the CE-Router.
9. Wait 300 second.
10. TN2 transmits a valid Router Solicitation.
11. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*

**Step 2:** The CE-Router must send its first DHCPv6 Rebind message T2 (80) seconds after the reception of the DHCPv6 Reply message from TN1. The CE-Router transmits a properly formatted Rebind message to TN1 containing:

- A "msg-type" field set to the value of REBIND (6).
- A header containing a Transaction ID
- A Client Identifier Option (containing a DUID)
- An IA PD Option with the proper IPv6 prefix associated with associated with the IA.
- An Elapsed Time Option

**Step 4:** The CE-Router must transmit a Router Advertisement containing a PIO with a prefix from the IA\_PD on the LAN network.

- *Part B*



**Step 6:** The CE-Router must properly transmit DHCPv6 Rebind messages according to the chart below. The transaction ID is the same for all retransmitted messages.

Rebind Message	Minimum Delay	Maximum Delay
First message	-	-
Second message	9 = IRT + RAND*IRT Where IRT=10, RAND= -.1	11 = IRT + RAND*IRT Where IRT=10, RAND= +.1
X message	540 seconds =.9*MRT where MRT=600	660 seconds =1.1*MRT where MRT=600
X+1 message	540 seconds =.9*MRT where MRT=600	660 seconds =1.1*MRT where MRT=600

X+1 message that after valid lifetime (3000 seconds) is not observed.

The first Rebind message contains an Elapsed Time option with its elapsed-time value set to 0, and CE-Router retransmitted the Rebind messages containing an Elapsed Time option with its elapsed-time value set to the time elapsed since the first Rebind message was received, but elapsed-time value set to 0xffff when the time elapsed 0xffff since the first Rebind message was received. The elapsed-time value of these Rebind messages should be in the range of the follow chart:

Rebind message	Minimum of Elapsed-time value	Maximum of Elapsed-time value
First message	0	0
Second message	Value=9000ms =IRT+RAND*IRT Where IRT=10s, RAND=-0.1	Value=11000ms = IRT+RAND*IRT Where IRT=10s, RAND=0.1
Third message	Value=26100ms =Valueprev+ RT RT=2*RTprev+RAND*RTprev Where RAND=-0.1	Value=34100ms =Valueprev+ RT RT=2*RTprev+RAND*RTprev Where RAND=0.1
	Value>Valueprev	Value>Valueprev
Y message	Value=0xffff	Value=0xffff
	Value=0xffff	Value=0xffff

- *Part C*

**Step 8:** The CE-Router must terminate the message transmission of DHCPv6 Rebind message after MRD (Remaining time until valid lifetimes of all addresses have expired). The CE-Router must not transmit any more Rebind messages.

**Step 11:** The CE-Router must transmit a Router Advertisement that does not contain a PIO with a prefix from the IA\_PD on the LAN network.

**Possible Problems:**

- The CE-Router may define other values for Transmission and Retransmission Parameters in RFC3315. These values can be used for Part B and C.



## Test CERouter.1.2.7: Transmission of Release messages for Prefix Delegation

**Purpose:** Verify an IPv6 CE Router properly transmits Release messages for prefix delegation

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 5.5, 14 and 18.1.6
- [DHCP 3633] – Section 12.1

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. Allow the IA\_NA lifetimes to be long enough such that they do not expire during the test. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Release message format*

1. Configure the CE-Router to release the IPv6 address on the WAN interface.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Release of Received Address*

3. Configure the CE-Router to release the IPv6 address on the WAN interface.
4. Observe the packets transmitted by the CE-Router.
5. TN2 transmits a valid Router Solicitation.
6. Observe the packets transmitted by the CE-Router.

#### *Part C: Retransmission of Release message*

7. Configure the CE-Router to release the IPv6 address on the WAN interface. TN1 does not transmit a DHCPv6 Reply messages in response to the first DHCPv6 Release messages.
8. Observe the packets transmitted by the CE-Router.

#### *Part D: Maximum Retransmission Count of Release message, no Reply message from Server*

9. Configure the CE-Router to release the IPv6 address on the WAN interface. TN1 does not transmit a DHCPv6 Reply messages in response to the first DHCPv6 Release messages.
10. Observe the packets transmitted by the CE-Router.

#### *Part E: Retransmission and message exchange termination, Server responds with Reply message*

11. Configure the CE-Router to release the IPv6 address on the WAN interface.
12. Wait for the CE-Router to transmit two DHCPv6 Release messages.
13. TN1 transmits a DHCPv6 Reply message to the CE-Router that includes a Status Code option with the value NoBinding for each IA in the CE-Router for each IA in the CE-Router's DHCPv6 Release message.
14. Observe the packets transmitted by the CE-Router.

#### *Part F: Elapsed-time value of the retransmit Release message*

15. Configure the CE-Router to release the IPv6 address on the WAN interface.
16. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** The CE-Router transmit a properly formatted DHCPv6 Release message to TN1 containing:





- A “msg-type” field set to the value of 8 (RELEASE).
- A header containing a Transaction ID.
- A Client Identifier Option (containing a DUID)
- A Server Identifier Option
- An IA PD Option with the proper IPv6 prefix associated with the IA
- An Elapsed Time Option

• *Part B*

**Step 4:** The CE-Router transmits a properly formatted DHCPv6 Release message to TN1.

**Step 6:** The CE-Router must transmit a Router Advertisement that does not contain a PIO with a prefix from the IA\_PD on the LAN network.

• *Part C*

**Step 8:** The CE-Router transmits a properly formatted DHCPv6 Release Message according to the Second Message in the chart below.

Release Message	Minimum Delay	Maximum Delay
First message	-	-
Second message	0.9 seconds = IRT + RAND*IRT Where IRT=1, RAND= -.1	1.3 seconds = IRT + RAND*IRT Where IRT=1, RAND= +.1

• *Part D*

**Step 10:** The CE-Router must terminate the message exchange after the transmission of REL\_MAX\_RC (5) Release messages. The CE-Router must not transmit any more Release messages. The transaction ID is the same for all retransmitted messages.

• *Part E*

**Step 14:** The CE-Router ceases the transmission of Release messages upon reception of the Reply message from TN1.

• *Part F*

**Step 16:** The CE-Router transmits the first DHCPv6 Release message contains an Elapsed Time option with its elapsed-time value set to 0, and CE-Router retransmitted the DHCPv6 Release messages containing an Elapsed Time option with its elapsed-time value set to the time elapsed since the first DHCPv6 Release message was received, The elapsed-time value of these DHCPv6 Release messages should be in the range of the follow chart:

Release message	Minimum of Elapsed-time value	Maximum of Elapsed-time value
First message	0	0
Second message	Value=900ms =IRT+RAND*IRT Where IRT=1s, RAND=-0.1	Value=1100ms = IRT+RAND*IRT Where IRT=1s, RAND=0.1
Third message	Value=2610ms =Valueprev+ RT RT=2*RTprev+RAND*Rtprev Where RAND=-0.1	Value=3410ms =Valueprev+ RT RT=2*Rtprev+RAND*Rtprev Where RAND=0.1
4 <sup>th</sup> message	Value=5859ms =Valueprev+ RT RT=2*Rtprev+RAND*Rtprev Where RAND=-0.1	Value=8261ms =Valueprev+ RT RT=2*Rtprev+RAND*Rtprev Where RAND=0.1



5 <sup>th</sup> message	Value=12032ms =Valueprev+ RT RT=2*Rtprev+RAND*Rtprev Where RAND=-0.1	Value=18448ms =Valueprev+ RT RT=2*Rtprev+RAND*Rtprev Where RAND=0.1
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**Possible Problems:**

- None.



## Test CERouter.1.2.8: Reception of Advertise messages

**Purpose:** Verify an IPv6 CE Router properly handles the reception of DHCPv6 Advertise messages for Prefix Delegation.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 17.1.3
- [DHCP 3633] – Section 11.1

**Test Setup:** The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. Enable DHCPv6 on the CE-Router.
2. Upon reception of a DHCPv6 Solicit message TN1 transmits properly formatted DHCPv6 Advertise message containing a Status Code of NoPrefixAvail (code 6). No IA\_NA is included in the Advertise message.
3. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 3:** The CE-Router must silently discard the DHCPv6 Advertise message. The CE-Router must continue to transmit DHCPv6 Solicit messages.

### Possible Problems:

- None.



## Test CERouter.1.2.9: Reception of a Reply Message for Prefix Delegation

**Purpose:** Verify an IPv6 CE Router properly handles the reception of DHCPv6 Reply message for Prefix Delegation.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 18.1.8
- [DHCP 3633] – Section 9,10 and 12.1

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning with the exception of Part E, G, H, I, and J. Allow the IA\_NA lifetimes to be long enough such that they do not expire during the test. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: T1 and T2 Times Recorded*

1. Wait T1 (50) seconds.
2. Observe the packets transmitted by the CE-Router.
3. Wait 30 seconds.
4. Observe the packets transmitted by the CE-Router.

#### *Part B: T1 and T2 times Updated*

5. Wait T1 (50 seconds). Upon reception of the DHCPv6 Renew message from the CE-Router, TN1 transmits a properly formatted DHCPv6 Reply message with an IA\_PD option containing a T1 set to 60s and a T2 set to 90s.
6. Wait 60 seconds.
7. Observe the packets transmitted by the CE-Router.
8. Wait 30 seconds.
9. Observe the packets transmitted by the CE-Router.

#### *Part C: Prefix Lifetimes*

10. Upon reception of a DHCPv6 Renew message TN1 transmits a properly formatted DHCPv6 Reply message with an IA\_PD with a valid lifetime of 100.
11. Observe the packets transmitted by the CE-Router.
12. Wait 110 seconds.
13. Observe the packets transmitted by the CE-Router.
14. TN2 transmits a valid Router Solicitation.
15. Observe the packets transmitted by the CE-Router.

#### *Part D: Valid Lifetime set to zero*

16. Upon reception of a DHCPv6 Renew message TN1 transmits a properly formatted DHCPv6 Reply message with an IA\_PD with a valid lifetime of 0.
17. Observe the packets transmitted by the CE-Router.
18. TN2 transmits a valid Router Solicitation.
19. Observe the packets transmitted by the CE-Router.

#### *Part E: New Prefix in IA\_PD Option*

20. Enable DHCPv6 on the CE-Router.
21. Upon reception of a DHCPv6 Solicit message TN1 transmits a properly formatted DHCPv6 Advertise message.



22. Upon reception of a DHCPv6 Request message TN1 transmits a properly formatted DHCPv6 Reply message with an IA\_PD with Prefix1 containing a values of T1=50 and T2 = 80.
23. Upon reception of a DHCPv6 Renew message TN1 transmits a properly formatted DHCPv6 Reply message with IA\_PD option including two IA prefix options containing Prefix1 and Prefix2 respectively.
24. Wait T1 (50) seconds.
25. Observe the packets transmitted by the CE-Router.

*Part F: IA Prefix option not included in IA from Server*

26. Upon reception of a DHCPv6 Renew message TN1 transmits a properly formatted DHCPv6 Reply message with an IA\_PD option without an IA prefix option.
27. Observe the packets transmitted by the CE-Router.
28. TN2 transmits a valid Router Solicitation.
29. Observe the packets transmitted by the CE-Router.

*Part G: Reply message contains UnspecFail*

30. Enable DHCPv6 on the CE-Router.
31. Upon reception of a DHCPv6 Solicit message TN1 transmits a properly formatted DHCPv6 Advertise message.
32. Upon reception of a DHCPv6 Request message TN1 transmits a properly formatted DHCPv6 Reply message containing a Status Code option with a value of UnspecFail.
33. Observe the packets transmitted by the CE-Router.

*Part H: Reply message contains UseMulticast*

34. Enable DHCPv6 on the CE-Router.
35. Upon reception of a DHCPv6 Solicit message TN1 transmits a properly formatted DHCPv6 Advertise message.
36. Upon reception of a DHCPv6 Request message TN1 transmits a properly formatted DHCPv6 Reply message containing a Status Code option with a value of UseMulticast.
37. Observe the packets transmitted by the CE-Router.

*Part I: Reply message contains NotOnLink*

38. Enable DHCPv6 on the CE-Router.
39. Upon reception of a DHCPv6 Solicit message TN1 transmits a properly formatted DHCPv6 Advertise message.
40. Upon reception of a DHCPv6 Request message TN1 transmits a properly formatted DHCPv6 Reply message containing a Status Code option with a value of NotOnLink.
41. Observe the packets transmitted by the CE-Router.

*Part J: Reply message contains NoPrefixAvail*

42. Enable DHCPv6 on the CE-Router.
43. Upon reception of a DHCPv6 Solicit message TN1 transmits a properly formatted DHCPv6 Advertise message.
44. Upon reception of a DHCPv6 Request message TN1 transmits a properly formatted DHCPv6 Reply message containing a Status Code option with a value of NoPrefixAvail in the IA\_PD option.
45. Observe the packets transmitted by the CE-Router.

*Part K: Reply message contains NoBinding in response to a Renew message*

46. Wait T1 timer (50 seconds).
47. Upon reception of a DHCPv6 Renew message TN1 transmits a properly formatted DHCPv6 Reply message containing a Status Code option with a value of NoBinding for the IA\_PD for which the CE-Router requested configuration.
48. Observe the packets transmitted by the CE-Router.



*Part L: Reply message contains NoBinding in response to a Rebind message*

49. Wait T2 timer (80 seconds).
50. Upon reception of a DHCPv6 Rebind message TN1 transmits a properly formatted DHCPv6 Reply message containing a Status Code option with a value of NoBinding for the IA\_PD for which the CE-Router requested configuration.
51. Observe the packets transmitted by the CE-Router.

*Part M: Reply message contains no IA\_PD response to a Renew message*

52. Wait T1 timer (50 seconds).
53. Upon reception of a DHCPv6 Renew message TN1 transmits a properly formatted DHCPv6 Reply message without an IA\_PD option.
54. Observe the packets transmitted by the CE-Router.
55. TN2 transmits a valid Router Solicitation.
56. Observe the packets transmitted by the CE-Router.

*Part N: Reply message contains no IA\_PD in response to a Rebind message*

57. Wait T2 timer (80 seconds).
58. Upon reception of a DHCPv6 Rebind message TN1 transmits a properly formatted DHCPv6 Reply message without an IA\_PD option.
59. Observe the packets transmitted by the CE-Router.
60. TN2 transmits a valid Router Solicitation.
61. Observe the packets transmitted by the CE-Router.

*Part O: Reply message contains NoBinding in response to a Release message*

62. Configure the CE-Router to release the IPv6 address on the WAN interface.
63. Upon reception of a DHCPv6 Release message TN1 transmits a properly formatted DHCPv6 Reply message containing a Status Code option with a value of NoBinding for the IA\_PD for which the CE-Router requested configuration.
64. Observe the packets transmitted by the CE-Router.
65. TN2 transmits a valid Router Solicitation.
66. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 2:** The CE-Router transmitted a DHCPv6 Renew message to TN1.
  - Step 4:** The CE-Router transmitted a DHCPv6 Rebind message to TN1.
- *Part B*
  - Step 7:** The CE-Router transmitted a DHCPv6 Renew message to TN1.
  - Step 9:** The CE-Router transmitted a DHCPv6 Rebind message to TN1.
- *Part C*
  - Step 11:** The CE-Router must transmit DHCPv6 Renew and Rebind messages to TN1 until the valid lifetime expires.
  - Step 13:** The CE-Router must transmit DHCPv6 Solicit messages.
  - Step 15:** The CE-Router must transmit a Router Advertisement that does not contain a PIO with a prefix from the IA\_PD on the LAN network.
- *Part D*
  - Step 17:** The CE-Router must not transmit anymore DHCPv6 Renew messages.
  - Step 19:** The CE-Router must transmit a Router Advertisement that does not contain a PIO with a prefix from the IA\_PD on the LAN network or the preferred lifetime of the prefix



from the IA\_PD must be zero. The valid lifetime in the PIO must not be greater than the valid lifetime in the IA\_PD.

- *Part E*  
**Step 25:** The CE-Router must transmit DHCPv6 Renew messages containing IA\_PDs for both Prefix1 and Prefix2.
- *Part F*  
**Step 27:** The CE-Router must continue transmit DHCPv6 Renew messages containing IA\_PD from step 26.  
**Step 29:** The CE-Router must transmit a Router Advertisement that contains a PIO with a prefix from the IA\_PD on the LAN network.
- *Part G*  
**Step 33:** The CE-Router must continue transmitting its Request message. The CE-Router must limit the rate at which it retransmits the message and limit the duration of the time during which it retransmits the message.
- *Part H*  
**Step 37:** The CE-Router must retransmit the original DHCPv6 Request message to the TN1 using multicast through the interface on which the DHCPv6 Reply message from TN1 was received.
- *Part I*  
**Step 41:** The CE-Router must transmit a DHCPv6 Solicit message to the multicast address of FF02::1:2 or retransmit the DHCPv6 Request message using the same transaction ID without specifying any addresses.
- *Part J*  
**Step 45:** The CE-Router must transmit a DHCPv6 Solicit message to the multicast address of FF02::1:2.
- *Part K*  
**Step 48:** The CE-Router must transmit a DHCPv6 Request message with a Server ID option identify TN1 for each of IA\_PD that the CE-router included in the DHCPv6 Renew message. The CE-Router must not transmit any additional DHCPv6 Renew messages.
- *Part L*  
**Step 51:** The CE-Router must transmit a DHCPv6 Request message. The CE-Router must not transmit any additional DHCPv6 Renew messages.
- *Part M*  
**Step 54:** The CE-Router must transmit a DHCPv6 Renew message before T1 seconds after receiving the DHCPv6 Reply message.  
**Step 56:** The CE-Router must transmit a Router Advertisement that contains PIO with a prefix from the IA\_PD on the LAN network.
- *Part N*  
**Step 59:** The CE-Router must transmit a DHCPv6 Rebind message before T1 seconds after receiving the DHCPv6 Reply message.  
**Step 61:** The CE-Router must transmit a Router Advertisement that contains PIO with a prefix from the IA\_PD on the LAN network.
- *Part O*  
**Step 64:** The CE-Router must not transmit a DHCPv6 Release message.  
**Step 66:** The CE-Router must transmit a Router Advertisement that does not contain a PIO with a prefix from the IA\_PD on the LAN network.



### Possible Problems:

- None.

### Test CERouter.1.2.10: Receipt of Invalid Reply Messages for Prefix Delegation

**Purpose:** Verify an IPv6 CE Router properly handles the validation of DHCPv6 Reply messages received for Prefix Delegation.

### References:

- [RFC 7084] – W-1
- [DHCP 3633] – Section 9 and 10
- [RFC 3315] – Section 18.1.8

**Test Setup:** Allow the IA\_NA lifetimes to be long enough such that they do not expire during the test. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

*Part A: Reply Message contains IA\_PD option with  $T1 > T2$*

1. Enable DHCPv6 on the CE-Router.
2. Upon reception of a DHCPv6 Solicit message TN1 transmits a properly formatted DHCPv6 Advertise message.
3. Upon reception of a DHCPv6 Request message TN1 transmits a properly formatted DHCPv6 Reply message containing a IA\_PD option with a T1 greater than T2.
4. TN2 transmits a valid Router Solicitation.
5. Observe the packets transmitted by the CE-Router.

*Part B: Reply Message contains invalid Prefix (preferred lifetime > valid lifetime)*

6. Enable DHCPv6 on the CE-Router.
7. Upon reception of a DHCPv6 Solicit message TN1 transmits a properly formatted DHCPv6 Advertise message.
8. Upon reception of a DHCPv6 Request message TN1 transmits a properly formatted DHCPv6 Reply message containing a IA\_PD with a preferred lifetime greater than valid lifetime.
9. TN2 transmits a valid Router Solicitation.
10. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 5:** The CE-Router must silently discard the invalid IA\_PD DHCPv6 Reply message. The CE-Router must transmit a Router Advertisement that does not contain a PIO with a prefix from the IA\_PD on the LAN network.
- *Part B*  
**Step 10:** The CE-Router must silently discard the invalid IA\_Prefix option in the DHCPv6 Reply message. The CE-Router must transmit a Router Advertisement that does not contain a PIO with a prefix from the IA\_PD on the LAN network

### Possible Problems:





- None.



## **Group 3: RFC 4861, 2460, 4443**

### **Scope**

The following tests cover the base specification for Internet Protocol version 6, Request For Comments 2460. The base specification specifies the basic IPv6 header and the initially defined IPv6 extension headers and options. It also discusses packet size issues, the semantics of flow labels and traffic classes, and the effects of IPv6 on upper-layer protocols.

The following tests cover the Neighbor Discovery Specification for Internet Protocol version 6, Request For Comments 4861. The Neighbor Discovery protocol is used by nodes to determine the link-layer address for neighbors known to reside on attached links as well as to quickly purge cached values that become invalid. Hosts also use Neighbor Discovery to find neighboring routers that are willing to forward packets on their behalf. Finally, nodes use the protocol to actively keep track of neighbors that are reachable and those that are not. When a router or the path to a router fails, a host actively searches for functioning alternates.

### **Overview**

These tests are designed to verify the readiness of an IPv6 implementation vis-à-vis the Neighbor Discovery specification.



### Test CERouter.1.3.1: On-link Determination

**Purpose:** Verify an IPv6 CE Router properly determines that a destination is on-link.

**References:**

- [RFC 7084] – W-3
- [ND] – Sections 5.2

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of part A and B. [Common Test Setup 1.2](#) is performed at the beginning of part C. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A	Packet B
IPv6 Header	IPv6 Header
Next Header: 58	Next Header: 58
Source Address: TN1's Link-local Address	Source Address: TN1's Global Address
ICMPv6 Echo Request	ICMPv6 Echo Request

Packet C
IPv6 Header
Next Header: 58
Source Address: TN3's Global Address
Destination Address: CE-Router's Global Address
ICMPv6 Echo Request

**Procedure:**

*Part A: Link-Local Address*

1. TN1 transmits Packet A an Echo Request with TN1's link-local source address.
2. Observe the packets transmitted by the CE-Router.

*Part B: Global Address, On-link Prefix covers TN1*

3. TN1 transmits Packet B, an Echo Request with TN1's global address.
4. Observe the packets transmitted by the CE-Router.

*Part C: Global Address, On-link Prefix does not cover TN3*

5. TN3 transmits Packet C, an Echo Request with TN3's global source address.
6. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*  
**Step 2:** The CE-Router sends a Neighbor Solicitation with Target Address equal to TN1's link-local address, indicating that the CE-Router has successfully determined that TN1 was on-link.



- *Part B*  
**Step 4:** TN1's global address is covered by the on-link prefix. Hence, the CE-Router must consider TN1's global address as on-link. The CE-Router sends a Neighbor Solicitation with Target Address equal to TN1's global address, indicating that the CE-Router has successfully determined that TN1 was on-link.
- *Part C*  
**Step 6:** TN3's global address is not covered by the on-link prefix. Hence, the CE-Router considers TN3's global address as off-link. The CE-Router sends a Neighbor Solicitation with Target Address equal to TR1's link-local address indicating that the CE-Router has successfully determined that TN3 was off-link.

**Possible Problems:**

- None.



### Test CERouter.1.3.2: Prefix Information Option Processing, On-link Flag

**Purpose:** Verify an IPv6 CE Router properly process the on-link flag of a Prefix Information Option.

**References:**

- [RFC 7084] – W-1
- [ND] – Section 6.3.4

**Test Setup:** The [Common Test Cleanup](#) procedure is performed after each part.

Router Advertisement A
IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address Destination Address: All-nodes Multicast Address
Router Advertisement Router Lifetime: 100 seconds Reachable Time: 10 seconds Retransmit Interval: 1 second
Prefix Option "on-link" (L) flag: 1 Valid Lifetime: 20 seconds Preferred Lifetime: 20 seconds Prefix: TR1's Global Prefix

Packet A
IPv6 Header Next Header: 58 Source Address: TN1's Global Address Destination Address: CE-Router's Link-local Address
ICMPv6 Echo Request

**Procedure:**

1. [Common Test Setup 1.2](#) is performed at the beginning of this test part using Router Advertisement A.
2. TN1 transmits Packet A. TN1 should not respond to Neighbor Solicitations from the CE-Router.
3. Observe the packets transmitted by the CE-Router.
4. TR1 transmits Router Advertisement A with the on-link flag clear.
5. TN1 transmits Packet A. TN1 should not respond to Neighbor Solicitations from the CE-Router.
6. Observe the packets transmitted by the CE-Router.



**Observable Results:**

**Step 3:** In response to Packet A, the CE-Router should transmit 3 Neighbor Solicitations with a Target Address of TN1's global address.

**Step 6:** In response to Packet A, the CE-Router should transmit 3 Neighbor Solicitations with a Target Address of TN1's global address.

**Possible Problems:**

- None.



### Test CERouter.1.3.3: Host Prefix List

**Purpose:** Verify an IPv6 CE Router properly updates its Prefix List upon receipt of Prefix Information Options, which have the on-link flag set.

#### References:

- [RFC 7084] – W-1
- [ND] – Sections 6.3.4

**Test Setup:** [Common Test Setup 1.2](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### Router Advertisement A

IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address Destination Address: All-nodes Multicast Address
Router Advertisement Router Lifetime: 20 seconds Reachable Time: 600 seconds Retransmit Interval: 1 second
Prefix Option "on-link" (L) flag: 1 Valid Lifetime: 10 seconds Preferred Lifetime: 10 seconds Prefix: TN1's Global Prefix

#### Packet B

IPv6 Header Next Header: 58 Source Address: TN1's Global Address Destination Address: CE- Router's Link-local Address ICMPv6 Echo Request
---

#### Procedure:

##### *Part A: Prefix Lifetime has not Expired*

1. TR1 transmits Router Advertisement A without the Prefix Option.
2. TR1 transmits a link-local Echo Request to the CE-Router.
3. Observe the packets transmitted by the CE-Router. TR1 transmits a Neighbor Advertisement in response to any Neighbor Solicitations from the CE-Router.



4. TR1 transmits Router Advertisement A. The Source Address is the TR1's Link-local Address. The Destination Address is the multicast address. The on-link flag is set. Wait 8 seconds.
5. TN1 transmits Packet B, whose Source Address is covered by the prefix advertised in Router Advertisement A.
6. Observe the packets transmitted by the CE-Router.

*Part B: Prefix Lifetime updated by Router Advertisement*

7. TR1 transmits Router Advertisement A without the Prefix Option.
8. TR1 transmits a link-local Echo Request to the CE-Router.
9. Observe the packets transmitted by the CE-Router. TR1 transmits a Neighbor Advertisement in response to any Neighbor Solicitations from the CE-Router.
10. TR1 transmits Router Advertisement A. Wait 8 seconds.
11. TR1 transmits Router Advertisement A. Wait 8 seconds.
12. TN1 transmits Packet B, whose Source Address is covered by the prefix advertised in Router Advertisement A.
13. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*
  - Step 3:** The CE-Router solicits and replies to the Echo Request transmitted by TR1.
  - Step 6:** In response to Packet B, the CE-Router should transmit Neighbor Solicitations with a Target Address of TN1's global address.
- *Part B*
  - Step 9:** The CE-Router solicits and replies to the Echo Request transmitted by TR1.
  - Step 13:** In response to Packet B, the CE-Router should transmit Neighbor Solicitations with a Target Address of TN1's global address.

**Possible Problems:**

- None.





## Test CERouter.1.3.4: Neighbor Solicitation Origination, Address Resolution

**Purpose:** Verify an IPv6 CE Router properly originates Neighbor Solicitations when trying to resolve the address of a neighbor.

### References:

- [RFC 7084] – W-3
- [ND] – Section 6.2.1, 7.2.2

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A	Packet B
IPv6 Header	IPv6 Header
Next Header: 58	Next Header: 58
Source Address: TN1's Link-local Address	Source Address: TN1's Global Address
Destination Address: CE-Router's Link-local Address	Destination Address: CE-Router's Global Address
ICMPv6 Echo Request	ICMPv6 Echo Request

### Procedure:

#### *Part A: Neighbor Solicitation Origination, Target Address Being Link-Local*

1. TR1 transmits a Router Advertisement with a Retransmit Interval value of 5 seconds.
2. TN1 transmits Packet A. The source address is TN1's link-local address and the destination address is the CE-Router's link-local address.
3. Observe the packets transmitted by the CE-Router. TN1 doesn't send any Neighbor Advertisements.

#### *Part B: Neighbor Solicitation Origination, Target Address Being Global*

4. TR1 transmits a Router Advertisement with a Retransmit Interval value of 5 seconds.
5. TN1 transmits Packet B. The source address is TN1's global address and the destination address is the CE-Router's global address.
6. Observe the packets transmitted by the CE-Router. TN1 doesn't send any Neighbor Advertisements.

### Observable Results:

- *Part A*  
**Step 3:** The CE-Router should transmit the Neighbor Solicitations with a Target Address equal to the TN1's Link-local Address at intervals of 5 seconds. The CE-Router MUST transmit no more than 1 Neighbor Solicitation every 5 seconds. Each Neighbor Solicitation MUST have a Source Link-Layer Address Option. The maximum number of Neighbor Solicitations should be MAX\_MULTICAST\_SOLICIT, which should be 3.
- *Part B*  
**Step 6:** The CE-Router should transmit the Neighbor Solicitations with a Target Address equal to the TN1's Global Address at intervals of 5 seconds. The CE-Router MUST



transmit no more than 1 Neighbor Solicitation every 5 seconds. Each Neighbor Solicitation MUST have a Source Link-Layer Address Option. The maximum number of Neighbor Solicitations should be MAX\_MULTICAST\_SOLICIT, which should be 3,

**Possible Problems:**

- None.



### Test CERouter.1.3.5: Neighbor Solicitation Processing, IsRouterFlag

**Purpose:** Verify an IPv6 CE Router does not modify the isRouter flag after receiving a Neighbor Solicitation.

**References:**

- [RFC 7084] – W-3
- [ND] – Sections 7.2.3
- [IPv6-ARCH] – Section 2.6.1, 2.8

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A

IPv6 Header Next Header: 58 Source Address: TN3's off-link Address Destination Address: CE-Router's Global Address
ICMPv6 Echo Request

Neighbor Solicitation B

IPv6 Header Next Header: 58 Destination Address: CE-Router's Link-local Address Source Address: TR1's Link-local Address
Neighbor Solicitation Target Address: CE-Router's Link-local Address

Neighbor Solicitation C

Neighbor Solicitation D

IPv6 Header Next Header: 58 Destination Address: CE-Router's Link-local Address Source Address: TR1's Link-local Address	Ipv6 Header Next Header: 58 Destination Address: CE-Router's Solicited-node Multicast Link-local Address Source Address: TR1's Link-local Address
Neighbor Solicitation Target Address: CE-Router's Link-local Address	Neighbor Solicitation Target Address: CE-Router's Link-local Address Source Link-Layer Address:



Source Link-Layer Address: TR1's Ethernet address	TR2's Ethernet address
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### Procedure:

#### *Part A: Unicast Neighbor Solicitation without SLLA*

1. TR1 transmits Neighbor Solicitation B.
2. TN3 transmits Packet A to the CE-Router.
3. Observe the packets transmitted by the CE-Router.

#### *Part B: Unicast Neighbor Solicitation with a SLLA*

4. TR1 transmits Neighbor Solicitation C.
5. TN3 transmits Packet A to the CE-Router.
6. Observe the packets transmitted by the CE-Router.

#### *Part C: Multicast Neighbor Solicitation with a different SLLA*

7. TR1 transmits Neighbor Solicitation D.
8. TN3 transmits Packet A to the CE-Router.
9. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 3:** The CE-Router transmits an Echo Reply using TR1 as its default router. The CE-Router should not update the isRouter flag after receiving the NS.
- *Part B*  
**Step 6:** The CE-Router transmits an Echo Reply using TR1 as its default router. The CE-Router should not update the isRouter flag after receiving the NS.
- *Part C*  
**Step 9:** The CE-Router transmits an Echo Reply using TR1 updated link-layer address as its default router. The CE-Router should not update the isRouter flag after receiving the NS.

### Possible Problems:

- None.



## Test CERouter.1.3.6: Neighbor Advertisement Processing, R-bit Change

**Purpose:** Verify an IPv6 CE Router properly takes action when a neighbor who is a router starts transmitting Neighbor Advertisements with the Router flag clear.

### References:

- [RFC 7084] – W-3
- [ND] – Section 7.2.5

**Test Setup:** The [Common Test Cleanup](#) procedure is performed after each part.

#### Router Advertisement

IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address
Router Advertisement Router Lifetime: 20 seconds Reachable Time: 100 seconds Retransmit Interval: 1 second Prefix: TR1's Global Prefix

#### Packet A

IPv6 Header Next Header: 58 Source Address: TN3's off-link Global Address Destination Address: CE-Router Global Address
ICMPv6 Echo Request

#### Neighbor Advertisement A    Neighbor Advertisement B

IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address	IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address
Neighbor Advertisement Router flag: 0 Solicited flag: 1 Override flag: 1	Neighbor Advertisement Router flag: 0 Solicited flag: 0 Override flag: 0

#### Neighbor Advertisement C    Neighbor Advertisement D

IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address	IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address
--	--



Neighbor Advertisement Router flag: 0 Solicited flag: 0 Override flag: 1	Neighbor Advertisement Router flag: 0 Solicited flag: 1 Override flag: 0
---	---

Neighbor Advertisement E IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address	Neighbor Advertisement F IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address
Neighbor Advertisement Router flag: 0 Solicited flag: 1 Override flag: 1 Target Link-Layer option: TR1's Link-layer address	Neighbor Advertisement Router flag: 0 Solicited flag: 0 Override flag: 0 Target Link-Layer option: TR1's Link-layer address

Neighbor Advertisement G IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address	Neighbor Advertisement H IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address
Neighbor Advertisement Router flag: 0 Solicited flag: 0 Override flag: 1 Target Link-Layer option: TR1's Link-layer address	Neighbor Advertisement Router flag: 0 Solicited flag: 1 Override flag: 0 Target Link-Layer option: TR1's Link-layer address

**Procedure:**

*Part A: Solicited and Override flag set without TLLA*

1. [Common Test Setup 1.2](#) is performed at the beginning of this test part using Router Advertisement without a Source Link-layer Address Option.
2. TN3 transmits Packet A.
3. Observe the packets transmitted by the CE-Router.
4. TR1 responds to Neighbor Solicitations from the CE-Router with a Neighbor Advertisement with the Router, Solicited, and Override flags set.
5. Observe the packets transmitted by the CE-Router.
6. TR1 transmits Neighbor Advertisement A.
7. TN3 transmits Packet A.
8. Observe the packets transmitted by the CE-Router.

*Part B: Solicited and Override flag clear without TLLA*

9. [Common Test Setup 1.2](#) is performed at the beginning of this test part using Router Advertisement without a Source Link-layer Address Option.
10. TN3 transmits Packet A.



11. Observe the packets transmitted by the CE-Router.
12. TR1 responds to Neighbor Solicitations from the CE-Router with a Neighbor Advertisement with the Router, Solicited, and Override flags set.
13. Observe the packets transmitted by the CE-Router.
14. TR1 transmits Neighbor Advertisement B.
15. TN3 transmits Packet A.
16. Observe the packets transmitted by the CE-Router.

*Part C: Solicited Flag clear and Override Flag set without TLLA*

17. [Common Test Setup 1.2](#) is performed at the beginning of this test part using Router Advertisement without a Source Link-layer Address Option.
18. TN3 transmits Packet A.
19. Observe the packets transmitted by the CE-Router.
20. TR1 responds to Neighbor Solicitations from the CE-Router with a Neighbor Advertisement with the Router, Solicited, and Override flags set.
21. Observe the packets transmitted by the CE-Router.
22. TR1 transmits Neighbor Advertisement C.
23. TN3 transmits Packet A.
24. Observe the packets transmitted by the CE-Router.

*Part D: Solicited Flag set and Override Flag clear without TLLA*

25. [Common Test Setup 1.2](#) is performed at the beginning of this test part using Router Advertisement without a Source Link-layer Address Option.
26. TN3 transmits Packet A.
27. Observe the packets transmitted by the CE-Router.
28. TR1 responds to Neighbor Solicitations from the CE-Router with a Neighbor Advertisement with the Router, Solicited, and Override flags set.
29. Observe the packets transmitted by the CE-Router.
30. TR1 transmits Neighbor Advertisement D.
31. TN3 transmits Packet A.
32. Observe the packets transmitted by the CE-Router.

*Part E: Solicited and Override Flags set with TLLA*

33. [Common Test Setup 1.2](#) is performed at the beginning of this test part using Router Advertisement without a Source Link-layer Address Option.
34. TN3 transmits Packet A.
35. Observe the packets transmitted by the CE-Router.
36. TR1 responds to Neighbor Solicitations from the CE-Router with a Neighbor Advertisement with the Router, Solicited, and Override flags set.
37. Observe the packets transmitted by the CE-Router.
38. TR1 transmits Neighbor Advertisement E.
39. TN3 transmits Packet A.
40. Observe the packets transmitted by the CE-Router.

*Part F: Solicited and Override Flags clear with TLLA*

41. [Common Test Setup 1.2](#) is performed at the beginning of this test part using Router Advertisement without a Source Link-layer Address Option.
42. TN3 transmits Packet A.
43. Observe the packets transmitted by the CE-Router.
44. TR1 responds to Neighbor Solicitations from the CE-Router with a Neighbor Advertisement with the Router, Solicited, and Override flags set.
45. Observe the packets transmitted by the CE-Router.



46. TR1 transmits Neighbor Advertisement F.
47. TN3 transmits Packet A.
48. Observe the packets transmitted by the CE-Router.

*Part G: Solicited Flag clear and Override flag clear with TLLA*

49. [Common Test Setup 1.2](#) is performed at the beginning of this test part using Router Advertisement without a Source Link-layer Address Option.
50. TN3 transmits Packet A.
51. Observe the packets transmitted by the CE-Router.
52. TR1 responds to Neighbor Solicitations from the CE-Router with a Neighbor Advertisement with the Router, Solicited, and Override flags set.
53. Observe the packets transmitted by the CE-Router.
54. TR1 transmits Neighbor Advertisement G.
55. TN3 transmits Packet A.
56. Observe the packets transmitted by the CE-Router.

*Part H: Solicited Flag set and Override Flag clear and TLLA*

57. [Common Test Setup 1.2](#) is performed at the beginning of this test part using Router Advertisement without a Source Link-layer Address Option.
58. TN3 transmits Packet A.
59. Observe the packets transmitted by the CE-Router.
60. TR1 responds to Neighbor Solicitations from the CE-Router with a Neighbor Advertisement with the Router, Solicited, and Override flags set.
61. Observe the packets transmitted by the CE-Router.
62. TR1 transmits Neighbor Advertisement H.
63. TN3 transmits Packet A.
64. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*
  - Step 3:** The CE-Router should solicit TR1 by transmitting Neighbor Solicitations with a Target Address of TR1's Link-local Address.
  - Step 5:** The CE-Router should transmit an Echo Reply to Packet A using the TR1 as the first hop.
  - Step 8:** The CE-Router MUST not transmit an Echo Reply using TR1 as the first hop in response to Packet A in Step 7 and the CE-Router's MUST not transmit multicast NS's with a target set to TR1's link-local address.
- *Part B*
  - Step 11:** The CE-Router should solicit TR1 by transmitting Neighbor Solicitations with a Target Address of TR1's Link-local Address.
  - Step 13:** The CE-Router should transmit an Echo Reply to Packet A using the TR1 as the first hop.
  - Step 16:** The CE-Router MUST not transmit an Echo Reply using TR1 as the first hop in response to Packet A in Step 15 and the CE-Router's MUST not transmit multicast NS's with a target set to TR1's link-local address.
- *Part C*
  - Step 19:** The CE-Router should solicit TR1 by transmitting Neighbor Solicitations with a Target Address of TR1's Link-local Address.





**Step 21:** The CE-Router should transmit an Echo Reply to Packet A using the TR1 as the first hop.

**Step 24:** The CE-Router MUST not transmit an Echo Reply using TR1 as the first hop in response to Packet A in Step 23 and the CE-Router's MUST not transmit multicast NS's with a target set to TR1's link-local address.

- *Part D*

**Step 27:** The CE-Router should solicit TR1 by transmitting Neighbor Solicitations with a Target Address of TR1's Link-local Address.

**Step 29:** The CE-Router should transmit an Echo Reply to Packet A using the TR1 as the first hop.

**Step 32:** The CE-Router MUST not transmit an Echo Reply using TR1 as the first hop in response to Packet A in Step 31 and the CE-Router's MUST not transmit multicast NS's with a target set to TR1's link-local address.

- *Part E*

**Step 35:** The CE-Router should solicit TR1 by transmitting Neighbor Solicitations with a Target Address of TR1's Link-local Address.

**Step 37:** The CE-Router should transmit an Echo Reply to Packet A using the TR1 as the first hop.

**Step 40:** The CE-Router MUST not transmit an Echo Reply using TR1 as the first hop in response to Packet A in Step 39 and the CE-Router's MUST not transmit multicast NS's with a target set to TR1's link-local address.

- *Part F*

**Step 43:** The CE-Router should solicit TR1 by transmitting Neighbor Solicitations with a Target Address of TR1's Link-local Address.

**Step 45:** The CE-Router should transmit an Echo Reply to Packet A using the TR1 as the first hop.

**Step 48:** The CE-Router MUST not transmit an Echo Reply using TR1 as the first hop in response to Packet A in Step 47 and the CE-Router's MUST not transmit multicast NS's with a target set to TR1's link-local address.

- *Part G*

**Step 51:** The CE-Router should solicit TR1 by transmitting Neighbor Solicitations with a Target Address of TR1's Link-local Address.

**Step 53:** The CE-Router should transmit an Echo Reply to Packet A using the TR1 as the first hop.

**Step 56:** The CE-Router MUST not transmit an Echo Reply using TR1 as the first hop in response to Packet A in Step 55 and the CE-Router's MUST not transmit multicast NS's with a target set to TR1's link-local address.

- *Part H*

**Step 59:** The CE-Router should solicit TR1 by transmitting Neighbor Solicitations with a Target Address of TR1's Link-local Address.

**Step 61:** The CE-Router should transmit an Echo Reply to Packet A using the TR1 as the first hop.

**Step 64:** The CE-Router MUST not transmit an Echo Reply using TR1 as the first hop in response to Packet A in Step 63 and the CE-Router's MUST not transmit multicast NS's with a target set to TR1's link-local address.

### Possible Problems:



- None.



## Test CERouter.1.3.7: Router Solicitation

**Purpose:** Verify an IPv6 CE Router properly sends valid Router Solicitations at the appropriate time.

### References:

- [RFC 7084] – W-2, W-3
- [ND] – Sections 4.1, 6.1.1, and 6.3.7

**Test Setup:** No Common Test Setup is performed. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

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

### Observable Results:

**Step 2:** The CE-Router should transmit up to MAX\_RTR\_SOLICITATIONS (3) Router Solicitations RTR\_SOLICITATION\_INTERVAL (4) seconds apart. The Router Solicitations should be sent from the link-local address of the CE-Router. The destination address should be the All-Routers multicast address.

### Possible Problems:

- None.



## Test CERouter.1.3.8: Router Solicitations, Solicited Router Advertisement

**Purpose:** Verify an IPv6 CE Router properly process Router Advertisements in response to Router Solicitations.

### References:

- [RFC 7084] – W-3
- [ND] – Section 6.3.7

**Test Setup:** No Common Test Setup is performed. The [Common Test Cleanup](#) procedure is performed after each part.

Router Advertisement A
IPv6 Header Next Header: 58 Hop Limit: [See below] Source Address: [See below] Destination Address: All-Node Multicast address
Router Advertisement ICMP Code: [See below] ICMP Checksum: [See below] Source Link-layer Address Option: [See below]

### Procedure:

#### *Part A: Valid Router Advertisement, No Source Link-layer Address Option*

1. Reboot the CE-Router.
2. Wait until the CE-Router transmits a Router Solicitation.
3. TR1 transmits Router Advertisement A without a Source Link-layer Address Option. The Source Address is the link-local address of TR1. The Hop Limit is 255. The ICMP Code is 0. The ICMP Checksum is valid.
4. Wait `RTR_SOLICITATION_INTERVAL+MAX_RTR_SOLICITATION_DELAY`.
5. Observe the packets transmitted by the CE-Router.

#### *Part B: Valid Router Advertisement, Source Link-Layer Address Option*

6. Reboot the CE-Router.
7. Wait until the CE-Router transmits a Router Solicitation.
8. TR1 transmits Router Advertisement A with a Source Link-layer Address Option.
9. Wait `RTR_SOLICITATION_INTERVAL+MAX_RTR_SOLICITATION_DELAY`
10. Observe the packets transmitted by the CE-Router.

#### *Part C: Invalid Router Advertisement, Global Source Address*

11. Reboot the CE-Router.
12. Wait until the CE-Router transmits a Router Solicitation.
13. TR1 transmits Router Advertisement A has a Source Address of the global address of TR1, but is valid otherwise.
14. Wait `RTR_SOLICITATION_INTERVAL+MAX_RTR_SOLICITATION_DELAY`



15. Observe the packets transmitted by the CE-Router.

*Part D: Invalid Router Advertisement, Bad Hop Limit*

16. Reboot the CE-Router.

17. Wait until the CE-Router transmits a Router Solicitation.

18. TR1 transmits Router Advertisement A has a Hop Limit of 2, but is valid otherwise.

19. Wait `RTR_SOLICITATION_INTERVAL+MAX_RTR_SOLICITATION_DELAY`

20. Observe the packets transmitted by the CE-Router.

*Part E: Invalid Router Advertisement, Bad ICMP Checksum*

21. Reboot the CE-Router.

22. Wait until the CE-Router transmits a Router Solicitation.

23. TR1 transmits Router Advertisement A has an invalid ICMP checksum, but is otherwise valid.

24. Wait `RTR_SOLICITATION_INTERVAL+MAX_RTR_SOLICITATION_DELAY`

25. Observe the packets transmitted by the CE-Router.

*Part F: Invalid Router Advertisement, Bad ICMP Code*

26. Reboot the CE-Router.

27. Wait until the CE-Router transmits a Router Solicitation.

28. TR1 transmits Router Advertisement A has an ICMP Code of 1, but is otherwise valid.

29. Wait `RTR_SOLICITATION_INTERVAL+MAX_RTR_SOLICITATION_DELAY`

30. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*

**Step 5:** The CE-Router should transmit only one Router Solicitation. The Router Solicitation should be sent from the link-local address of the CE-Router. The destination address should be the All-Routers multicast address.

- *Part B*

**Step 10:** The CE-Router should transmit only one Router Solicitation. The Router Solicitation should be sent from the link-local address of the CE-Router. The destination address should be the All-Routers multicast address.

- *Part C*

**Step 15:** The CE-Router should ignore the invalid Router Advertisement and continue to transmit Router Solicitations. The Router Solicitations should be sent from the link-local address of the CE-Router. The destination address should be the All-Routers multicast address.

- *Part D*

**Step 20:** The CE-Router should ignore the invalid Router Advertisement and continue to transmit Router Solicitations. The Router Solicitations should be sent from the link-local address of the CE-Router. The destination address should be the All-Routers multicast address.

- *Part E*

**Step 25:** The CE-Router should ignore the invalid Router Advertisement and continue to transmit Router Solicitations. The Router Solicitations should be sent from the link-local address of the CE-Router. The destination address should be the All-Routers multicast address.

- *Part F*

**Step 30:** The CE-Router should ignore the invalid Router Advertisement and continue to transmit Router Solicitations. The Router Solicitations should be sent from the link-local



address of the CE-Router. The destination address should be the All-Routers multicast address.

**Possible Problems:**

- The CE-Router may only transmit one Router Solicitation when initializing. If this is the true this test may be omitted.



## Test CERouter.1.3.9: Host Ignores Router Solicitations

**Purpose:** Verify an IPv6 CE Router properly ignores Router Solicitations on the WAN interface.

### References:

- [RFC 7084] – W-3
- [ND]- Section 6.2.6

**Test Setup:** [Common Test Setup 1.2](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Router Solicitation A
IPv6 Header
Next Header: 58
Destination Address: [See below]
Router Solicitation
Source Link-layer Address Option

### Procedure:

#### *Part A: All-Router Multicast Destination*

1. TN1 transmits Router Solicitation A. The Destination Address is the All-Router multicast Address.
2. Wait (RETRANS\_TIMER \* MAX\_\*CAST\_SOLICIT). (3 seconds)
3. TN1 transmits a link-local Echo Request to the CE-Router.
4. Wait 2 seconds.
5. Observe the packets transmitted by the CE-Router.

#### *Part B: All-Nodes Multicast Destination*

6. TN1 transmits Router Solicitation A. The Destination Address is the All-Nodes multicast Address.
7. Wait (RETRANS\_TIMER \* MAX\_\*CAST\_SOLICIT). (3 seconds)
8. TN1 transmits a link-local Echo Request to the CE-Router.
9. Wait 2 seconds.
10. Observe the packets transmitted by the CE-Router.

#### *Part C: Link-local Unicast Destination*

11. TN1 transmits Router Solicitation A. The Destination Address is the link local address of the CE-Router.
12. Wait (RETRANS\_TIMER \* MAX\_\*CAST\_SOLICIT). (3 seconds)
13. TN1 transmits a link-local Echo Request to the CE-Router.
14. Wait 2 seconds
15. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 5:** The CE-Router should send a multicast Neighbor Solicitation for TN1 indicating the CE-Router did process the Router Solicitation from TN1.



- *Part B*  
**Step 10:** The CE-Router should send a multicast Neighbor Solicitation for TN1 indicating the CE-Router did process the Router Solicitation from TN1.
- *Part C*  
**Step 15:** The CE-Router should send a multicast Neighbor Solicitation for TN1 indicating the CE-Router did process the Router Solicitation from TN1.

**Possible Problems:**

- None.





### Test CERouter.1.3.10: Default Router Switch

**Purpose:** Verify an IPv6 CE Router properly maintains at least two routers in its Default Router List and will switch routers when the router in use fails.

**References:**

- [RFC 7084] – W-3
- [ND] – Section 5.2, 5.3

**Test Setup:** [Common Test Setup 1.2](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Router Advertisement A	Router Advertisement B
IPv6 Header Next Header: 58 Source Address: TR1's Link Local Address	IPv6 Header Next Header: 58 Source Address: TR2's Link Local Address
Router Advertisement Router Lifetime: 45 seconds Reachable Time: 10 seconds Retransmit Interval: 1 second Prefix Length: 64 L Bit: 1 (on-link) Prefix: TN1's Global Prefix	Router Advertisement Router Lifetime: 45 seconds Reachable Time: 10 seconds Retransmit Interval: 1 second Prefix Length: 64 L Bit: 1 (on-link) Prefix: TN1's Global Prefix

Packet A

IPv6 Header Next Header: 58 Source Address: TN3's Global Address Destination Address: CE- Router's Global Address ICMPv6 Echo Request
---

**Procedure:**

1. TR1 transmits Router Advertisement A.
2. TN3 transmits Packet A.
3. Observe the packets transmitted by the CE-Router. TR1 transmits a Neighbor Advertisement in response to any Neighbor Solicitations from the CE-Router.
4. TR2 transmits Router Advertisement B.
5. TN3 transmits Packet A every 3 seconds for 30 seconds. Packet A is an ICMPv6 Echo Request that has an off-link global source address.
6. Observe the packets transmitted by the CE-Router.



7. When Reachable Time expires, and the CE-Router solicits TR1, no Neighbor Advertisements are transmitted by TR1.
8. Observe the packets transmitted by the CE-Router.

**Observable Results:**

**Step 3:** The CE-Router should transmit a Neighbor Solicitation with a Target Address equal to TR1's link-local address. The CE-Router should send an Echo Reply to TN3 via TR1 in response to Packet A.

**Step 6:** The CE-Router should send Echo Replies to TR1's link local address until Reachable Time expires. When Reachable Time expires, the CE-Router should send 3 Neighbor Solicitations to TR1's link local address.

**Step 8:** The CE-Router selects TR2 from its Default Router list. The CE-Router sends Neighbor Solicitations to TR2's link local address. After sending the packets to TR2, the CE-Router probes TR2 as a side effect

**Possible Problems:**

- None.



## Test CERouter.1.3.11: Router Advertisement Processing, Validity

**Purpose:** Verify an IPv6 CE Router properly discards an invalid Router Advertisement.

### References:

- [RFC 7084] – W-3
- [ND] – Section 6.1.2

**Test Setup:** No Common Test Setup is performed. [Common Test Cleanup](#) procedure is performed after each part.

Router Advertisement
IPv6 Header Next Header: 58 Hop Limit: [See below] Source Address: [See below] Destination Address: Multicast Address
Router Advertisement ICMP Code: [See below] ICMP Checksum: [See below] Router Lifetime: 20 seconds Reachable Time: 600 seconds Retransmit Interval: 1 second
Source Link-layer Address Option

### Procedure:

#### Part A: Global Source Address

1. TR1 transmits the Router Advertisement. The Source Address is the global address of TR1. The Router Advertisements is valid otherwise.
2. Wait (RETRANS\_TIMER \* MAX\_\*CAST\_SOLICIT). (3 seconds)
3. TR1 transmits a link-local Echo Request to the CE-Router.
4. Observe the packets transmitted by the CE-Router.

#### Part B: Hop Limit less than 255.

5. TR1 transmits the Router Advertisement. The Hop Limit is 2. The Router Advertisement is valid otherwise.
6. Wait (RETRANS\_TIMER \* MAX\_\*CAST\_SOLICIT). (3 seconds)
7. TR1 transmits a link-local Echo Request to the CE-Router.
8. Observe the packets transmitted by the CE-Router.

#### Part C: Invalid Checksum

9. TR1 transmits the Router Advertisement. The ICMPv6 Checksum is invalid. The Router Advertisement is valid otherwise.
10. Wait (RETRANS\_TIMER \* MAX\_\*CAST\_SOLICIT). (3 seconds)
11. TR1 transmits a link-local Echo Request to the CE-Router.
12. Observe the packets transmitted by the CE-Router.

#### Part D: Invalid ICMP Code



13. TR1 transmits the Router Advertisement. The ICMP Code is 1. The Router Advertisement is valid otherwise.
14. Wait (RETRANS\_TIMER \* MAX\_\*CAST\_SOLICIT). (3 seconds)
15. TR1 transmits a link-local Echo Request to the CE-Router.
16. Observe the packets transmitted by the CE-Router.

*Part E: Invalid ICMP Length*

17. TR1 transmits the Router Advertisement with an ICMPv6 Length of 14. The Router Advertisement is valid otherwise.
18. Wait (RETRANS\_TIMER \* MAX\_\*CAST\_SOLICIT). (3 seconds)
19. TR1 transmits a link-local Echo Request to the CE-Router.
20. Observe the packets transmitted by the CE-Router.

*Part F: Option of Length 0*

21. TR1 transmits the Router Advertisement with an option of length 0. The Router Advertisement is valid otherwise.
22. Wait (RETRANS\_TIMER \* MAX\_\*CAST\_SOLICIT). (3 seconds)
23. TR1 transmits a link-local Echo Request to the CE-Router.
24. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A-F*  
In all parts, the CE-Router should transmit a multicast Neighbor Solicitations for TR1, indicating the CE-Router did not have a NCE for TR1.

**Possible Problems:**

- None.



## Test CERouter.1.3.12: Router Advertisement Processing, Cur Hop Limit

**Purpose:** Verify an IPv6 CE Router properly processes the Cur Hop Limit field of a Router Advertisement.

### References:

- [RFC 7084] – W-3
- [ND] – Sections 4.2, 6.2.1 and 6.3.4

**Test Setup:** [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: Unspecified*

1. TN1 transmits an Echo Request to the CE-Router.
2. Observe the packets transmitted by the CE-Router.
3. TR1 transmits a Router Advertisement with a Cur Hop Limit value of 0 (Zero).
4. TN1 transmits an Echo Request to the CE-Router.
5. Observe the packets transmitted by the CE-Router.

#### *Part B: Non-Zero*

6. TN1 transmits an Echo Request to the CE-Router.
7. Observe the packets transmitted by the CE-Router.
8. TR1 transmits a Router Advertisement with a Cur Hop Limit value of 100.
9. TN1 transmits an Echo Request to the CE-Router.
10. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** The CE-Router should respond to the Request from TN1. Observe the Hop Limit value in the Echo Reply packet the CE-Router transmits.  
**Step 5:** The CE-Router should respond to the Request from TN1. The Hop Limit value in the Echo Reply should be the same as was used in step 2.
- *Part B*  
**Step 7:** The CE-Router The CE-Router should respond to the Request from TN1. Observe the Hop Limit value in the Echo Reply packet the CE-Router transmits.  
**Step 10:** The CE-Router should respond to the Request from TN1. The Hop Limit value in the Echo Reply should be 15.

### Possible Problems:

- None.



### Test CERouter.1.3.13: Router Advertisement Processing, Router Lifetime

**Purpose:** Verify an IPv6 CE Router properly process a Router Advertisement and the Router Lifetime field within it.

**References:**

- [RFC 7084] – W-3
- [ND] – Section 6.3.4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of part A. [Common Test Setup 1.3](#) is performed at the beginning of part B and C. The [Common Test Cleanup](#) procedure is performed after each part.

Router Advertisement IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address Destination Address: All- Nodes Multicast Address
Router Advertisement Router Lifetime: 20 seconds Reachable Time: 600 seconds Retransmit Interval: 1 second
Prefix Option Valid Lifetime: 100 seconds Preferred Lifetime: 20 seconds Prefix: TR1's Global Prefix

**Procedure:**

*Part A: Router Lifetime Updated with Same Lifetime*

1. TR1 transmits the Router Advertisement.
2. TN3 transmits a global Echo Request to the CE-Router every second for 19 seconds.
3. Observe the packets transmitted by the CE-Router.
4. TR1 transmits the Router Advertisement.
5. TN3 transmits a global Echo Request to the CE-Router every second for 21 seconds.
6. Observe the packets transmitted by the CE-Router.

*Part B: Router Lifetime Set to Zero*

7. TN3 transmits a global Echo Request to the CE-Router.
8. Observe the packets transmitted by the CE-Router.
9. TR1 transmits the Router Advertisement with Router Lifetime set to zero.
10. TN3 transmits a global Echo Request to the CE-Router.
11. Observe the packets transmitted by the CE-Router.
12. TR2 transmits the Router Advertisement with Router Lifetime set to zero.
13. TN3 transmits a global Echo Request to the CE-Router.
14. Observe the packets transmitted by the CE-Router.



*Part C: Router Lifetime Set to Five; Allowed to Expire*

15. TN3 transmits a global Echo Request to the CE-Router.
16. Observe the packets transmitted by the CE-Router.
17. TR1 transmits the Router Advertisement with Router Lifetime set to five.
18. Wait seven seconds.
19. TN3 transmits a global Echo Request to the CE-Router.
20. Observe the packets transmitted by the CE-Router.
21. TR2 transmits the Router Advertisement with Router Lifetime set to five.
22. Wait seven seconds.
23. TN3 transmits a global Echo Request to the CE-Router.
24. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*
  - Step 3:** The CE-Router should respond to the Echo Requests from TN2 using TR1 as a first hop.
  - Step 4:** The CE-Router should update the Router Lifetime for TR1.
  - Step 6:** The CE-Router should respond to the Echo Requests from TN2 using TR1 as a first hop until the Router Lifetime expires. In response to the final Echo Request, the CE-Router **MUST** not transmit an Echo Reply or transmit multicast NS's with a target address set to TR1's link-local address.
- *Part B*
  - Step 8:** The CE-Router should use TR1 or TR2 as a first hop.
  - Step 11:** The CE-Router should use TR2 as a first hop.
  - Step 14:** The CE-Router must not transmit an Echo Reply or transmit multicast NS's with a target address set to TR1's or TR2's link-local address.
- *Part C*
  - Step 16:** The CE-Router should use TR1 or TR2 as a first hop.
  - Step 20:** The CE-Router should use TR2 as a first hop.
  - Step 24:** The CE-Router must not transmit an Echo Reply or transmit multicast NS's with a target address set to TR1's or TR2's link-local address.

**Possible Problems:**

- None.



## Test CERouter.1.3.14: Router Advertisement Processing, Reachable Time

**Purpose:** Verify an IPv6 CE Router properly updates its BaseReachableTime variable and re-computes its ReachableTime variable upon receipt of a Router Advertisement or a configuration with a specified Reachable Time.

### References:

- [RFC 7084] – W-3
- [ND] – Sections 6.2.1 and 6.3.4

**Test Setup:** [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:

1. TR1 transmits the Router Advertisement with a Reachable Time of 10 seconds.
2. TN1 transmits a link-local Echo Request to the CE-Router. TN1 must reply to any Neighbor Solicitations from the CE-Router.
3. Observe the packets transmitted by the CE-Router.
4. Repeat Step 2 every seconds for 40 seconds.
5. Observe the packets transmitted by the CE-Router.
6. TR1 transmits the Router Advertisement with a Reachable time of 40 seconds.
7. Repeat Step 2 every second for 140 seconds.
8. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 3:** The CE-Router should solicit for TN1's link-local address and transmit an Echo Reply.

**Step 5:** The CE-Router should transmit a Neighbor Solicitation with a Target Address of TN1's link-local address at an interval between 10 and 20 seconds. [ReachableTime time (between 5 and 15 seconds) + DELAY\_FIRST\_PROBE\_TIME (5 seconds)].

**Step 8:** The CE-Router should transmit Neighbor Solicitations at an interval between 25 and 65 seconds. [ReachableTime time (between 20 and 60 seconds) + DELAY\_FIRST\_PROBE\_TIME (5 seconds)].

### Possible Problems:

- None.





### Test CERouter.1.3.15: Router Advertisement Processing, Neighbor Cache

**Purpose:** Verify an IPv6 CE Router properly updates its Neighbor Cache upon receipt of a Router Advertisement.

**References:**

- [RFC 7084] – W-3
- [ND] – Section 6.3.4 and 7.3.3

**Test Setup:** [Common Test Setup 1.2](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Router Advertisement A

IPv6 Header Next Header: 58 Source Address: TR2's Link-local Address
Router Advertisement Router Lifetime: 0 seconds Reachable Time: 10 seconds Retransmit Interval: 1 second Source Link-layer Option

Echo Request B

IPv6 Header Next Header: 58 Source Address: TR2's Link- local Address Destination Address: CE- Router's Link-local Address ICMPv6 Echo Request
--

Neighbor Advertisement C

IPv6 Header Next Header: 58 Source Address: TR2's Link-local Address Destination Address: CE- Router's Link-local Address
Neighbor Advertisement Router flag: 1 Solicited flag: 1 Override flag: 1 Target Address: TR2's Link-local Address



**Procedure:**

*Part A: RA processing, no NCE*

1. TR2 transmits Router Advertisement A.
2. TR2 transmits an Echo Request to the CE-Router.
3. Observe the packets transmitted by the CE-Router.

*Part B: RA processing, NCE INCOMPLETE*

4. TR2 transmits Echo Request B. TR2 does not respond to any Neighbor Solicitations from the CE-Router.
5. Observe the packets transmitted by the CE-Router.
6. TR2 transmits Router Advertisement A.
7. Observe the packets transmitted by the CE-Router.

*Part C: RA with SLLA changed, NCE Reachable*

8. TR2 transmits Echo Request B. TR2 does not respond to any Neighbor Solicitations from the CE-Router.
9. Observe the packets transmitted by the CE-Router.
10. TR2 transmits Neighbor Advertisement C.
11. Observe the packets transmitted by the CE-Router.
12. TR2 transmits Router Advertisement A with a different Source Link-Layer Address.
13. TR2 transmits an Echo Request to the CE-Router.
14. Observe the packets transmitted by the CE-Router.

*Part D: RA with SLLA unchanged, NCE Reachable*

15. TR2 transmits Echo Request B. TR2 does not respond to any Neighbor Solicitations from the CE-Router.
16. Observe the packets transmitted by the CE-Router.
17. TR2 transmits Neighbor Advertisement C.
18. Observe the packets transmitted by the CE-Router.
19. TR2 transmits Router Advertisement A with a same Source Link-Layer Address.
20. TR2 transmits an Echo Request to the CE-Router.
21. Observe the packets transmitted by the CE-Router.

*Part E: RA without SLLA, NCE REACHABLE*

22. TR2 transmits Echo Request B. TR2 does not respond to any Neighbor Solicitations from the CE-Router.
23. Observe the packets transmitted by the CE-Router.
24. TR2 transmits Neighbor Advertisement C.
25. Observe the packets transmitted by the CE-Router.
26. TR2 transmits Router Advertisement A without a Source Link-Layer Address.
27. TR2 transmits an Echo Request to the CE-Router.
28. Observe the packets transmitted by the CE-Router

*Part F: RA with SLLA changed, NCE PROBE*

29. TR2 transmits Echo Request B. TR2 does not respond to any Neighbor Solicitations from the CE-Router.
30. Observe the packets transmitted by the CE-Router.
31. TR2 transmits Neighbor Advertisement C.
32. Observe the packets transmitted by the CE-Router.
33. Wait (REACHABLE\_TIME \* MAX\_RANDOM\_FACTOR) seconds.
34. TR2 transmits Echo Request B.



35. Observe the packets transmitted by the CE-Router.
36. Wait (DELAY\_FIRST\_PROBE\_TIME) seconds.
37. Observe the packets transmitted by the CE-Router.
38. TR2 transmits Router Advertisement A with a different Source Link-Layer Address.
39. TR2 transmits an Echo Request to the CE-Router.
40. Observe the packets transmitted by the CE-Router.

*Part G: RA with SLLA unchanged, NCE PROBE*

41. TR2 transmits Echo Request B. TR2 does not respond to any Neighbor Solicitations from the CE-Router.
42. Observe the packets transmitted by the CE-Router.
43. TR2 transmits Neighbor Advertisement C.
44. Observe the packets transmitted by the CE-Router.
45. Wait (REACHABLE\_TIME \* MAX\_RANDOM\_FACTOR) seconds.
46. TR2 transmits Echo Request B.
47. Observe the packets transmitted by the CE-Router.
48. Wait (DELAY\_FIRST\_PROBE\_TIME) seconds.
49. Observe the packets transmitted by the CE-Router.
50. TR2 transmits Router Advertisement A with a same Source Link-Layer Address.
51. TR2 transmits an Echo Request to the CE-Router.
52. Observe the packets transmitted by the CE-Router.

*Part H: RA without SLLA, NCE PROBE*

53. TR2 transmits Echo Request B. TR2 does not respond to any Neighbor Solicitations from the CE-Router.
54. Observe the packets transmitted by the CE-Router.
55. TR2 transmits Neighbor Advertisement C.
56. Observe the packets transmitted by the CE-Router.
57. Wait (REACHABLE\_TIME \* MAX\_RANDOM\_FACTOR) seconds.
58. TR2 transmits Echo Request B.
59. Observe the packets transmitted by the CE-Router.
60. Wait (DELAY\_FIRST\_PROBE\_TIME) seconds.
61. Observe the packets transmitted by the CE-Router.
62. TR2 transmits Router Advertisement A with a without Source Link-Layer Address.
63. TR2 transmits an Echo Request to the CE-Router.
64. Observe the packets transmitted by the CE-Router.

*Part I: RA with SLLA changed, NCE STALE*

65. TR2 transmits Echo Request B. TR2 does not respond to any Neighbor Solicitations from the CE-Router.
66. Observe the packets transmitted by the CE-Router.
67. TR2 transmits Neighbor Advertisement C.
68. Observe the packets transmitted by the CE-Router.
69. Wait (REACHABLE\_TIME \* MAX\_RANDOM\_FACTOR) seconds.
70. TR2 transmits Router Advertisement A with a different Source Link-Layer Address.
71. TR2 transmits Echo Request to the CE-Router.
72. Observe the packets transmitted by the CE-Router.

*Part J: RA with SLLA unchanged, NCE STALE*

73. TR2 transmits Echo Request B. TR2 does not respond to any Neighbor Solicitations from the CE-Router.
74. Observe the packets transmitted by the CE-Router.



75. TR2 transmits Neighbor Advertisement C.
76. Observe the packets transmitted by the CE-Router.
77. Wait (REACHABLE\_TIME \* MAX\_RANDOM\_FACTOR) seconds.
78. TR2 transmits Router Advertisement A with a same Source Link-Layer Address.
79. TR2 transmits Echo Request to the CE-Router.
80. Observe the packets transmitted by the CE-Router.

*Part K: RA without SLLA, NCE STALE*

81. TR2 transmits Echo Request B. TR2 does not respond to any Neighbor Solicitations from the CE-Router.
82. Observe the packets transmitted by the CE-Router.
83. TR2 transmits Neighbor Advertisement C.
84. Observe the packets transmitted by the CE-Router.
85. Wait (REACHABLE\_TIME \* MAX\_RANDOM\_FACTOR) seconds.
86. TR2 transmits Router Advertisement A without a Source Link-Layer Address.
87. TR2 transmits Echo Request to the CE-Router.
88. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*

**Step 3:** The CE-Router NCE for TR2, set the NCE's state to **STALE**, and record TR2's Link-layer Address. Because the CE-Router's NCE for TR2 is in state **STALE**, the CE-Router should send an Echo Reply to TR2 and enter state **DELAY**. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should send a unicast Neighbor Solicitation to TR2.
- *Part B*

**Step 5:** The CE-Router The CE-Router should create a Neighbor Cache Entry for TR2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TR2.

**Step 7:** The CE-Router must update the state of TR2's NCE to **STALE** and update its Link-layer Address. Because the CE-Router's NCE for TR2 is in state **STALE**, the CE-Router should send an Echo Reply to TR2's earlier request using the received Link-Layer address and enter state **DELAY**. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should send a unicast Neighbor Solicitation to TR2.
- *Part C*

**Step 9:** The CE-Router should create a Neighbor Cache Entry for TR2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TR2.

**Step 11:** The CE-Router should update the state of TR2's NCE to **REACHABLE** and record TR2's Link-layer Address. Because the CE-Router is in state **REACHABLE**, after receiving the earlier Echo Request from TR2, the CE-Router should send an Echo Reply using the received Link-Layer Address. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TR2.

**Step 14:** The CE-Router must change the state of the TR2's NCE to STALE and update its Link-layer Address according to the Router Advertisement received in Step 12. Because the CE-Router's NCE for TR2 is in state **STALE**, the CE-Router should send an Echo Reply to TR2 using the new Link-Layer address and enter state **DELAY**. After



DELAY\_FIRST\_PROBE\_TIME, the CE-Router should send a unicast Neighbor Solicitation to TR2.

- *Part D*

**Step 16:** The CE-Router The CE-Router should create a Neighbor Cache Entry for TR2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TR2.

**Step 18:** The CE-Router should update the state of TR2's NCE to **REACHABLE** and record TR2's Link-layer Address. Because the CE-Router is in state **REACHABLE**, after receiving the earlier Echo Request from TR2, the CE-Router should send an Echo Reply using the received Link-Layer Address. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TR2.

**Step 21:** The CE-Router must not change the state of the TR2's NCE. After receiving the Echo Request from TR2, the CE-Router should send an Echo Reply using the same Link-Layer Address. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TR2.

- *Part E*

**Step 23:** The CE-Router The CE-Router should create a Neighbor Cache Entry for TR2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TR2.

**Step 25:** The CE-Router should update the state of TR2's NCE to **REACHABLE** and record TR2's Link-layer Address. Because the CE-Router is in state **REACHABLE**, after receiving the earlier Echo Request from TR2, the CE-Router should send an Echo Reply using the received Link-Layer Address. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TR2.

**Step 28:** The CE-Router must not change the state of the TR2's NCE. After receiving the Echo Request from TR2, the CE-Router should send an Echo Reply using the same Link-Layer Address. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TR2.

- *Part F*

**Step 30:** The CE-Router The CE-Router should create a Neighbor Cache Entry for TR2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TR2.

**Step 32:** The CE-Router should update the state of TR2's NCE to **REACHABLE** and record TR2's Link-layer Address. Because the CE-Router is in state **REACHABLE**, after receiving the earlier Echo Request from TR2, the CE-Router should send an Echo Reply using the received Link-Layer Address. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TR2.

**Step 35:** The CE-Router should update the state of TR2's NCE to **STALE**, send an Echo Reply to TR2 using the same Link-Layer address and enter state **DELAY**.

**Step 37:** The CE-Router should update the state of TR2's NCE to **PROBE** by sending a unicast Neighbor Solicitation to TR2.

**Step 40:** The CE-Router must change the state of the TR2's NCE to **STALE** and update TR2's Link-Layer Address according to the received Router Advertisement. Because the CE-Router's NCE for TR2 is in state **STALE**, the CE-Router should send an Echo Reply to TR2 using the new Link-Layer Address and enter state **DELAY**. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should send a unicast Neighbor Solicitation to TR2.

- *Part G*



**Step 42:** The CE-Router The CE-Router should create a Neighbor Cache Entry for TR2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TR2.

**Step 44:** The CE-Router should update the state of TR2's NCE to **REACHABLE** and record TR2's Link-layer Address. Because the CE-Router is in state **REACHABLE**, after receiving the earlier Echo Request from TR2, the CE-Router should send an Echo Reply using the received Link-Layer Address. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TR2.

**Step 47:** The CE-Router should update the state of TR2's NCE to **STALE**, send an Echo Reply to TR2 using the same Link-Layer address and enter state **DELAY**.

**Step 49:** The CE-Router should update the state of TR2's NCE to **PROBE** by sending a unicast Neighbor Solicitation to TR2.

**Step 52:** The CE-Router must not change the state of the TR2's NCE. The CE-Router must continue to be in state **PROBE** and send unicast Neighbor Solicitations to TR2 up to MAX\_UNICAST\_SOLICIT times.

- *Part H*

**Step 54:** The CE-Router The CE-Router should create a Neighbor Cache Entry for TR2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TR2.

**Step 56:** The CE-Router should update the state of TR2's NCE to **REACHABLE** and record TR2's Link-layer Address. Because the CE-Router is in state **REACHABLE**, after receiving the earlier Echo Request from TR2, the CE-Router should send an Echo Reply using the received Link-Layer Address. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TR2.

**Step 59:** The CE-Router should update the state of TR2's NCE to **STALE**, send an Echo Reply to TR2 using the same Link-Layer address and enter state **DELAY**.

**Step 61:** The CE-Router should update the state of TR2's NCE to **PROBE** by sending a unicast Neighbor Solicitation to TR2.

**Step 64:** The CE-Router must not change the state of the TR2's NCE. The CE-Router must continue to be in state **PROBE** and send unicast Neighbor Solicitations to TR2 up to MAX\_UNICAST\_SOLICIT times.

- *Part I*

**Step 66:** The CE-Router should create a Neighbor Cache Entry for TR2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TR2.

**Step 68:** The CE-Router should update the state of TR2's NCE to **REACHABLE** and record TR2's Link-layer Address. Because the CE-Router is in state **REACHABLE**, after receiving the earlier Echo Request from TR2, the CE-Router should send an Echo Reply using the received Link-Layer Address. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TR2.

**Step 72:** The CE-Router must change the state of the TN1's NCE to **STALE** and update TR2's Link-Layer Address according to the received Router Advertisement. Because the CE-Router's NCE for TR2 is in state **STALE**, the CE-Router should send an Echo Reply to TR2 using the new Link-Layer Address and enter state **DELAY**. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should send a unicast Neighbor Solicitation to TR2.

- *Part J*

**Step 74:** The CE-Router should create a Neighbor Cache Entry for TR2 and set the state of



the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TR2.

**Step 76:** The CE-Router should update the state of TR2's NCE to **REACHABLE** and record TR2's Link-layer Address. Because the CE-Router is in state **REACHABLE**, after receiving the earlier Echo Request from TR2, the CE-Router should send an Echo Reply using the received Link-Layer Address. After **DELAY\_FIRST\_PROBE\_TIME**, the CE-Router should not send a unicast Neighbor Solicitation to TR2.

**Step 80:** The CE-Router must change the state of the TN1's NCE to **STALE** and update TR2's Link-Layer Address according to the received Router Advertisement. Because the CE-Router's NCE for TR2 is in state **STALE**, the CE-Router should send an Echo Reply to TR2 using the unchanged Link-Layer Address and enter state **DELAY**. After **DELAY\_FIRST\_PROBE\_TIME**, the CE-Router should send a unicast Neighbor Solicitation to TR2.

- *Part K*

**Step 82:** The CE-Router should create a Neighbor Cache Entry for TR2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TR2.

**Step 84:** The CE-Router should update the state of TR2's NCE to **REACHABLE** and record TR2's Link-layer Address. Because the CE-Router is in state **REACHABLE**, after receiving the earlier Echo Request from TR2, the CE-Router should send an Echo Reply using the received Link-Layer Address. After **DELAY\_FIRST\_PROBE\_TIME**, the CE-Router should not send a unicast Neighbor Solicitation to TR2.

**Step 88:** The CE-Router must change the state of the TN1's NCE to **STALE** and update TR2's Link-Layer Address according to the received Router Advertisement. Because the CE-Router's NCE for TR2 is in state **STALE**, the CE-Router should send an Echo Reply to TR2 using the unchanged Link-Layer Address and enter state **DELAY**. After **DELAY\_FIRST\_PROBE\_TIME**, the CE-Router should send a unicast Neighbor Solicitation to TR2.

#### **Possible Problems:**

- None.



## Test CERouter.1.3.16: Router Advertisement Processing, IsRouter flag

**Purpose:** Verify an IPv6 CE Router properly updates the IsRouter flag in its Neighbor Cache upon receipt of a Router Advertisement.

### References:

- [RFC 7084] – W-3
- [ND] – Section 6.3.4

**Test Setup:** [Common Test Setup 1.2](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### Router Advertisement A

IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address
Router Advertisement Router Lifetime: 600 seconds Reachable Time: 0 seconds Retransmit Interval: 1 second Source Link-layer Option

#### Echo Request A

IPv6 Header Next Header: 58 Source Address: TN3's off-link Global Address Destination Address: CE-Router's Global Address ICMPv6 Echo Request
---

### Procedure:

#### Part A: RA without Source Link-layer option

1. TR1 transmits a Link-local Echo Request to the CE-Router.
2. TR1 answers any Neighbor Solicitations with a Neighbor Advertisement (R=0, S=1, O=1) to the CE-Router.
3. Observe the packets transmitted by the CE-Router.
4. TR1 transmits Router Advertisement A without a Source Link-layer option to the CE-Router.
5. Wait for the CE-Router to perform Duplicate Address Detection on its global address.
6. TN3 transmits Echo Request A to the CE-Router with a nexthop of TR1.
7. Observe the packets transmitted by the CE-Router.

#### Part B: RA with the same Source Link-layer option as cached

8. TR1 transmits a Link-local Echo Request to the CE-Router.





9. TR1 answers any Neighbor Solicitations with a Neighbor Advertisement (R=0, S=1, O=1) to the CE-Router.
10. Observe the packets transmitted by the CE-Router.
11. TR1 transmits Router Advertisement A with the same Source Link-layer option to the CE-Router.
12. Wait for the CE-Router to perform Duplicate Address Detection on its global address.
13. TN3 transmits Echo Request A to the CE-Router with a nexthop of TR1.
14. Observe the packets transmitted by the CE-Router.

*Part C: RA with different Source Link-layer option as cached*

15. TR1 transmits a Link-local Echo Request to the CE-Router.
16. TR1 answers any Neighbor Solicitations with a Neighbor Advertisement (R=0, S=1, O=1) to the CE-Router.
17. Observe the packets transmitted by the CE-Router.
18. TR1 transmits Router Advertisement A with a different Source Link-layer option to the CE-Router.
19. Wait for the CE-Router to perform Duplicate Address Detection on its global address.
20. TN3 transmits Echo Request A to the CE-Router with a nexthop of TR1.
21. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*
  - Step 3:** The CE-Router should transmit an Echo Reply to TR1's link local address and update its NCE to state REACHABLE. The CE-Router sets the isRouter flag to false.
  - Step 7:** The CE-Router sets the isRouter flag to true and transmits an Echo Reply to TN3's off-link address with a next hop of TR1.
- *Part B*
  - Step 10:** The CE-Router should transmit an Echo Reply to TR1's link local address and update its NCE to state REACHABLE. The CE-Router sets the isRouter flag to false.
  - Step 14:** The CE-Router sets the isRouter flag to true and transmits an Echo Reply to TN3's off-link address with a next hop of TR1.
- *Part C*
  - Step 17:** The CE-Router should transmit an Echo Reply to TR1's link local address and update its NCE to state REACHABLE. The CE-Router sets the isRouter flag to false.
  - Step 21:** The CE-Router sets the isRouter flag to true and transmits an Echo Reply to TN3's off-link address with a next hop of TR1.

**Possible Problems:**

- None.



## Test CERouter.1.3.17: Next-hop Determination

**Purpose:** Verify an IPv6 CE Router properly determines the next hop.

### References:

- [RFC 7084] – W-3
- [ND] – Sections 3.1, 5.2 and 6.3.6

**Test Setup:** [Common Test Setup 1.2](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### Router Advertisement A

IPv6 Header Next Header: 58 Source Address: TR1's Link- local Address
Router Advertisement Router Lifetime: 600 seconds Reachable Time: 0 seconds Retransmit Interval: 1 second Source Link-layer Option

#### Echo Request B

IPv6 Header Next Header: 58 Source Address: TN3's off- link Global Address Destination Address: CE- Router's Link-Local Address ICMPv6 Echo Request
---

### Procedure:

1. TR1 transmits Router Advertisement A to the CE-Router.
2. TN3 transmits Echo Request B to the CE-Router with a nexthop of TR1.
3. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 5:** The CE-Router should transmit an Echo Reply to TN3's off-link global address using TR1 as it's next hop.

### Possible Problems:

- None.



### Test CERouter.1.3.18: Router Advertisement Processing, On-link determination

**Purpose:** Verify an IPv6 CE Router properly rejects an invalid prefix length, however the prefix length is still valid for on-link determination when the on-link flag is true.

**References:**

- [RFC 7084] – W-3
- 

**Test Setup:** The [Common Test Cleanup](#) procedure is performed after each part.

Router Advertisement A
IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address
Router Advertisement Router Lifetime: 600 seconds Reachable Time: 10 seconds Retransmit Interval: 1 second Source Link-layer Option
Prefix Option Prefix Length: 96 "on-link" (L) flag: 1 Valid Lifetime: 20 seconds Preferred Lifetime: 20 seconds Prefix: TR1's Global Prefix "Y"

Echo Request B
IPv6 Header Next Header: 58 Source Address: TN1's Prefix "Y" Global Address Destination Address: CE-Router's Global Address ICMPv6 Echo Request

**Procedure:**

1. [Common Test Setup 1.2](#) is performed at the beginning of this test part using Router Advertisement A.
2. TN1 transmits Echo Request B to the CE-Router.
3. Observe the packets transmitted by the CE-Router.



**Observable Results:**

**Step 3:** The CE-Router should transmits an Echo Reply to TN1's global address on-link.

**Possible Problems:**

- None.



### Test CERouter.1.3.19: Unrecognized – End Node

**Purpose:** Verify an IPv6 CE Router properly processes an IPv6 packet destined for it that contains a Routing header with an unrecognized Routing Type value.

#### References:

- [RFC 7084] – G-1
- [IPv6-SPEC] – Sections 4.4
- [RFC-5095] – Section 3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A
IPv6 Header Source Address: TN3's Global Address Destination Address: CE-Router's Global Address Next Header: 43
Routing Header Next Header: 58 Header Ext. Length: 6 Routing Type: 33 Segments Left: 0 Address [1]: Global Address 2 Address [2]: Global Address 3 Address [3]: TR1's Global Address
ICMPv6 Echo Request

#### Procedure:

##### *Part A: Unrecognized Routing Type 33*

1. TR1 forwards Packet A, an Echo Request that has a Routing header with a Routing Type value of 33 and Segments Left value of 0. The Echo Request is destined for the CE-Router.
2. Observe the packets transmitted by the CE-Router.

##### *Part B: Unrecognized Routing Type 0*

3. TR1 forwards Packet A, an Echo Request that has a Routing header with a Routing Type value of 0 and Segments Left value of 0. The Echo Request is destined for the CE-Router.
4. Observe the packets transmitted by the CE-Router.

#### Observable Results:

- *Part A*  
**Step 2:** CE-Router must ignore the unrecognized Routing Type value and should respond to the Request by sending an Echo Reply to TN3 using TR1 as the first-hop.
- *Part B*



**Step 4:** CE-Router must ignore the unrecognized Routing Type value and should respond to the Request by sending an Echo Reply to TN3 using TR1 as the first-hop.

**Possible Problems:**

- None.



## Test CERouter.1.3.20: Unrecognized Routing Type – Intermediate Node

**Purpose:** Verify an IPv6 CE Router properly processes an IPv6 packet as the intermediate node that contains a Routing header with an unrecognized Routing Type value.

### References:

- [RFC 7084] – G-1
- [IPv6-SPEC] – Sections 4.4
- [RFC-5095] – Section 3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A
IPv6 Header Source Address: TN3's Global Address Destination Address: CE-Router Global Address Next Header: 43
Routing Header Next Header: 58 Header Ext. Length: 6 Routing Type: 33 Segments Left: 1 Address [1]: Global Address 2 Address [2]: Global Address 3 Address [3]: TR1's Global Address
ICMPv6 Echo Request

### Procedure:

#### Part A: Unrecognized Routing Type 33

1. TR1 forwards Packet A, an Echo Request that has a Routing header with a Routing Type value of 33 and Segments Left value of 1. The Echo Request is destined for the CE-Router.
2. Observe the packets transmitted by the CE-Router.

#### Part B: Unrecognized Routing Type 0

3. TR1 forwards Packet A, an Echo Request that has a Routing header with a Routing Type value of 0 and Segments Left value of 1. The Echo Request is destined for the CE-Router.
4. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router must discard the Echo Request and send an ICMP Parameter Problem, Code 0, message to TN3's Global Address. The Pointer field must be 0x2A (offset of the Routing Type field of the Routing header).
- *Part B*



**Step 4:** CE-Router must discard the Echo Request and send an ICMP Parameter Problem, Code 0, message to TN3's Global Address. The Pointer field must be 0x2A (offset of the Routing Type field of the Routing header).

**Possible Problems:**

- None.





## **Group 4: RFC 4862**

### **Scope**

The following tests cover the IPv6 Stateless Address Autoconfiguration specification, Request For Comments 4862. These tests verify the process for generating a link-local address, the process for generating site-local and global addresses via stateless address autoconfiguration, and the Duplicate Address Detection procedure. The following tests also verify that a host correctly processes a Router Advertisement and correctly assigns lifetimes.

### **Overview**

These tests are designed to verify the readiness of an IPv6 implementation vis-à-vis the IPv6 Stateless Address Autoconfiguration specification.



## Test CERouter.1.4.1: Address Autoconfiguration and Duplicate Address Detection

**Purpose:** Verify an IPv6 CE Router properly initialize on a network using address autoconfiguration and communicate with other on-link partners.

### References:

- [RFC 7084] – WAA-1
- [ADDRCONF] – Sections 1, 5.3, 5.4
- [IPv6-ARCH] – Sections 2.5.1, 2.5.2, 2.7.1

**Test Setup:** No Common Test Setup is performed. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. Initialize all the devices on WAN.
2. Allow time for all devices on WAN to perform stateless address autoconfiguration and DAD.
3. Configure TN1 to transmit a DAD Neighbor Solicitation from the unspecified address with the Target Address set to the CE-Router's link-local address.
4. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** The CE-Router should perform DAD on its tentative address for its interface on WAN sending DupAddrDetectTransmits Neighbor Solicitations, every RetransTimer. The CE-Router should assign the tentative address to its interface. Interface IDs are required to be 64 bits long and to be constructed in Modified EUI-64 format.

**Step 4:** The CE-Router must transmit a DAD NA for its autoconfigured link-local address.

### Possible Problems:

- None.



## Test CERouter.1.4.2: Receiving DAD Neighbor Solicitations and Advertisements

**Purpose:** Verify an IPv6 CE Router properly

**References:**

- [RFC 7084] – WAA-1
- [ADDRCONF] – Sections 1, 5.4, 5.4.1, 5.4.3, 5.4.4 and 5.4.5

**Test Setup:** No [Common Test Setup](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Neighbor Solicitation A

IPv6 Header Next Header: 58 Source Address: Unspecified Address Destination Address: Solicited multicast of the CE-Router's tentative Link-local Address Hop Limit: 255
Neighbor Solicitation Target Address: (See Below)

### Neighbor Advertisement B

IPv6 Header Next Header: 58 Source Address: CE-Router's Link-local Address Destination Address: all-nodes multicast address Hop Limit: 255
Neighbor Advertisement Router flag: 0 Solicited flag: 0 Override flag: 1 Target Address: (See Below) TLLOPT: TN1's MAC address

**Procedure:**

*Part A: CE-Router receives DAD NS (target != CE-Router)*

1. Initialize all devices on WAN.
2. After TN1 receives a DAD NS message from the CE-Router. Configure TN1 to transmit DAD Neighbor Solicitation A with the Target Address set to TN1's link-local address.



3. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
4. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
5. Observe the packets transmitted by the CE-Router.
6. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
7. Observe the packets transmitted by the CE-Router.

*Part B: CE-Router receives DAD NS (target == CE-Router)*

8. Initialize all devices on WAN.
9. After TN1 receives a DAD NS message from the CE-Router. Configure TN1 to transmit DAD Neighbor Solicitation A with the Target Address set to the CE-Router's tentative link-local address.
10. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
11. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
12. Observe the packets transmitted by the CE-Router.
13. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
14. Observe the packets transmitted by the CE-Router.

*Part C: CE-Router receives DAD NA (target != CE-Router)*

15. Initialize all devices on WAN.
16. After TN1 receives a DAD NS message from the CE-Router. Configure TN1 to transmit DAD Neighbor Advertisement B with the Target Address set to TN1's link-local address.
17. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
18. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
19. Observe the packets transmitted by the CE-Router.
20. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
21. Observe the packets transmitted by the CE-Router.

*Part D: CE-Router receives DAD NA (target == CE-Router)*

22. Initialize all devices on WAN.
23. After TN1 receives a DAD NS message from the CE-Router. Configure TN1 to transmit DAD Neighbor Advertisement B with the Target Address set to the CE-Router's tentative link-local address.
24. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
25. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address and no TLL Option.
26. Observe the packets transmitted by the CE-Router.
27. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
28. Observe the packets transmitted by the CE-Router.

### **Observable Results:**



- *Part A*
  - Step 3:** The CE-Router should silently ignore the DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 5:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 7:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part B*
  - Step 10:** The CE-Router should receive more DAD NS messages than expected with its tentative link-local address as the Target address. The CE-Router should determine its tentative address is a duplicate and should not assign the tentative address to its interface and must disable IP operation. The CE-Router must not transmit any Router Solicitations if the CE-Router is a Host.
  - Step 12:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.
  - Step 14:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.
- *Part C*
  - Step 17:** The CE-Router should silently ignore the DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 19:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 21:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part D*
  - Step 24:** The CE-Router should receive more DAD NS messages than expected with its tentative link-local address as the Target address. The CE-Router should determine its tentative address is a duplicate and should not assign the tentative address to its interface and must disable IP operation. The CE-Router must not transmit any Router Solicitations if the CE-Router is a Host.
  - Step 26:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.
  - Step 28:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

**Possible Problems:**

- None.



### Test CERouter.1.4.3: Validation of DAD Neighbor Solicitations

**Purpose:** Verify an IPv6 CE Router properly ignore invalid neighbor solicitations while performing Duplicate Address Detection.

#### References:

- [RFC 7084] – WAA-1
- [ADDRCONF] – Sections 5.4.1 and 5.4.5
- [ND] – Section 7.1.1

**Test Setup:** No Common Test Setup is performed. The [Common Test Cleanup](#) procedure is performed after each part.

#### Procedure:

*Part A: CE-Router receives invalid DAD NS (ICMP length < 24 octets)*

1. Initialize all devices on WAN.
2. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Solicitation A with the ICMP length set to 16.
3. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
4. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
5. Observe the packets transmitted by the CE-Router.
6. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
7. Observe the packets transmitted by the CE-Router.

*Part B: CE-Router receives invalid DAD NS (HopLimit != 255)*

8. Initialize all devices on WAN.
9. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Solicitation A with the Hop Limit set to 254.
10. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
11. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
12. Observe the packets transmitted by the CE-Router.
13. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
14. Observe the packets transmitted by the CE-Router.

*Part C: CE-Router receives invalid DAD NS (Dst = CE-Router's tentative address)*

15. Initialize all devices on WAN.
16. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Solicitation A with the Destination address set to the CE-Router's tentative link-local address.
17. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
18. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.



19. Observe the packets transmitted by the CE-Router.
20. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
21. Observe the packets transmitted by the CE-Router.

*Part D: CE-Router receives invalid DAD NS (Dst = allnode)*

22. Initialize all devices on WAN.
23. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Solicitation A with the Destination address set to the all-nodes multicast address.
24. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
25. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
26. Observe the packets transmitted by the CE-Router.
27. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
28. Observe the packets transmitted by the CE-Router.

*Part E: CE-Router Receives invalid DAD NS (ICMP code != zero )*

29. Initialize all devices on WAN.
30. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Solicitation A with the ICMP code set to 1.
31. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
32. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
33. Observe the packets transmitted by the CE-Router.
34. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
35. Observe the packets transmitted by the CE-Router.

*Part F: CE-Router receives invalid DAD NS (Invalid Checksum)*

36. Initialize all devices on WAN.
37. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Solicitation A with an invalid ICMP Checksum.
38. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
39. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
40. Observe the packets transmitted by the CE-Router.
41. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
42. Observe the packets transmitted by the CE-Router.

*Part G: CE-Router receives invalid DAD NS (target == multicast address)*

43. Initialize all devices on WAN.
44. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Solicitation A with the Target Address set to the solicited multicast of the CE-Router's tentative link-local address.
45. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.



46. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
47. Observe the packets transmitted by the CE-Router.
48. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
49. Observe the packets transmitted by the CE-Router.

*Part H: CE-Router receives invalid DAD NS (contains SSL)*

50. Initialize all devices on WAN.
51. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Solicitation A containing a SLL Option set to TN1's MAC address.
52. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
53. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
54. Observe the packets transmitted by the CE-Router.
55. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
56. Observe the packets transmitted by the CE-Router.

*Part I: CE-Router receives valid DAD NS (Reserved Field)*

57. Initialize all devices on WAN.
58. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Solicitation A with the Reserved field set to 0xFFFFFFFF.
59. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
60. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
61. Observe the packets transmitted by the CE-Router.
62. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
63. Observe the packets transmitted by the CE-Router.

*Part J: CE-Router receives valid DAD NS (contains TLL)*

64. Initialize all devices on WAN.
65. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Solicitation A with containing a TLL Option set to TN1's MAC address.
66. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
67. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
68. Observe the packets transmitted by the CE-Router.
69. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
70. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*

**Step 3:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.





**Step 5:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

**Step 7:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

- *Part B*

**Step 10:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.

**Step 12:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

**Step 14:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

- *Part C*

**Step 17:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.

**Step 19:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

**Step 21:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

- *Part D*

**Step 24:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.

**Step 26:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

**Step 28:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

- *Part E*

**Step 31:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.

**Step 33:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

**Step 35:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

- *Part F*

**Step 38:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.

**Step 40:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

**Step 42:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

- *Part G*

**Step 45:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.

**Step 47:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

**Step 49:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

- *Part H*



**Step 52:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.

**Step 54:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

**Step 56:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

- *Part I*

**Step 59:** The CE-Router should ignore the contents of the Reserved field. The CE-Router should not assign the tentative address to its interface.

**Step 61:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

**Step 63:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

- *Part J*

**Step 66:** The CE-Router should ignore any options they do not recognize and continue processing the message. The CE-Router should not assign the tentative address to its interface.

**Step 68:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

**Step 70:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

**Possible Problems:**

- None.



## Test CERouter.1.4.4: Validation of DAD Neighbor Advertisements

**Purpose:** Verify an IPv6 CE Router properly ignore invalid neighbor advertisements while performing Duplicate Address Detection.

### References:

- [RFC 7084] – WAA-1
- [ADDRCONF] – Sections 5.4.1 and 5.4.5
- [ND] – Section 7.1.2

**Test Setup:** No Common Test Setup is performed. The [Common Test Cleanup](#) procedure is performed after each part.

### Neighbor Advertisement A

IPv6 Header Next Header: 58 Source Address: CE-Router's Link-local Address Destination Address: all-nodes multicast address Hop Limit: 255
Neighbor Advertisement Router flag: 0 Solicited flag: 0 Override flag: 1 Target Address: CE-Router's tentative link-local address TLLOPT: TN1's MAC address

### Procedure:

*Part A: CE-Router receives invalid DAD NA (ICMP length < 24 octets)*

1. Initialize all devices on WAN.
2. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Advertisement A with the ICMP length set to 16.
3. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
4. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
5. Observe the packets transmitted by the CE-Router.
6. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
7. Observe the packets transmitted by the CE-Router.

*Part B: CE-Router receives invalid DAD NA (HopLimit != 255)*

8. Initialize all devices on WAN.



9. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Advertisement A with the Hop Limit set to 254.
  10. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
  11. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
  12. Observe the packets transmitted by the CE-Router.
  13. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
  14. Observe the packets transmitted by the CE-Router.
- Part C: CE-Router receives invalid DAD NA (ICMP code != zero)*
15. Initialize all devices on WAN.
  16. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Advertisement A with the ICMP code set to 1.
  17. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
  18. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
  19. Observe the packets transmitted by the CE-Router.
  20. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
  21. Observe the packets transmitted by the CE-Router.
- Part D: CE-Router receives invalid DAD NA (Invalid Checksum)*
22. Initialize all devices on WAN.
  23. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Advertisement A with an invalid ICMP Checksum.
  24. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
  25. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
  26. Observe the packets transmitted by the CE-Router.
  27. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
  28. Observe the packets transmitted by the CE-Router.
- Part E: CE-Router receives invalid DAD NA (Solicited Flag == 1)*
29. Initialize all devices on WAN.
  30. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Advertisement A with the Solicited flag set to 1.
  31. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
  32. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
  33. Observe the packets transmitted by the CE-Router.
  34. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
  35. Observe the packets transmitted by the CE-Router.
- Part F: CE-Router receives invalid DAD NA (target == multicast address)*
36. Initialize all devices on WAN.



37. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Advertisement A with the Target Address set to the solicited multicast of the CE-Router's tentative link-local address.
  38. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
  39. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
  40. Observe the packets transmitted by the CE-Router.
  41. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
  42. Observe the packets transmitted by the CE-Router.
- Part G: CE-Router receives invalid DAD NA (option length == zero)*
43. Initialize all devices on WAN.
  44. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Advertisement A with the TTLOPT length set to 0.
  45. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
  46. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
  47. Observe the packets transmitted by the CE-Router.
  48. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
  49. Observe the packets transmitted by the CE-Router.
- Part H: CE-Router receives valid DAD NA (Reserved Field)*
50. Initialize all devices on WAN.
  51. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Advertisement A with the Reserved field set to 0x1FFFFFFF.
  52. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
  53. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
  54. Observe the packets transmitted by the CE-Router.
  55. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
  56. Observe the packets transmitted by the CE-Router.
- Part I: CE-Router receives valid DAD NA (contains SLL)*
57. Initialize all devices on WAN.
  58. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Advertisement A containing a SLL Option set to CE-Router's MAC address.
  59. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
  60. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
  61. Observe the packets transmitted by the CE-Router.
  62. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
  63. Observe the packets transmitted by the CE-Router.



## Observable Results:

- *Part A*
  - Step 3:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 5:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 7:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part B*
  - Step 10:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 12:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 14:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part C*
  - Step 17:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 19:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 21:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part D*
  - Step 24:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 26:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 28:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part E*
  - Step 31:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 33:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 35:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part F*
  - Step 38:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 40:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 42:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part G*
  - Step 45:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.



**Step 47:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

**Step 49:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

- *Part H*

**Step 52:** The CE-Router should ignore the contents of the Reserved field. The CE-Router should not assign the tentative address to its interface.

**Step 54:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

**Step 56:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

- *Part I*

**Step 59:** The CE-Router should ignore any options they do not recognize and continue processing the message. The CE-Router should not assign the tentative address to its interface.

**Step 61:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

**Step 63:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

**Possible Problems:**

- None.



## Test CERouter.1.4.5: Receiving Neighbor Solicitations for Address Resolution

**Purpose:** Verify an IPv6 CE Router properly ignores neighbor solicitations performing address resolution while performing Duplicate Address Detection.

### References:

- [RFC 7084] – WAA-1
- [ADDRCONF] – Section 1, 5.4.3

**Test Setup:** No Common Test Setup is performed. The [Common Test Cleanup](#) procedure is performed after each part.

### Neighbor Solicitation A

IPv6 Header Next Header: 58 Source Address: TN1's Link-local Address Destination Address: Solicited multicast of the CE-Router's tentative Link-local Address Hop Limit: 255
Neighbor Solicitation Target Address: CE-Router's tentative link-local address SLLOPT: TN1's MAC address

### Procedure:

*Part A: CE-Router receives NS (src == unicast)*

1. Initialize all devices on WAN.
2. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Solicitation A.
3. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.
4. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
5. Observe the packets transmitted by the CE-Router.
6. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
7. Observe the packets transmitted by the CE-Router.

*Part B: CE-Router receives NS (Src == unicast && Dst == CE-Router's tentative address)*

8. Initialize all devices on WAN.
9. After TN1 receives a DAD NS message from the CE-Router, configure TN1 to transmit Neighbor Solicitation A with the Destination Address set to the CE-Router's tentative link-local address.
10. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.





11. Transmit a NS from TN1 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
12. Observe the packets transmitted by the CE-Router.
13. Transmit a NS from TN1 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address
14. Observe the packets transmitted by the CE-Router.

#### Observable Results:

- *Part A*
  - Step 3:** The CE-Router should silently ignore the NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 5:** The CE-Router transmits a Solicited NA for its autoconfigured link-local address.
  - Step 7:** The CE-Router transmits a Solicited NA for its autoconfigured link-local address.
- *Part B*
  - Step 10:** The CE-Router should silently ignore the NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 12:** The CE-Router transmits a Solicited NA for its autoconfigured link-local address.
  - Step 14:** The CE-Router transmits a Solicited NA for its autoconfigured link-local address.

#### Possible Problems:

- None.



## Test CERouter.1.4.6: Global Address Autoconfiguration and DAD

**Purpose:** Verify an IPv6 CE Router properly performs DAD on its autoconfigured unicast address.

### References:

- [RFC 7084] – WAA-1
- [ADDRCONF] – Sections 5.4
- [IPv6-ARCH] – Section 2, 2.5.7

**Test Setup:** No Common Test Setup is performed. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Unicast Autoconfigured Address - Global*

1. Initialize all the devices on the WAN.
2. Configure TR1 to send out ONE Router Advertisement on Link B with Prefix “X” with a valid lifetime set to 40 seconds.
3. Allow time for the CE-Router’s to perform stateless address autoconfiguration and Duplicate Address Detection.
4. Transmit a DAD NS from TN1 with the Target Address set to the CE-Router’s global address.
5. Observe the packets transmitted by the CE-Router.

#### *Part B: Unicast Autoconfigured Address – Prefix ending in zero valued fields*

6. Initialize all the devices on the WAN.
7. Configure TR1 to send out ONE Router Advertisement on Link B with Prefix “8000:0000::/64” with a valid lifetime set to 40 seconds.
8. Allow time for the CE-Router’s to perform stateless address autoconfiguration and Duplicate Address Detection.
9. Transmit a DAD NS from TN1 with the Target Address set to the CE-Router’s global address.
10. Observe the packets transmitted by the CE-Router.

#### *Part C: Unicast Autoconfigured Address- Site-Local*

11. Initialize all the devices on the WAN.
12. Configure TR1 to send out ONE Router Advertisement on Link B with Prefix “X” with a valid lifetime set to 40 seconds.
13. Allow time for the CE-Router’s to perform stateless address autoconfiguration and Duplicate Address Detection.
14. Transmit a DAD NS from TN1 with the Target Address set to the CE-Router’s global address.
15. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 3:** The CE-Router should perform DAD on its tentative global address for its interface on WAN sending DupAddrDetectTransmits Neighbor Solicitations, every RetransTimer. The CE-ROUTER should assign the tentative global address to its interface.
  - Step 5:** The CE-Router must transmit a DAD NA for its autoconfigured global address.
- *Part B*



**Step 8:** The CE-Router should perform DAD on its tentative global address for its interface on WAN sending DupAddrDetectTransmits Neighbor Solicitations, every RetransTimer. The CE-ROUTER should assign the tentative global address to its interface.

**Step 10:** The CE-Router must transmit a DAD NA for its autoconfigured global address.

- *Part C*

**Step 13:** The CE-Router should perform DAD on its tentative global address for its interface on WAN sending DupAddrDetectTransmits Neighbor Solicitations, every RetransTimer. The CE-Router should assign the tentative global address to its interface.

**Step 15:** The CE-Router must transmit a DAD NA for its autoconfigured global address.

**Possible Problems:**

- None.



## Test CERouter.1.4.7: Address Lifetime Expiry

**Purpose:** Verify an IPv6 CE Router properly handle expired or invalid addresses.

### References:

- [RFC 7084] – WAA-1
- [ADDRCONF] – Section 4.1 and 5.5.4

**Test Setup:** No Common Test Setup is performed. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. Initialize all the devices on the WAN.
2. Configure TR1 to send out ONE Router Advertisement on WAN with Prefix “X” with a valid lifetime set to 40 seconds.
3. Allow time for the CE-Router to perform stateless address autoconfiguration and Duplicate Address Detection.
4. Configure TR1 to transmit a NS message for address resolution with the target address set to the CE-Router’s global address for Prefix “X”. Observe packets on WAN.
5. Wait 35 seconds.
6. Repeat Step 4.
7. Wait 10 seconds.
8. Configure TR1 to transmit a NS message for address resolution with the target address set to the CE-Router’s global address for Prefix “X”. Observe the packets on WAN.

### Observable Results:

**Step 3:** The CE-Router must transmit a DAD NS for its autoconfigured global address.

**Step 4:** The CE-Router must transmit a Solicited NA for its autoconfigured global address.

**Step 6:** The CE-Router must transmit a Solicited NA for its autoconfigured global address.

**Step 8:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured global address using Prefix “X”.

### Possible Problems:

- None.



## Test CERouter.1.4.8: Multiple Prefixes and Network Renumbering

**Purpose:** Verify an IPv6 CE Router with multiple prefixes can communicate with another host on a different network when its site has been renumbered.

### References:

- [RFC 7084] – WAA-1
- [ADDRCONF] – Section 4.1
- [IPv6-ARCH] – Section 2.1
- [ND] Section 6.3.4, 6.3.5, 12

**Test Setup:** Initialize all devices on the WAN. [Common Test Setup 1.1](#) is performed at the beginning of this test part, the prefix lifetime will be configured to 20 seconds. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. Configure TR1 to discontinue to send RA's for Prefix "X".
2. Configure TR1 to send out Router Advertisements on WAN with Prefix "Y" with a Valid Lifetime of 30 seconds.
3. Wait 10 seconds allowing time for the CE-Router to configure a new global address with the new prefix and for Duplicate Address Detection to be performed.
4. Configure TR1 to transmit a NS message for address resolution with the target address set to the CE-Router's global address for Prefix "X". Observe packets on the WAN.
5. Configure TR1 to transmit a NS message for address resolution with the target address set to the CE-Router's global address for Prefix "Y". Observe packets on the WAN.
6. Wait 11 seconds allowing enough time to elapse so that Prefix "X" has timed out and Prefix "Y" has not timed out.
7. Repeat Step 4.
8. Repeat Step 5.
9. Configure TR1 to discontinue sending RA's for Prefix "Y". Wait 10 seconds allowing enough time to elapse so the Prefix "Y" has timed out.
10. Configure TR1 to transmit a NS message for address resolution with the target address set to the CE-Router's global address for Prefix "Y". Observe packets on the WAN.

### Observable Results:

**Step 2:** The CE-Router should configure a new global address with the new prefix, Prefix "Y".

**Step 4:** The CE-Router must transmit a Solicited NA for its autoconfigured global address with Prefix "X".

**Step 5:** The CE-Router must transmit a Solicited NA for its autoconfigured global address with Prefix "Y".

**Step 7:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "X".

**Step 8:** The CE-Router must transmit a Solicited NA for its autoconfigured global address with Prefix "Y".



**Step 10:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured global address with Prefix “Y”.

**Possible Problems:**

- None.



## Test CERouter.1.4.9: Prefix-Information Option Processing

**Purpose:** Verify an IPv6 CE Router properly processes the Prefix Information Option in the Router Advertisement.

### References:

- [RFC 7084] – WAA-1
- [ADDRCONF] – Section 5.5.3
- {ND} – Section 4.6.2

**Test Setup:** Initialize all devices on the WAN. Initialize the CE-Router after each part. The [Common Test Cleanup](#) procedure is performed after each part.

### Router Advertisement A

IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address Destination Address: Multicast Address
Router Advertisement Router Lifetime: 20 seconds Reachable Time: 10 seconds Retransmit Interval: 1 second
Prefix Option "on-link" (L) flag: 1 Valid Lifetime: 20 seconds Preferred Lifetime: 20 seconds Prefix: TR1's Global Prefix "X"

### Procedure:

#### Part A: Router Advertisement with multiple Prefix Options

1. TR1 transmits a Router Advertisement with the Autonomous flag set, NextHop=255, and multiple prefix options, Prefix "X" with a valid lifetime of 20s and Prefix "Y" with a valid lifetime of 40s.
2. Configure TR1 to transmit a NS message for address resolution with the target address set to the CE-Router's global address for Prefix "X". Observe the packets on the WAN.
3. Configure TR1 to transmit a NS message for address resolution with the target address set to the CE-Router's global address for Prefix "Y". Observe the packets on the WAN.
4. Wait for 21s so the lifetime expires for Prefix "X".
5. Repeat Step 2.
6. Wait for 20s so the lifetime expires for Prefix "Y".
7. Report Step 3.

#### Part B: Autonomous Flag is not set

8. TR1 transmits a Router Advertisement A with the Autonomous flag not set.



9. TR1 transmits a NS message for address resolution with the target address set to the CE-Router's global address for Prefix "X".
10. Observe the packets transmitted by the CE-Router.

*Part C: Prefix is set to link-local prefix*

11. TR1 transmits a Router Advertisement A with the prefix set to a link-local prefix.
12. TR1 transmits a NS message for address resolution with the target address set to the CE-Router's global address for Prefix "X".
13. Observe the packets transmitted by the CE-Router.

*Part D: preferred lifetime > valid lifetime*

14. TR1 transmits a Router Advertisement A with the preferred lifetime set to 30 seconds.
15. TR1 transmits a NS message for address resolution with the target address set to the CE-Router's global address for Prefix "X".
16. Observe the packets transmitted by the CE-Router.

*Part E: prefix length > 128 bits*

17. The CE-Router must have an interface identifier length greater than zero. TR1 transmits a Router Advertisement A with a Prefix Length set to 128.
18. TR1 transmits a NS message for address resolution with the target address set to the CE-Router's global address for Prefix "X".
19. Observe the packets transmitted by the CE-Router.

*Part F: prefix length < 64 bits*

20. The CE-Router must have an interface identifier length greater than zero. TR1 transmits a Router Advertisement A with a Prefix Length set to zero.
21. TR1 transmits a NS message for address resolution with the target address set to the CE-Router's global address for Prefix "X".
22. Observe the packets transmitted by the CE-Router.

*Part G: (64 bits < prefix length < 128 bits)*

23. The CE-Router must have an interface identifier length greater than zero. TR1 transmits a Router Advertisement A with a Prefix Length set to 120.
24. TR1 transmits a NS message for address resolution with the target address set to the CE-Router's global address for Prefix "X".
25. Observe the packets transmitted by the CE-Router.

*Part H: Valid Lifetime is zero*

26. TR1 transmits a Router Advertisement A with the Valid Lifetime set to zero.
27. TR1 transmits a NS message for address resolution with the target address set to the CE-Router's global address for Prefix "X".
28. Observe the packets transmitted by the CE-Router.

*Part I: Invalid RA with Hop Limit 254*

29. TR1 transmits a Router Advertisement A with a Hop Limit set to 254.
30. TR1 transmits a NS message for address resolution with the target address set to the CE-Router's global address for Prefix "X".
31. Observe the packets transmitted by the CE-Router.

*Part J: Valid Lifetime is 0xffffffff*

32. TR1 transmits a Router Advertisement A with the Valid Lifetime set to -0xffffffff.
33. TR1 transmits a NS message for address resolution with the target address set to the CE-Router's global address for Prefix "X".
34. Observe the packets transmitted by the CE-Router

**Observable Results:**





- *Part A*
  - Step 1:** The CE-Router should process the Prefix Information Option and form an address for each prefix.
  - Step 2:** The CE-Router must transmit a Solicited NA for its autoconfigured global address with Prefix “X”.
  - Step 3:** The CE-Router must transmit a Solicited NA for its autoconfigured global address with Prefix “Y”.
  - Step 4:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured global address with Prefix “X”.
  - Step 7:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured global address with Prefix “Y”.
- *Part B*
  - Step 8:** The CE-Router should silently ignore the Prefix Information Option and not form an address using Prefix “X”.
  - Step 10:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured global address with Prefix “X”.
- *Part C*
  - Step 11:** The CE-Router should silently ignore the Prefix Information Option and not form an address using Prefix “X”.
  - Step 13:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured global address with Prefix “X”.
- *Part D*
  - Step 14:** The CE-Router should silently ignore the Prefix Information Option and not form an address using Prefix “X”.
  - Step 16:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured global address with Prefix “X”.
- *Part E*
  - Step 17:** The CE-Router should silently ignore the Prefix Information Option and not form an address using Prefix “X”.
  - Step 19:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured global address with Prefix “X”.
- *Part F*
  - Step 20:** The CE-Router should silently ignore the Prefix Information Option and not form an address using Prefix “X”.
  - Step 22:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured global address with Prefix “X”.
- *Part G*
  - Step 23:** The CE-Router should silently ignore the Prefix Information Option and not form an address using Prefix “X”.
  - Step 25:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured global address with Prefix “X”.
- *Part H*
  - Step 26:** The CE-Router should silently ignore the Prefix Information Option and not form an address using Prefix “X”.
  - Step 28:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured global address with Prefix “X”.
- *Part I*



**Step 29:** The CE-Router should silently ignore the Prefix Information Option and not form an address using Prefix “X”.

**Step 31:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured global address with Prefix “X”.

- *Part J*

**Step 34:** The CE-Router should process the Prefix Information Options and form an address for Prefix “X”. The CE-Router must transmit a Solicited NA for its autoconfigured global address with Prefix “X”.

**Possible Problems:**

- None.



## Test CERouter.1.4.10: Prefix-Information Option Processing, Lifetime

**Purpose:** Verify an IPv6 CE Router properly updates its Address List upon receipt of Prefix Information Options.

### References:

- [RFC 7084] – WAA-1
- [ADDRCONF] – Section 5.5.3

**Test Setup:** Initialize the CE-Router before each part. No [Common Test Setup](#) is performed. The [Common Test Cleanup](#) procedure is performed after each part.

Router Advertisement A
IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address Destination Address: Multicast Address
Router Advertisement Router Lifetime: 60 seconds Reachable Time: 600 seconds Retransmit Interval: 1 second
Prefix Option "on-link" (L) flag: 1 Valid Lifetime: 20 seconds Preferred Lifetime: 20 seconds Prefix: Global Prefix "X"

### Procedure:

#### *Part A: Prefix Lifetime greater than Remaining Lifetime*

1. TR1 transmits Router Advertisement A with a Valid Lifetime of 30 seconds.
2. Wait 10 seconds.
3. TR1 transmits a Router Advertisement with a prefix of TR1's Global Prefix and a Valid Lifetime of 60 seconds.
4. Wait 25 seconds.
5. Configure TR1 to transmit a NS message for address resolution with the target address set to the CE-Router's Global address for Prefix "X".
6. Observe the packets transmitted by the CE-Router.

#### *Part B: Prefix Lifetime greater than two hours*

7. TR1 transmits Router Advertisement A with a Valid Lifetime of 3hrs.
8. TR1 transmits a Router Advertisement with a prefix of TR1's Global Prefix and a Valid Lifetime of 2hrs 30 seconds.
9. Wait 2hrs 45 seconds.
10. Configure TR1 to transmit a NS message for address resolution with the target address set to the CE-Router's Global address for Prefix "X".



11. Observe the packets transmitted by the CE-Router.

*Part C: Prefix Lifetime less than the Remaining Lifetime and the Remaining Lifetime is less than 2 hours*

12. TR1 transmits Router Advertisement A with a Valid Lifetime of 60 seconds.

13. TR1 transmits a Router Advertisement with a prefix of TR1's Global Prefix and a Valid Lifetime of 30 seconds

14. Wait 35 seconds.

15. Configure TR1 to transmit a NS message for address resolution with the target address set to the CE-Router's Global address for Prefix "X".

16. Observe the packets transmitted by the CE-Router.

*Part D: Prefix Lifetime less than 2 hours and the Remaining Lifetime is greater than 2 hours*

17. TR1 transmits Router Advertisement A with a Valid Lifetime of 2hrs 30s.

18. TR1 transmits a Router Advertisement with a prefix of TR1's Global Prefix and a Valid Lifetime of 10 seconds.

19. Wait 11 seconds.

20. TR1 transmits a NS message for address resolution with the target address set to the CE-Router's Global address for Prefix "X". Observe the packets transmitted by the CE-Router.

21. Wait 2hrs 15 seconds.

22. TR1 transmits a NS message for address resolution with the target address set to the CE-Router's Global address for Prefix "X".

23. Observe the packets transmitted by the CE-Router.

#### **Observable Results:**

- *Part A*

**Step 6:** The CE-Router must update its Remaining Lifetime and must not timeout Prefix "X" after 30 seconds. The CE-Router must transmit a Solicited NA for its autoconfigured global address with Prefix "X".

- *Part B*

**Step 11:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "X".

- *Part C*

**Step 16:** The CE-Router must transmit a Solicited NA for its autoconfigured global address with Prefix "X".

- *Part D*

**Step 21:** The CE-Router must transmit a Solicited NA for its autoconfigured global address with Prefix "X".

**Step 23:** The Remaining Lifetime should time out the global Prefix "X". The CE-Router must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "X".

#### **Possible Problems:**

- None.



## Group 5: RFC 1981

### Scope

The following tests cover the Path MTU Discovery for IP version 6, Request For Comments 1981. The Path MTU Discovery protocol is a technique to dynamically discover the PMTU of a path. The basic idea is that a source node initially assumes that the PMTU of a path is the (known) MTU of the first hop in the path. If any of the packets sent on the path are too large to be forwarded by some node along the path, that node will discard them and return ICMPv6 Packet Too Big messages. Upon receipt of such a message, the source node reduces its assumed PMTU for the path based on the MTU of the constricting hop as reported in the Packet Too Big message. The Path MTU Discovery process ends when the nodes' estimate of the PMTU is less than or equal to the actual PMTU.

### Overview

These tests are designed to verify the readiness of an IPv6 implementation vis-à-vis the Path MTU Discovery IPv6 specification.

### Default Packets

Router Advertisement
IPv6 Header Source Address: TR1's Link-Local Address Destination Address: All-Nodes multicast address Next Header: 58
ICMPv6 Header Type: 134 Code: 0 M Bit (managed): 0 O Bit (other): 0 Router Lifetime: 20 seconds Reachable Time: 10 seconds Retrans Timer: 1 second
Prefix Option Type: 3 L Bit (on-link flag): 1 A Bit (addr conf): 1 Valid Lifetime: 20 seconds Preferred Lifetime: 20 seconds Prefix: link's prefix



Echo Request

IPv6 Header Payload Length: 1460 bytes Next Header: 58
ICMPv6 Header Type: 128 Code: 0

Packet Too Big message

Redirect message

IPv6 Header Next Header: 58 Source Address: TR1's Link Local Address Destination Address: NUT's Link Local Address	IPv6 Header Next Header: 58 Source Address: TR1's Link Local Address Destination Address: NUT's Link Local Address
ICMPv6 Header Type: 2 Code: 0 MTU: 1280	ICMPv6 Header Type: 137 Code: 0
Invoking Packet	Invoking Packet



## Test CERouter.1.5.1: Confirm Ping

**Purpose:** Verify an IPv6 CE Router properly replies to variable sized ICMP Echo Request.

### References:

- [RFC 7084] – G-1
- [ICMPv6] – Section 4.2
- [IPv6-SPEC] – Section 5

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### Router Advertisement A

IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address Destination Address: All- nodes Multicast Address
Router Advertisement Router Lifetime: 100 seconds Reachable Time: 10 seconds Retransmit Interval: 1 second
Prefix Option "on-link" (L) flag: [See below] Valid Lifetime: 20 seconds Preferred Lifetime: 20 seconds Prefix: TR1's Global Prefix "Y"

#### Echo Request B

IPv6 Header Next Header: 58 Source Address: TN1's Prefix "Y" Global Address Destination Address: CE- Router's Global Address
ICMPv6 Echo Request

### Procedure:

*Part A: ICMPv6 Echo Request 64 octets*

1. TR1 forwards an Echo Request from TN3 to the CE-Router. The packet size of the Echo Request is 64 octets.
2. Observe the packets transmitted by the CE-Router.

*Part B: ICMPv6 Echo Request 1280 octets*



3. TR1 forwards an Echo Request from TN3 to the CE-Router. The packet size of the Echo Request is 1280 octets.
4. Observe the packets transmitted by the CE-Router.

*Part C: ICMPv6 Echo Request 1500 octets*

5. TR1 forwards an Echo Request from TN3 to the CE-Router. The packet size of the Echo Request is 1500 octets.
6. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*  
**Step 2:** CE-Router must send an Echo Reply to TR1 64 octets in packet size.
- *Part B*  
**Step 4:** CE-Router should send an Echo Reply to TR1 1280 octets in packet size.
- *Part C*  
**Step 6:** CE-Router should send an Echo Reply to TR1 1500 octets in packet size.

**Possible Problems:**

- None.





## Test CERouter.1.5.2: Stored PMTU

**Purpose:** Verify an IPv6 CE Router properly store Path MTU information for multiple destinations.

### References:

- [RFC 7084] – G-1
- [PMTU] – Section 5.2

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part. TN4 is moved to Network 2 (off-link).

### Procedure:

1. TN1 transmits an Echo Request on-link to the CE-Router with packet size equal to 1500 octets.
2. TR1 forwards an Echo Request from TN3 on-link to the CE-Router with packet size equal to 1500 octets.
3. TR1 forwards an Echo Request from TN4 on-link to the CE-Router with packet size equal to 1500 octets.
4. Observe the packets transmitted by the CE-Router.
5. TR1 transmits a Packet Too Big message to the CE-Router for the Echo Reply to TN3, which contains an MTU field with a value of 1400.
6. TN1 transmits an Echo Request on-link to the CE-Router with packet size equal to 1500 octets.
7. TR1 forwards an Echo Request from TN3 on-link to the CE-Router with packet size equal to 1500 octets.
8. TR1 forwards an Echo Request from TN4 on-link to the CE-Router with packet size equal to 1500 octets.
9. Observe the packets transmitted by the CE-Router.
10. TR1 transmits a Packet Too Big message to the CE-Router for the Echo Reply to TN4, which contains an MTU field with a value of 1280.
11. TN1 transmits an Echo Request on-link to the CE-Router with packet size equal to 1500 octets.
12. TR1 forwards an Echo Request from TN3 on-link to the CE-Router with packet size equal to 1500 octets.
13. TR1 forwards an Echo Request from TN4 on-link to the CE-Router with packet size equal to 1500 octets.
14. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 4:** CE-Router must transmit three Echo Replies, one to TN1, one to TN3, and one to TN4.

**Step 9:** CE-Router must transmit three Echo Requests. The Echo Replies to TN1 and TN4 should be no larger than 1500 octets. The CE-Router does not have to fragment these packets. The CE-Router should correctly fragment its Echo Reply to TN3 with each fragment no larger than 1400 octets. These fragments may be smaller.

**Step 14:** CE-Router must transmit three Echo Requests. The Echo Replies to TN1 should be no larger than 1500 octets. The CE-Router does not have to fragment these packets. The CE-Router should correctly fragment its Echo Reply to TN3 with each fragment no larger than 1400 octets.



These fragments may be smaller. The CE-Router should correctly fragment its Echo Reply to TN3 with each fragment no larger than 1280 octets.

**Possible Problems:**

- The Node Under Test may choose to implement on PMTU for all destinations. In that case, each response in all parts should be no larger than 1280 octets.



### Test CERouter.1.5.3: Non-zero ICMPv6 Code

**Purpose:** Verify an IPv6 CE Router properly processes a Packet Too Big message with a non-zero ICMPv6 code field.

#### References:

- [RFC 7084] – G-1
- [PMTU]
- [ICMPV6] – Section 3.2

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### Procedure:

1. TR1 forwards an Echo Request from TN3 to the CE-Router.
2. Observe the packets transmitted by the CE-Router.
3. TR1 transmits a Packet Too Big message to the CE-Router, which contains an invalid ICMPv6 code field value of 0xFF. The MTU field is set to 1280.
4. TR1 forwards an Echo Request from TN3 to the CE-Router.
5. Observe the packets transmitted by the CE-Router.

#### Observable Results:

**Step 2:** CE-Router must respond to the Echo Request using TR1 as a first hop.

**Step 5:** CE-Router must correctly fragment its response to the Echo Request using TR1

#### Possible Problems:

- None.



## Test CERouter.1.5.4: Reduces PMTU On-link

**Purpose:** Verify an IPv6 CE Router properly processes a Packet Too Big message indicating a reduction in Path MTU for an on-link destination.

### References:

- [RFC 7084] – G-1
- [PMTU] - Sections 3, 5.1

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Link-Local*

1. TR1 transmits a 1500 byte link-local Echo Request to the CE-Router.
2. Observe the packets transmitted by the CE-Router.
3. Even though TR1 is configured with a link MTU associated with its media type (1500 for Ethernet), TR1 transmits a Packet Too Big message to the CE-Router with an MTU of 1280.
4. TR1 transmits a 1500 byte link-local fragmented Echo Request to the CE-Router. The fragmented packets are no larger than 1280 octets in size.
5. Observe the packets transmitted by the CE-Router.

#### *Part B: Global*

6. TR1 transmits a 1500 byte on-link global Echo Request to the CE-Router.
7. Observe the packets transmitted by the CE-Router.
8. Even though TR1 is configured with a link MTU associated with its media type (1500 for Ethernet), TR1 transmits a Packet Too Big message to the CE-Router with an MTU of 1280.
9. TR1 transmits a 1500 byte on-link global fragmented Echo Request to the CE-Router. The fragmented packets are no larger than 1280 octets in size.
10. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 2:** CE-Router must respond to the Echo Request.
  - Step 5:** CE-Router must correctly fragment its response to the Echo Request indicating the NUT processed the Packet Too Big message. The fragmented packets must not be larger than 1280 octets in size.
- *Part B*
  - Step 7:** CE-Router must respond to the Echo Request.
  - Step 10:** CE-Router must correctly fragment its response to the Echo Request indicating the NUT processed the Packet Too Big message. The fragmented packets must not be larger than 1280 octets in size.

### Possible Problems:

- None.



## Test CERouter.1.5.5: Reduces PMTU Off-link

**Purpose:** Verify an IPv6 CE Router properly reduces its estimate of the MTU for a path due to a Packet Too Big message indicating in the Path MTU for a global destination.

### References:

- [RFC 7084] – G-1
- [PMTU] - Sections 4, 5.1

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part. TN4 is moved to Network 2 (off-link).

### Procedure:

1. TR1 forwards an Echo Request from TN3 to the CE-Router.
2. Observe the packets transmitted by the CE-Router.
3. TR1 transmits a Packet Too Big message to the CE-Router with an MTU field set to 1400 octets.
4. TR1 forwards an Echo Request from TN3 to the CE-Router with a packet size of 1500 octets.
5. Observe the packets transmitted by the CE-Router.
6. TR1 transmits another Packet Too Big message containing an MTU field set to 1280 octets.
7. TR1 forwards an Echo Request from TN3 to the CE-Router with a packet size of 1500 octets.
8. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router must respond to the Echo Request using TR1 as the first hop.

**Step 5:** CE-Router must correctly fragment its response to the Echo Request using TR1 as a first hop, indicating the CE-Router processed the Packet Too Big message. The fragmented packets must not be larger than 1400 octets in size.

**Step 8:** CE-Router must correctly fragment its response to the Echo Request using TR1 as a first hop, indicating the CE-Router processed the Packet Too Big message. The fragmented packets must not be larger than 1280 octets in size.

### Possible Problems:

- None.



## Test CERouter.1.5.6: Receiving MTU Below IPv6 Minimum Link MTU

**Purpose:** Verify an IPv6 CE Router properly does not reduce its estimate of the Path MTU below the IPv6 minimum link MTU.

### References:

- [RFC 7084] – G-1
- [PMTU] – Section 4
- [IPv6-SPEC] – Section 5

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: MTU equal 56*

1. TR1 forwards an Echo Request from TN3 to the CE-Router. The packet size is 1280 octets.
2. Observe the packets transmitted by the CE-Router.
3. TR1 transmits a Packet Too Big message to the CE-Router, which contains an MTU field of 56 octets.
4. TR1 forwards an Echo Request from TN3 to the CE-Router. The packet size is 1280 octets.
5. Observe the packets transmitted by the CE-Router.

#### *Part B: MTU equal to 1279*

6. TR1 forwards an Echo Request from TN3 to the CE-Router. The packet size is 1280 octets.
7. Observe the packets transmitted by the CE-Router.
8. TR1 transmits a Packet Too Big message to the CE-Router, which contains an MTU field of 1279 octets.
9. TR1 forwards an Echo Request from TN3 to the CE-Router. The packet size is 1280 octets.
10. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A and B*
  - Step 2 and 7:** CE-Router must send an Echo Request using TR1 as a first hop.
  - Step 5 and 10:** CE-Router responds to the Echo Request, and must not reduce the size of packets to below the IPv6 minimum link MTU. Instead, it must include a Fragment Header in the Echo Reply packet. The Echo Reply packet size should still be 1280 octets.

### Possible Problems:

- None.



## Test CERouter.1.5.7: Increase Estimate

**Purpose:** Verify an IPv6 CE Router properly does not increase its estimate of the MTU for a path due to the Packet Too Big message.

### References:

- [RFC 7084] – G-1
- [PMTU] – Section 4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: MTU increase*

1. TR1 forwards an Echo Request from TN3 to the CE-Router. The packet size is 1500 octets.
2. Observe the packets transmitted by the CE-Router.
3. TR1 transmits a Packet Too Big message to the CE-Router, which contains an MTU field of 1280 octets.
4. TR1 forwards an Echo Request from TN3 to the CE-Router. The packet size is 1500 octets.
5. Observe the packets transmitted by the CE-Router.
6. TR1 transmits a Packet Too Big message to the CE-Router, which contains an MTU field of 1500 octets.
7. TR1 forwards an Echo Request from TN3 to the CE-Router. The packet size is 1500 octets.
8. Observe the packets transmitted by the CE-Router.

#### *Part B: MTU equal to 0x1FFFFFFF*

9. TR1 forwards an Echo Request from TN3 to the CE-Router. The packet size is 1500 octets.
10. Observe the packets transmitted by the CE-Router.
11. TR1 transmits a Packet Too Big message to the CE-Router, which contains an MTU field of 1280 octets.
12. TR1 forwards an Echo Request from TN3 to the CE-Router. The packet size is 1500 octets.
13. Observe the packets transmitted by the CE-Router.
14. TR1 transmits a Packet Too Big message to the CE-Router, which contains an MTU field of 0x1FFFFFFF octets.
15. TR1 forwards an Echo Request from TN3 to the CE-Router. The packet size is 1500 octets.
16. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A and B*
  - Step 2 and 10:** CE-Router must send an Echo Request using TR1 as a first hop.
  - Step 5 and 13:** CE-Router must fragment the response to the Echo Request using TR1 as a first hop, indicating the CE-Router processed the Packet Too Big message.
  - Step 8 and 16:** CE-Router must correctly fragment the response to the Echo Request using TR1 as a first hop so the packet size is equal to or under 1280 octets. The CE-Router should not process the second Packet Too Big message indicating an increase in the PMTU.



**Possible Problems:**

- None.





## Test CERouter.1.5.8: Router Advertisement with MTU Option

**Purpose:** Verify an IPv6 CE Router properly processes a Router Advertisement with an MTU option and reduces its estimate.

### References:

- [RFC 7084] – G-1
- [PMTU] - Sections 2
- [ND] – Section 4.2 and 6.3.4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part. TN4 is moved to Network 2 (off-link).

### Procedure:

1. TR1 forwards an Echo Request from TN3 to the CE-Router with packet size equal to 1500 octets.
2. Observe the packets transmitted by the CE-Router.
3. TR1 transmits a Router Advertisement with an MTU set to 1280 to the all-nodes multicast address.
4. TR1 forwards a fragmented Echo Request from TN3 to the CE-Router with a packet size of 1500 octets.
5. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router must respond to the Echo Request using TR1 as the first hop. The CE-Router does not have to fragment the Echo Reply.

**Step 5:** CE-Router must update its Link MTU for TR1 to 1280 octets. The CE-Router must correctly fragment the response to the Echo Request, indicating the CE-Router adjusted its estimate of the Path MTU to the new Link MTU for its first hop (also the destination). The fragmented packets must not be larger than 1280 octets in size.

### Possible Problems:

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



## Test CERouter.1.5.9: Checking For Increase in PMTU

**Purpose:** Verify an IPv6 CE Router properly waits the proper amount of time to check for PMTU increases.

### References:

- [RFC 7084] – G-1
- [PMTU] - Sections 4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part. TN4 is moved to Network 2 (off-link).

### Procedure:

1. TR1 forwards an Echo Request from TN3 to the CE-Router.
2. Observe the packets transmitted by the CE-Router.
3. TR1 transmits a Packet Too Big message to the NUT. The MTU field is 1280 octets.
4. TR1 forwards an Echo Request from TN3 to the CE-Router.
5. Observe the packets transmitted by the CE-Router.
6. TR1 forwards an Echo Request from TN3 every 30 seconds for 5 minutes after the Packet Too Big Message was sent.
7. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router must respond to the Echo Request using TR1 as the first hop.

**Step 5:** CE-Router must correctly fragment the response to the Echo Request, indicating it processed the Packet Too Big Message from TR1. The fragmented packets must not be larger than 1280 octets in size.

**Step 7:** CE-Router must not transmit any packets larger than 1280 octets for 5 minutes from the time it received the Packet Too Big Message from TR1 in step 3.

### Possible Problems:

- None.



## **Group 6: RFC 7084**

### **Scope**

The following tests cover IPv6 CE Router WAN Configuration defined in 7084.

### **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 CERouter.1.6.1: Router Solicitation Transmission

**Purpose:** Verify an IPv6 CE Router properly generates a link-local address and finishes Duplicate Address Detection prior to sending any Router Solicitations.

### References:

- [RFC 7084] – W-2

**Test Setup:** No Common Test Setup is performed. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. Initialize all the devices on the WAN.
2. Observe the packets transmitted by the CE-Router.

### 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).

### Possible Problems:

- None.



## Test CERouter.1.6.2: L Flag Processing

**Purpose:** Verify an IPv6 CE Router properly process the L flag in Prefix Information Options.

### References:

- [RFC 7084] – WAA-2
- [RFC 5942] – Section 4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The L flag is set in Router Advertisement in Part A. The L flag is clear in Router Advertisement in Part B. The [Common Test Cleanup](#) procedure is performed after each part.

#### Router Advertisement A

IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address Destination Address: All- nodes Multicast Address
Router Advertisement Router Lifetime: 100 seconds Reachable Time: 10 seconds Retransmit Interval: 1 second
Prefix Option "on-link" (L) flag: [See below] Valid Lifetime: 20 seconds Preferred Lifetime: 20 seconds Prefix: TR1's Global Prefix "Y"

#### Echo Request B

IPv6 Header Next Header: 58 Source Address: TN1's Prefix "Y" Global Address Destination Address: CE- Router's Global Address ICMPv6 Echo Request
--

### Procedure:

#### Part A: L Flag Set

1. TR1 transmits a Router Advertisement A with the L Flag set in Common Test Setup.
2. TN1 transmits an Echo Request B.
3. Observe the packets transmitted by the CE-Router.

#### Part B: L Flag Clear



4. TR1 transmits a Router Advertisement A with the L Flag clear set in Common Test Setup.
5. TN1 transmits an ICMPv6 Echo Request B.
6. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*  
**Step 3:** CE-Router must transmit an ICMPv6 Echo Reply directly on-link to TN1.
- *Part B*  
**Step 6:** CE-Router must transmit an ICMPv6 Echo Reply to TN1 using TR1 as the next hop.

**Possible Problems:**

- None.



### Test CERouter.1.6.3: Reconfigure Message

**Purpose:** Verify an IPv6 CE Router properly implements the DHCPv6 Reconfigure Accept Option.

**References:**

- [RFC 7084] – WAA-4
- [RFC 3315] – Section 23

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of Part B and C. The [Common Test Cleanup](#) procedure is performed after each part.

Reconfigure A
IPv6 Header Next Header: 58 Source Address: TN1's Link-local Address Destination Address: CE- Router's Link-local Address
UDP Src Port: 547 Dst Port: 546
DHCPv6 Reconfigure (10) Client Identifier Server Identifier
Reconfigure Message Option: Value: 05 (Renew)
Authentication Option

**Procedure:**

*Part A: Reconfigure Accept*

1. Enable DHCPv6 on the CE-Router.
2. Observe the packets transmitted by the CE-Router.

*Part B: Reconfigure Message*

3. TN1 transmits Reconfigure A to the CE-Router.
4. Observe the packets transmitted by the CE-Router.

*Part C: Reconfigure Message without Authentication*

5. TN1 transmits a Reconfigure A without the Authentication Option.
6. Observe the packets transmitted by the CE-Router.

*Part D: Reconfigure Message with an invalid Authentication*

7. TN1 transmits a Reconfigure A with an Authentication Option with an incorrect Authentication Information.
8. Observe the packets transmitted by the CE-Router.

**Observable Results:**



- *Part A*  
**Step 2:** CE-Router must transmit a DHCPv6 Solicit message containing a Reconfigure Accept Option.
- *Part B*  
**Step 4:** CE-Router must transmit a DHCPv6 Renew message to TN1.
- *Part C*  
**Step 6:** CE-Router must NOT transmit a DHCPv6 Renew message to TN1.
- *Part D*  
**Step 8:** CE-Router must NOT transmit a DHCPv6 Renew message to TN1.

**Possible Problems:**

- None.





## Test CERouter.1.6.4: M Flag Processing

**Purpose:** Verify an IPv6 CE Router properly process the M flag in Router Advertisement.

### References:

- [RFC 7084] – WAA-6

**Test Setup:** No [Common Test Setup](#) is performed. The [Common Test Cleanup](#) procedure is performed after each part.

Router Advertisement A
IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address Destination Address: All-nodes Multicast Address
Router Advertisement Router Lifetime: 100 seconds Reachable Time: 10 seconds Retransmit Interval: 1 second M Flag: 0x1
Prefix Option Prefix: TR1's Global Prefix

### Procedure:

1. Initialize all the devices on the WAN.
2. In response to Router Solicitations from the CE-Router, TR1 transmits Router Advertisement A.
3. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 3:** CE-Router must transmit a DHCPv6 Solicit message containing an IA\_NA option.

### Possible Problems:

- None.



## Test CERouter.1.6.5: Prefix Delegation Size

**Purpose:** Verify an IPv6 CE Router properly handles DHCPv6 delegated prefix that are different sizes than the hint given by the CE-Router.

### References:

- [RFC 7084] – WPD-2

**Test Setup:** No Common Test Setup is performed. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Longer Prefix Length*

1. Enable DHCPv6 on the CE-Router.
2. TN1 transmits a DHCPv6 Advertise message with an IA\_PD prefix length that is a longer in length than the requested prefix length in the DHCPv6 Solicit message.
3. Observe the packets transmitted by the CE-Router.

#### *Part B: Shorter Prefix Length*

4. Enable DHCPv6 on the CE-Router.
5. TN1 transmits a DHCPv6 Advertise message with an IA\_PD prefix length that is a shorter in length than the requested prefix length in the DHCPv6 Solicit message.
6. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 3:** CE-Router must transmit a DHCPv6 Request message with IA\_PD with a prefix length that matches the value in the DHCPv6 Advertise message.
- *Part B*  
**Step 6:** CE-Router must transmit a DHCPv6 Request message with IA\_PD with a prefix length that matches the value in the DHCPv6 Advertise message.

### Possible Problems:

- The CE-Router may not support DHCPv6 Prefix Delegation Hints, this test case may be omitted if that's true.
- A CE-Router might only ask for a Hint Prefix Length of 64, if is the case a longer prefix can't be asked for so Part A may be omitted.



## Test CERouter.1.6.6: M and O Flag for Prefix Delegation

**Purpose:** Verify an IPv6 CE Router properly handles the M and O flag for determining initiating DHCPv6 Prefix Delegation.

### References:

- [RFC 7084] – WPD-4

**Test Setup:** No Common Test Setup is performed. The [Common Test Cleanup](#) procedure is performed after each part.

Router Advertisement A
IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address Destination Address: All-nodes Multicast Address
Router Advertisement Router Lifetime: 100 seconds Reachable Time: 10 seconds Retransmit Interval: 1 second M Flag: [See Below] O Flag: [See Below]
Prefix Option Prefix: TR1's Global Prefix

### Procedure:

#### *Part A: M Flag set*

1. Initialize all the devices on the WAN.
2. In response to Router Solicitations from the CE-Router, TR1 transmits Router Advertisement A with the M flag set and the O flag clear.
3. Observe the packets transmitted by the CE-Router.

#### *Part B: O flag set*

4. Initialize all the devices on the WAN.
5. In response to Router Solicitations from the CE-Router, TR1 transmits Router Advertisement A with the o flag set and the M flag clear.
6. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 3:** CE-Router must transmit a DHCPv6 Solicit message containing an IA\_PD option.
- *Part B*  
**Step 6:** CE-Router must transmit a DHCPv6 Solicit message containing an IA\_PD option.



**Possible Problems:**

- None.



## Test CERouter.1.6.7: Dynamic Routing Protocol

**Purpose:** Verify an IPv6 CE Router does not initiate any dynamic routing protocols.

### References:

- [RFC 7084] – WPD-7

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. Initialize the CE-Router.
2. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router must not transmit any Routing Protocol packets.

### Possible Problems:

- None.



## **Section 2: LAN Interface**

### **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.



## **Group 1: RFC 3315 – Server Specification**

### **Scope**

The following tests cover specifications for the server implementation of the Dynamic Host Configuration Protocol for IPv6 (DHCPv6), Request For Comments 3315.

The scope of the tests includes major functionality groups such as server behavior in client-initiated configuration exchange, server behavior in server-initiated configuration exchange and message validation by server. The section provides test cases to verify the operation of DHCPv6 servers' functionality most commonly implemented in practice.

The section is structured mainly with regard to the above functionality groups. The organization of this section however will tend to depart from the organization of RFC 3315 when grouping based on considerations of test setup and procedure is applied.

### **Overview**

These tests are designed to verify the readiness of a DHCPv6 server implementation vis-à-vis the base specifications of the Dynamic Host Configuration Protocol for IPv6.



## Test CERouter.2.1.1: Basic Message Exchange

**Purpose:** Verify an IPv6 CE Router properly handles the reception of DHCPv6 message during the basic message exchange.

### References:

- [RFC 7084] – L-8
- [RFC 3315] – Section 5.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Valid Advertise and Reply message*

1. TN2 transmits a DHCPv6 Solicit to FF02::1:2.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a DHCPv6 Request message to the CE-Router.
4. Observe the packets transmitted by the CE-Router.

#### *Part B: Valid Reply message in response to a Confirm message*

5. TN2 transmits a DHCPv6 Solicit to FF02::1:2.
6. Observe the packets transmitted by the CE-Router.
7. TN2 transmits a DHCPv6 Request message to the CE-Router.
8. Observe the packets transmitted by the CE-Router.
9. TN2 transmits a valid DHCPv6 Confirm message with an IA\_NA and IA Address Option to the CE-Router.
10. Observe the packets transmitted by the CE-Router.

#### *Part C: Valid Reply message in response to a Renew message*

11. TN2 transmits a DHCPv6 Solicit to FF02::1:2.
12. Observe the packets transmitted by the CE-Router.
13. TN2 transmits a DHCPv6 Request message to the CE-Router.
14. Observe the packets transmitted by the CE-Router.
15. TN2 transmits a valid DHCPv6 Renew message with an IA\_NA and IA Address Option to the CE-Router.
16. Observe the packets transmitted by the CE-Router.

#### *Part D: Valid Reply message in response to a Rebind message*

17. TN2 transmits a DHCPv6 Solicit to FF02::1:2.
18. Observe the packets transmitted by the CE-Router.
19. TN2 transmits a DHCPv6 Request message to the CE-Router.
20. Observe the packets transmitted by the CE-Router.
21. TN2 transmits a valid DHCPv6 Rebind message with an IA\_NA and IA Address Option to the CE-Router.
22. Observe the packets transmitted by the CE-Router.

#### *Part E: Valid Reply message in response to a Release message*

23. TN2 transmits a DHCPv6 Solicit to FF02::1:2.
24. Observe the packets transmitted by the CE-Router.
25. TN2 transmits a DHCPv6 Request message to the CE-Router.





26. Observe the packets transmitted by the CE-Router.
27. TN2 transmits a valid DHCPv6 Release message with an IA\_NA and IA Address Option to the CE-Router.
28. Observe the packets transmitted by the CE-Router.

*Part F: Valid Reply message in response to a Decline message*

29. TN2 transmits a DHCPv6 Solicit to FF02::1:2.
30. Observe the packets transmitted by the CE-Router.
31. TN2 transmits a DHCPv6 Request message to the CE-Router.
32. Observe the packets transmitted by the CE-Router.
33. TN2 transmits a valid DHCPv6 Decline message with an IA\_NA and IA Address Option to the CE-Router.
34. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*
  - Step 2:** CE-Router transmitted a DHCPv6 Advertise message in response to the DHCPv6 Solicit message.
  - Step 4:** CE-Router transmitted a DHCPv6 Reply message in response to the DHCPv6 Request message.
- *Part B*
  - Step 6:** CE-Router transmitted a DHCPv6 Advertise message in response to the DHCPv6 Solicit message.
  - Step 8:** CE-Router transmitted a DHCPv6 Reply message in response to the DHCPv6 Request message.
  - Step 10:** CE-Router transmitted a DHCPv6 Reply message in response to the DHCPv6 Confirm message and the DHCPv6 Reply message should not contain an IA\_NA.
- *Part C*
  - Step 12:** CE-Router transmitted a DHCPv6 Advertise message in response to the DHCPv6 Solicit message.
  - Step 14:** CE-Router transmitted a DHCPv6 Reply message in response to the DHCPv6 Request message.
  - Step 16:** CE-Router transmitted a DHCPv6 Reply message in response to the DHCPv6 Renew message.
- *Part D*
  - Step 18:** CE-Router transmitted a DHCPv6 Advertise message in response to the DHCPv6 Solicit message.
  - Step 20:** CE-Router transmitted a DHCPv6 Reply message in response to the DHCPv6 Request message.
  - Step 22:** CE-Router transmitted a DHCPv6 Reply message in response to the DHCPv6 Rebind message.
- *Part E*
  - Step 24:** CE-Router transmitted a DHCPv6 Advertise message in response to the DHCPv6 Solicit message.
  - Step 26:** CE-Router transmitted a DHCPv6 Reply message in response to the DHCPv6 Request message.
  - Step 28:** CE-Router transmitted a DHCPv6 Reply message in response to the DHCPv6 Release message.



- *Part F*
  - Step 30:** CE-Router transmitted a DHCPv6 Advertise message in response to the DHCPv6 Solicit message.
  - Step 32:** CE-Router transmitted a DHCPv6 Reply message in response to the DHCPv6 Request message.
  - Step 34:** CE-Router transmitted a DHCPv6 Reply message in response to the DHCPv6 Decline message.

**Possible Problems:**

- None.



## Test CERouter.2.1.2: Transaction ID Consistency

**Purpose:** Verify an IPv6 CE Router properly uses the same transaction id as the client.

### References:

- [RFC 7084] – L-8
- [RFC 3315] – Section 15.1

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. TN2 transmits a valid DHCPv6 Solicit message with a transaction-id of 100.
2. Observe the packets transmitted by the CE-Router.
3. Upon reception of an Advertise message from the CE-Router, TN2 transmits a valid DHCPv6 Request message with a transaction-id of 101.
4. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router transmitted a DHCPv6 Advertise message in response to the DHCPv6 Solicit message from TN2 with matching transaction ids (100).

**Step 4:** CE-Router transmitted a DHCPv6 Reply message in response to the DHCPv6 Request message from TN2 with matching transaction ids (101).

### Possible Problems:

- None.



## Test CERouter.2.1.3: Implementation of DHCP Constants

**Purpose:** Verify an IPv6 CE Router properly listens on the correct UDP ports and transmits message to the correct DHCP constants address.

### References:

- [RFC 7084] – L-8
- [RFC 3315] – Section 5.2
- [RFC 2463] – Section 3.1

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Valid UDP port*

1. TN2 transmits a DHCPv6 Solicit message to the UDP destination port 547.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Invalid UDP Port*

3. TN2 transmits a DHCPv6 Solicit message to the UDP destination port 4010.
4. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router must transmit DHCPv6 Advertise message with a destination UDP port set to 546.
- *Part B*  
**Step 4:** CE-Router should silently ignore the DHCPv6 Solicit message from TN2 and does not send any DHCPv6 message.

### Possible Problems:

- None.



## Test CERouter.2.1.4: Server Message Format

**Purpose:** Verify an IPv6 CE Router properly transmits a DHCPv6 message with the proper format when acting as a server.

### References:

- [RFC 7084] – L-8
- [RFC 3315] – Section 6, 7, 7.1, 7.2

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. TN2 transmits a DHCPv6 Solicit message to the multicast address FF02::1:2.
2. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router transmits a properly formatted DHCPv6 Advertise message containing the following elements:

- The msg-type field was set to the value of 2 (Advertise).
- A header containing a non-zero value Transaction ID
- A Server Identifier Option (containing a DUID)
- A Client Identifier Option (containing a DUID)

### Possible Problems:

- None.



## Test CERouter.2.1.5: DHCPv6 Option

**Purpose:** Verify an IPv6 CE Router properly processes DHCP Options when acting a DHCPv6 server.

### References:

- [RFC 7084] – L-8, L-10
- [RFC 3315] – Section 22.3
- [RFC 3646] – Section 3 and 4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Server Identifier Option*

1. TN2 transmits a DHCPv6 Solicit message.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Client Identifier Option*

3. TN2 transmits a DHCPv6 Solicit message.
4. Observe the packets transmitted by the CE-Router.

#### *Part C: IA\_NA Option*

5. TN2 transmits a DHCPv6 Solicit message with an IA\_NA option.
6. Observe the packets transmitted by the CE-Router.

#### *Part D: IA Address Option*

7. TN2 transmits a DHCPv6 Solicit message with an IA\_NA option and an IA Address option.
8. Observe the packets transmitted by the CE-Router.

#### *Part E: Status Code Option Format*

9. TN2 transmits a DHCPv6 Solicit message.
10. After reception of a DHCPv6 Advertise message from CE-Router, TN2 transmits a DHCPv6 Request message with an inappropriate IP address for the LAN network in the IA Address option.
11. Observe the packets transmitted by the CE-Router.

#### *Part F: DNS Recursive Name Server Option Format*

12. TN2 transmits a DHCPv6 Solicit message with an IA\_NA option and an Option Request Option containing a DNS Recursive Name Server Option.
13. Observe the packets transmitted by the CE-Router.

#### *Part G: Domain Search List Option Format*

14. TN2 transmits a DHCPv6 Solicit message with an IA\_NA option and an Option Request Option containing a Domain Search List Option.
15. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router transmits a properly formatted DHCPv6 Advertise message containing the following Server Identifier option values:
  - An option-code set to OPTION\_SERVERID(2)
  - An option-length set to the length of DUID in octets



- DUID Field set to any non-zero number
- *Part B*

**Step 4:** CE-Router transmits a properly formatted DHCPv6 Advertise message containing the following Client Identifier option values:

  - An option-code set to OPTION\_CLIENTID(1)
  - An option-length set to the length of DUID in octets
  - DUID Field set to any non-zero number
- *Part C*

**Step 6:** CE-Router transmits a properly formatted DHCPv6 Advertise message containing the following IA\_NA values:

  - An option-code set to OPTION\_IA\_NA (3)
  - An option-length set to 12 + length of IA\_NA options field
  - Same IAID value as in the Solicit message.
  - Time T1 set to a number
  - Time T2 set to a number
- *Part D*

**Step 8:** CE-Router transmits a properly formatted DHCPv6 Advertise message containing the following IA Address values:

  - An option-code set to OPTION\_IA\_NA (5)
  - An option-length set to 24 + length of IAAddr options field
  - Any Valid IPv6 Address
  - A preferred lifetime
  - A valid lifetime
- *Part E*

**Step 11:** CE-Router transmits a properly formatted DHCPv6 Reply message containing a IA\_NA with the following Status Code option values:

  - An option-code set to OPTION\_STATUS\_CODE (13)
  - An option-length set to 2 + length of status-message
  - A status-code set to NotOnLink (4)
  - A status-message set to any
- *Part F*

**Step 13:** CE-Router transmits a properly formatted DHCPv6 Advertise message containing the following DNS Recursive Name Server values:

  - An option-code set to OPTION\_DNS\_SERVERS (23)
  - An option-length set to the length of the list of DNS recursive name servers in octets; must be a multiple of 16.
  - DNS-recursive-name-server set to IPv6 address of DNS recursive name server.
- *Part G*

**Step 15:** CE-Router transmits a properly formatted DHCPv6 Advertise message containing the following Domain Search List option values:

  - An option-code set to OPTION\_DOMAIN\_LIST (24)
  - An option-length set to the length of the 'searchlist' field in octets
  - DNS-recursive-name-server set to the specification of the list of domains names in the Domain Search List.

#### Possible Problems:

- None.



## Test CERouter.2.1.6: DHCP Unique Identifier (DUID) Contents

**Purpose:** Verify an IPv6 CE Router properly transmits the correct DUID contents.

### References:

- [RFC 7084] – L-8
- [RFC 3315] – Section 9

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: DUID Format*

1. TN2 transmits a DHCPv6 Solicit message.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: DUID Consistency*

3. TN2 transmits a DHCPv6 Solicit message.
4. Observe the packets transmitted by the CE-Router.
5. Reboot the CE-Router. Perform [Common Test Setup 1.1](#).
6. TN2 transmits a DHCPv6 Solicit message.
7. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*

**Step 2:** The CE-Router transmits a properly formatted DHCPv6 Solicit message containing one of the following DUID options:

#### **DUID-LLT**

- An option-code set to OPTION\_SERVERID(2)
- An option-length set to the length of DUID in octets
- The type field was set to the value of 0x01
- A hardware type set to the IANA-assigned value
- A time value of DUID
- A link-layer address

#### **DUID-EN**

- An option-code set to OPTION\_SERVERID(2)
- An option-length set to the length of DUID in octets
- The type field was set to the value of 0x02
- An Enterprise Number of DUID, IANA value
- A non-zero identifier number of the DUID

#### **DUID-LL**

- An option-code set to OPTION\_SERVERID(2)
- An option-length set to the length of DUID in octets
- The type field was set to the value of 0x03
- A hardware type set to the IANA-assigned value





- A link-layer address of DUID
- *Part B*
  - Step 4:** The CE-Router transmits a properly formatted DHCPv6 Solicit message containing the following DUID-LLT option:

**DUID-LLT**

- An option-code set to OPTION\_SERVERID(2)
- An option-length set to the length of DUID in octets
- The type field was set to the value of 0x01
- A hardware type set to the IANA-assigned value
- A time value of DUID
- A link-layer address

**DUID-EN**

- An option-code set to OPTION\_SERVERID(2)
- An option-length set to the length of DUID in octets
- The type field was set to the value of 0x02
- An Enterprise Number of DUID, IANA value
- A non-zero identifier number of the DUID

**DUID-LL**

- An option-code set to OPTION\_SERVERID(2)
- An option-length set to the length of DUID in octets
- The type field was set to the value of 0x03
- A hardware type set to the IANA-assigned value
- A link-layer address of DUID

**Step 7:** The CE-Router transmits a properly formatted DHCPv6 Solicit message with the DUID option containing the same values as in Step 4.

**Possible Problems:**

- None.



## Test CERouter.2.1.7: Transmission of Advertise Messages

**Purpose:** Verify an IPv6 CE Router properly transmits Advertise message in response to Solicit messages.

### References:

- [RFC 7084] – L-8, L-10
- [RFC 3315] 17.2.2
- [RFC 3646] – Section 3 and 4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

*Part A: Advertise message transmission*

1. TN2 transmits a DHCPv6 Solicit message.
2. Observe the packets transmitted by the CE-Router.

*Part B: Advertise message in response to Solicit message with IA\_NA Option*

3. TN2 transmits a DHCPv6 Solicit message with an IA\_NA option.
4. Observe the packets transmitted by the CE-Router.

*Part C: Advertise message transmission with Multiple IA\_NA Options*

5. TN2 transmits a valid DHCPv6 Solicit message with two IA\_NA options.
6. Observe the packets transmitted by the CE-Router.

*Part D: Advertise message transmission with ORO (DNS Recursive Name Server Option)*

7. TN2 transmits a valid DHCPv6 Solicit message with an IA\_NA option and an Option Request Option (DNS Recursive Name Server option).
8. Observe the packets transmitted by the CE-Router.

*Part E: Advertise message transmission with ORO (Domain Search List Option)*

9. TN2 transmits a valid DHCPv6 Solicit message with an IA\_NA option and an Option Request Option (DNS Search List option).
10. Observe the packets transmitted by the CE-Router.

*Part F: Advertise message transmission with ORO (DNS Recursive Name Server and Domain Search List option)*

11. TN2 transmits a valid DHCPv6 Solicit message with an IA\_NA option and an Option Request Option containing both a DNS Recursive Name Server option and Domain Search List Option.
12. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 2:** CE-Router transmits a properly formatted DHCPv6 Advertise message containing the following elements:
    - Destination address set to TN2's unicast address same as the Solicit message's source address.
    - A msg-type field set to ADVERTISE (2)



- A transaction-id set to the same as the Solicit message's transaction-id
- A Server Identifier option (containing a DUID)
- A Client Identifier option set to the same as Solicit message's Client Identifier option
- *Part B*
  - Step 4:** CE-Router transmits a properly formatted DHCPv6 Advertise message containing the following elements:
    - Destination address set to TN2's unicast address same as the Solicit message's source address.
    - A msg-type field set to ADVERTISE (2)
    - A transaction-id set to the same as the Solicit message's transaction-id
    - A Server Identifier option (containing a DUID)
    - A Client Identifier option set to the same as Solicit message's Client Identifier option
    - An IA\_NA option set to the following values:
      - An option-code set to OPTION\_IA\_NA (3)
      - An option-length set to 12 + length of IA\_NA options field
      - An IAID value set to the same as Solicit message's IAID
      - Time T1 set to a number
      - Time T2 set to a number
    - An IA Address option set to the following values:
      - An option-code set to OPTION\_IAADDR (5)
      - An option-length set to 24 + length of IAAddr options field
      - Any Valid IPv6 Address
      - Preferred Lifetime
      - Valid Lifetime
- *Part C*
  - Step 6:** CE-Router transmits a properly formatted DHCPv6 Advertise message containing the following elements:
    - Destination address set to TN2's unicast address same as the Solicit message's source address.
    - A msg-type field set to ADVERTISE (2)
    - A transaction-id set to the same as the Solicit message's transaction-id
    - A Server Identifier option (containing a DUID)
    - A Client Identifier option set to the same as Solicit message's Client Identifier option
    - Two IA\_NA options
- *Part D*
  - Step 8:** CE-Router transmits a properly formatted DHCPv6 Advertise message containing the following elements:
    - Destination address set to TN2's unicast address same as the Solicit message's source address.
    - A msg-type field set to ADVERTISE (2)
    - A transaction-id set to the same as the Solicit message's transaction-id
    - A Server Identifier option (containing a DUID)
    - A Client Identifier option set to the same as Solicit message's Client Identifier option
    - A DNS Recursive Name Server option set to the following values:
      - An option-code set to OPTION\_DNS\_SERVERS(23)
      - An option-length set to the length of the list of DNS recursive name servers in octets; must be a multiple of 16.



- DNS-recursive-name-server set to IPv6 address of DNS recursive name server
- *Part E*
  - Step 10:** CE-Router transmits a properly formatted DHCPv6 Advertise message containing the following elements:
    - Destination address set to TN2's unicast address same as the Solicit message's source address.
    - A msg-type field set to ADVERTISE (2)
    - A transaction-id set to the same as the Solicit message's transaction-id
    - A Server Identifier option (containing a DUID)
    - A Client Identifier option set to the same as Solicit message's Client Identifier option
    - A Domain Search List option set to the following values:
      - An option-code set to OPTION\_DOMAIN\_LIST (24)
      - An option-length set to the length of the searchlist field in octets.
      - DNS-recursive-name-server set to the specification of the list of domain names in the Domain Search List.
- *Part F*
  - Step 12:** CE-Router transmits a properly formatted DHCPv6 Advertise message containing the following elements:
    - Destination address set to TN2's unicast address same as the Solicit message's source address.
    - A msg-type field set to ADVERTISE (2)
    - A transaction-id set to the same as the Solicit message's transaction-id
    - A Server Identifier option (containing a DUID)
    - A Client Identifier option set to the same as Solicit message's Client Identifier option
    - A DNS Recursive Name Server option set to the following values:
      - An option-code set to OPTION\_DNS\_SERVERS(23)
      - An option-length set to the length of the list of DNS recursive name servers in octets; must be a multiple of 16.
      - DNS-recursive-name-server set to IPv6 address of DNS recursive name server
    - A Domain Search List option set to the following values:
      - An option-code set to OPTION\_DOMAIN\_LIST (24)
      - An option-length set to the length of the searchlist field in octets.
      - DNS-recursive-name-server set to the specification of the list of domain names in the Domain Search List.

**Possible Problems:**

- None.



## Test CERouter.2.1.8: Transmission of Reply Messages

**Purpose:** Verify an IPv6 CE Router properly transmits Reply messages.

### References:

- [RFC 7084] – L-8, L-10
- [RFC 3315] – Sections 17.2.3 and 18.2
- [RFC 3646] – Section 3 and 4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Reply Message*

1. TN2 transmits a valid DHCPv6 Solicit message.
2. After the reception of a DHCPv6 Advertise message from the CE-Router, TN2 transmits a valid DHCPv6 Request message.
3. Observe the packets transmitted by the CE-Router.

#### *Part B: Reply message in response to Request message with ORO (DNS Recursive Name Server option)*

4. TN2 transmits a valid Solicit message with an IA\_NA option and an Option Request Option (DNS Recursive Name Server option).
5. After the reception of an Advertise message from the CE-Router, TN2 transmits a valid Request message with an IA\_NA option and an Option Request Option (DNS Recursive Name Server option).
6. Observe the packets transmitted by the CE-Router.

#### *Part C: Reply message in response to Request message with ORO (Domain Search List Option)*

7. TN2 transmits a valid Solicit message with an IA\_NA option and an Option Request Option (DNS Recursive Name Server option).
8. After the reception of an Advertise message from the CE-Router, TN2 transmits a valid Request message with an IA\_NA option and an Option Request Option (DNS Recursive Name Server option).
9. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 3:** CE-Router transmits a properly formatted Reply message containing the following elements:
    - Destination address set to TN2's unicast address same as the Request message's source address.
    - A msg-type field set to REPLY (7)
    - A transaction-id set to the same as Request message's transaction-id
    - A Server Identifier option (containing a DUID)
    - A Client Identifier option set to the same as Request message's Client Identifier option



- An IA NA option set to the following values:
  - An option-code set to OPTION\_IA\_NA (3)
  - An option-length set to 12 + length of IA\_NA options field
  - Time T1 set to a number
  - Time T2 set to a number
- An IA Address option set to the following values:
  - An option-code set to OPTION\_IAADDR (5)
  - An option-length set to 24 + length of IAADDR options field
  - Any Valid IPv6 Address
  - A preferred lifetime
  - A valid lifetime
- *Part B*

**Step 6:** CE-Router transmits a properly formatted Reply message containing the following elements:

  - Destination address set to TN2's unicast address same as the Request message's source address.
  - A msg-type field set to REPLY (7)
  - A transaction-id set to the same as Request message's transaction-id
  - A Server Identifier option (containing a DUID)
  - A Client Identifier option set to the same as Request message's Client Identifier option
  - A DNS Recursive Name Server option set to the following values:
    - An option-code set to OPTION\_DNS\_SERVERS(23)
    - An option-length set to the length of the list of DNS recursive name servers in octets; must be a multiple of 16.
    - DNS-recursive-name-server set to IPv6 address of DNS recursive name server.
- *Part C*

**Step 9:** CE-Router transmits a properly formatted Reply message containing the following elements:

  - Destination address set to TN2's unicast address same as the Request message's source address.
  - A msg-type field set to REPLY (7)
  - A transaction-id set to the same as Request message's transaction-id
  - A Server Identifier option (containing a DUID)
  - A Client Identifier option set to the same as Request message's Client Identifier option
  - A Domain Search List option set to the following values:
    - An option-code set to OPTION\_DOMAIN\_LIST(24)
    - An option-length set to the length of the 'searchlist' field in octets
    - DNS-recursive-name-server set to the specification of the list of domain names in the Domain Search List.

**Possible Problems:**

- None.



## Test CERouter.2.1.9: Reception of Solicit Message

**Purpose:** Verify an IPv6 CE Router properly handles the reception of Solicit messages.

### References:

- [RFC 7084] – L-8
- [RFC 3315] – Section 9, 15 and 17.2.1

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Reception of Solicit message via unicast*

1. TN2 transmits a DHCPv6 Solicit message with a unicast destination address to the CE-Router.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Reception of Solicit message with DUID-LLT*

3. TN2 transmits a DHCPv6 Solicit message using a DUID-LLT.
4. Observe the packets transmitted by the CE-Router.

#### *Part C: Reception of Solicit message with DUID-EN*

5. TN2 transmits a DHCPv6 Solicit message using a DUID-EN.
6. Observe the packets transmitted by the CE-Router.

#### *Part D: Reception of Solicit message with DUID-LL*

7. TN2 transmits a DHCPv6 Solicit message using a DUID-LL.
8. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router must not transmit any DHCPv6 Advertise message in the response to the DHCPv6 Solicit message.
- *Part B*  
**Step 4:** CE-Router transmits DHCPv6 Advertise message with Client ID option same as the DHCPv6 Solicit message.
- *Part C*  
**Step 6:** CE-Router transmits DHCPv6 Advertise message with Client ID option same as the DHCPv6 Solicit message.
- *Part D*  
**Step 8:** CE-Router transmits DHCPv6 Advertise message with Client ID option same as the DHCPv6 Solicit message.

### Possible Problems:

- None.



## Test CERouter.2.1.10: Reception of Request Messages

**Purpose:** Verify an IPv6 CE Router properly handles the reception of Request messages.

### References:

- [RFC 7084] – L - 8
- [RFC 3315] – Section 18.2.1

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Reception of Request message via unicast*

1. TN2 transmits a valid DHCPv6 Solicit message.
2. After the reception of a DHCPv6 Advertise message for the CE-Router, TN2 transmits a DHCPv6 Request message with unicast destination address to the CE-Router.
3. Observe the packets transmitted by the CE-Router.

#### *Part B: Reception of Request message with inappropriate address for link*

4. TN1 transmits a valid DHCPv6 Solicit message with an IA\_NA option.
5. After the reception of a DHCPv6 Advertise message from the CE-Router, TN2 transmits a DHCPv6 Request message with inappropriate address for the LAN network in the IA\_NA option.
6. Observe the packets transmitted by the CE-Router.

#### *Part C: Reception of twice Request messages*

7. TN1 transmits a valid DHCPv6 Solicit message an IA\_NA option.
8. After the reception of a DHCPv6 Advertise message from the CE-Router, TN2 transmits a valid DHCPv6 Request message with IA\_NA option on the LAN network.
9. Observe the messages transmitted by the CE-Router.
10. After the reception of a DHCPv6 Reply message from the CE-Router, TN2 transmits a valid DHCPv6 Request message with IA\_NA option on LAN network.
11. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 3:** CE-Router transmits a DHCPv6 Reply message containing a Status Code option with the value UseMulticast, a Server Identifier option, the Client Identifier option from the TN2 message, and no other options.
- *Part B*  
**Step 6:** CE-Router transmits a DHCPv6 Reply message containing an IA\_NA option with a Status Code option with the value NotOnLink, a Server Identifier option, the Client Identifier option from the TN1 message.
- *Part C*  
**Step 9:** CE-Router transmits a valid DHCPv6 Reply message containing a Server Identifier option, the Client Identifier option from the TN1 message, and IA\_NA option.





**Step 11:** CE-Router transmits a valid DHCPv6 Reply message containing a Server Identifier option, the Client Identifier option from the TN1 message, and IA\_NA option that same as Step 9's IA\_NA option.

**Possible Problems:**

- None.



## Test CERouter.2.1.11: Reception of Confirm Messages

**Purpose:** Verify an IPv6 CE Router properly handles the reception of Confirm messages.

### References:

- [RFC 7084] – L -8
- [RFC 3315] – Section 15 and 18.2.2

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Reception of Confirm message via unicast*

1. TN2 transmits a DHCPv6 Solicit.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a DHCPv6 Request message to the CE-Router.
4. Observe the packets transmitted by the CE-Router.
5. TN2 transmits a DHCPv6 Confirm message including an IA\_NA option and IA Address option with unicast destination address to CE-Router.
6. Observe the packets transmitted by the CE-Router.

#### *Part B: Reception of valid Confirm message*

7. TN2 transmits a DHCPv6 Solicit.
8. Observe the packets transmitted by the CE-Router.
9. TN2 transmits a DHCPv6 Request message to the CE-Router.
10. Observe the packets transmitted by the CE-Router.
11. TN2 transmits a valid DHCPv6 Confirm message including an IA\_NA option and IA Address option on LAN network.
12. Observe the packets transmitted by the CE-Router.

#### *Part C: Reception of Confirm message with invalid addresses*

13. TN2 transmits a DHCPv6 Solicit.
14. Observe the packets transmitted by the CE-Router.
15. TN2 transmits a DHCPv6 Request message to the CE-Router.
16. Observe the packets transmitted by the CE-Router.
17. TN2 transmits a valid DHCPv6 Confirm message including an IA\_NA option with an invalid address on the LAN network.
18. Observe the packets transmitted by the CE-Router.

#### *Part D: Reception of Confirm message with no addresses*

19. TN2 transmits a DHCPv6 Solicit.
20. Observe the packets transmitted by the CE-Router.
21. TN2 transmits a DHCPv6 Request message to the CE-Router.
22. Observe the packets transmitted by the CE-Router.
23. TN2 transmits a valid DHCPv6 Confirm message including an IA\_NA option without IA Address option on the LAN network.
24. Observe the packets transmitted by the CE-Router.

### Observable Results:



- *Part A*
  - Step 2:** CE-Router transmitted a DHCPv6 Advertise message in response to the DHCPv6 Solicit message.
  - Step 4:** CE-Router transmitted a DHCPv6 Reply message in response to the DHCPv6 Request message.
  - Step 6:** CE-Router must not transmit any DHCPv6 Reply message in the response to the DHCPv6 Confirm message.
- *Part B*
  - Step 8:** CE-Router transmitted a DHCPv6 Advertise message in response to the DHCPv6 Solicit message.
  - Step 10:** CE-Router transmitted a DHCPv6 Reply message in response to the DHCPv6 Request message.
  - Step 12:** CE-Router transmits a DHCPv6 Reply message containing a Status Code option with the value Success (or without a Status Code option), a Server Identifier option, the Client Identifier option from the TN2 message.
- *Part C*
  - Step 14:** CE-Router transmitted a DHCPv6 Advertise message in response to the DHCPv6 Solicit message.
  - Step 16:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.
  - Step 18:** CE-Router transmits a DHCPv6 Reply message containing a Status Code option with the value NotOnLink, a Server Identifier option, the Client Identifier option from the TN2 message.
- *Part D*
  - Step 20:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.
  - Step 22:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.
  - Step 24:** CE-Router must not transmit any DHCPv6 Reply message in the response to the DHCPv6 Confirm message.

**Possible Problems:**

- None.



## Test CERouter.2.1.12: Reception of Renew Messages

**Purpose:** Verify an IPv6 CE Router properly handles the reception of Renew messages.

### References:

- [RFC 7084] – L-8, L-10
- [RFC 3315] – Section 18.2.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Reception of Renew message via unicast*

1. TN2 transmits a DHCPv6 Solicit.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a DHCPv6 Request message to the CE-Router.
4. Observe the packets transmitted by the CE-Router.
5. TN2 transmits a DHCPv6 Renew message including an IA\_NA option and IA Address option with unicast destination address to CE-Router.
6. Observe the packets transmitted by the CE-Router.

#### *Part B: Reception of valid Renew message*

7. TN2 transmits a DHCPv6 Solicit.
8. Observe the packets transmitted by the CE-Router.
9. TN2 transmits a DHCPv6 Request message to the CE-Router.
10. Observe the packets transmitted by the CE-Router.
11. TN2 transmits a valid DHCPv6 Renew message including an IA\_NA option with a valid Identifier and IA Address option on LAN network.
12. Observe the packets transmitted by the CE-Router.

#### *Part C: Reception of Renew message with invalid addresses*

13. TN2 transmits a DHCPv6 Solicit.
14. Observe the packets transmitted by the CE-Router.
15. TN2 transmits a DHCPv6 Request message to the CE-Router.
16. Observe the packets transmitted by the CE-Router.
17. TN2 transmits a valid DHCPv6 Renew message including an IA\_NA option and a IA Address option with an inappropriate address on the LAN network.
18. Observe the packets transmitted by the CE-Router.

#### *Part D: Reception of Renew message with invalid IA\_NA Identifier*

19. TN2 transmits a DHCPv6 Solicit.
20. Observe the packets transmitted by the CE-Router.
21. TN2 transmits a DHCPv6 Request message to the CE-Router.
22. Observe the packets transmitted by the CE-Router.
23. TN2 transmits a valid DHCPv6 Renew message including an IA\_NA option with an invalid Identifier and IA Address option on the LAN network.
24. Observe the packets transmitted by the CE-Router.

#### *Part E: Reception of Renew message with ORO (DNS Recursive Name Server option)*



25. TN2 transmits a valid Solicit message with an IA\_NA option and an Option Request Option (DNS Recursive Name Server option).
  26. Observe the packets transmitted by the CE-Router.
  27. TN2 transmits a valid Request message with an IA\_NA option and an Option Request Option (DNS Recursive Name Server option).
  28. Observe the packets transmitted by the CE-Router.
  29. TN2 transmits a valid Renew message including an IA\_NA option with IA Address option and Option Request Option (DNS Recursive Name Server option).
  30. Observe the packets transmitted by the CE-Router.
- Part F: Reception of Renew message with ORO (Domain Server List option)*
31. TN2 transmits a valid Solicit message with an IA\_NA option and an Option Request Option (DNS Recursive Name Server option).
  32. Observe the packets transmitted by the CE-Router.
  33. TN2 transmits a valid Request message with an IA\_NA option and an Option Request Option (DNS Recursive Name Server option).
  34. Observe the packets transmitted by the CE-Router.
  35. TN2 transmits a valid Renew message including an IA\_NA option with IA Address option and Option Request Option (Domain Server List option).
  36. Observe the packets transmitted by the CE-Router.

#### Observable Results:

- *Part A*
  - Step 2:** CE-Router transmitted an DHCPv6 Advertise message in response to the Solicit message.
  - Step 4:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.
  - Step 6:** CE-Router transmits a DHCPv6 Reply message containing a Status Code option with the value UseMulticast, a Server Identifier option, the Client Identifier option from the TN2 message, and no other options.
- *Part B*
  - Step 8:** CE-Router transmitted an DHCPv6 Advertise message in response to the Solicit message.
  - Step 10:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.
  - Step 12:** CE-Router transmits a properly formatted DHCPv6 Reply message containing a Server Identifier option, the Client Identifier option from the TN2 message, and IA\_NA option with IA Address option.
- *Part C*
  - Step 14:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.
  - Step 16:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.
  - Step 18:** CE-Router transmits a DHCPv6 Reply message containing a Server Identifier option, the Client Identifier option from the TN2 message, and IA\_NA option with IA Address option with PreferredLifetime and ValidLifetime set to 0.
- *Part D*



**Step 20:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.

**Step 22:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.

**Step 24:** CE-Router transmits a DHCPv6 Reply message containing a Status Code option with the value NoBinding, a Server Identifier option, the Client Identifier option from the TN2 message, and not include any IA Address options.

- *Part E*

**Step 26:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.

**Step 28:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.

**Step 30:** CE-Router transmits a DHCPv6 Reply message containing a Server Identifier option, the Client Identifier option from the TN2 message, IA\_NA option with IA Address option and DNS Recursive Name Server option.

- *Part F*

**Step 32:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.

**Step 34:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.

**Step 36:** CE-Router transmits a DHCPv6 Reply message containing a Server Identifier option, the Client Identifier option from the TN2 message, IA\_NA option with IA Address option and Domain Search List option.

**Possible Problems:**

- None.



## Test CERouter.2.1.13: Reception of Rebind Messages

**Purpose:** Verify an IPv6 CE Router properly handles the reception of Rebind messages.

### References:

- [RFC 7084] – L – 8, L-10
- [RFC 3315] – Section 15 and 18.2.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Reception of Rebind message via unicast*

1. TN2 transmits a DHCPv6 Solicit.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a DHCPv6 Request message to the CE-Router.
4. Observe the packets transmitted by the CE-Router.
5. TN2 transmits a DHCPv6 Rebind message including an IA\_NA option and IA Address option with unicast destination address to CE-Router.
6. Observe the packets transmitted by the CE-Router.

#### *Part B: Reception of valid Rebind message*

7. TN2 transmits a DHCPv6 Solicit.
8. Observe the packets transmitted by the CE-Router.
9. TN2 transmits a DHCPv6 Request message to the CE-Router.
10. Observe the packets transmitted by the CE-Router.
11. TN2 transmits a valid DHCPv6 Rebind message including an IA\_NA option and IA Address option on LAN network.
12. Observe the packets transmitted by the CE-Router.

#### *Part C: Reception of Rebind message with invalid IA\_NA Identifier and invalid address*

13. TN2 transmits a DHCPv6 Solicit.
14. Observe the packets transmitted by the CE-Router.
15. TN2 transmits a DHCPv6 Request message to the CE-Router.
16. Observe the packets transmitted by the CE-Router.
17. TN2 transmits a valid DHCPv6 Rebind message including an IA\_NA option with an invalid Identifier and IA Address option with an inappropriate address on LAN network.
18. Observe the packets transmitted by the CE-Router.

#### *Part D: Reception of Rebind message with ORO (DNS Recursive Name Server option)*

19. TN2 transmits a DHCPv6 Solicit with an IA\_NA option and an Option Request Option (DNS Recursive Name Server option).
20. Observe the packets transmitted by the CE-Router.
21. TN2 transmits a DHCPv6 Request message to the CE-Router with transmits a valid Request message with an IA\_NA option and an Option Request Option (DNS Recursive Name Server option).
22. Observe the packets transmitted by the CE-Router.
23. TN2 transmits a valid DHCPv6 Rebind message including an IA\_NA option and Option Request Option (DNS Recursive Name Server option) on LAN network.



24. Observe the packets transmitted by the CE-Router.

*Part E: Reception of Rebind message with ORO (Domain Search List option)*

25. TN2 transmits a DHCPv6 Solicit with an IA\_NA option and an Option Request Option (Domain Search List option).

26. Observe the packets transmitted by the CE-Router.

27. TN2 transmits a DHCPv6 Request message to the CE-Router with transmits a valid Request message with an IA\_NA option and an Option Request Option (Domain Search List option).

28. Observe the packets transmitted by the CE-Router.

29. TN2 transmits a valid DHCPv6 Rebind message including an IA\_NA option and Option Request Option (Domain Search List option) on LAN network.

30. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*

**Step 2:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.

**Step 4:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.

**Step 6:** CE-Router must not transmit any DHCPv6 Reply message in the response to the Rebind message.

- *Part B*

**Step 8:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.

**Step 10:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.

**Step 12:** CE-Router transmits a properly formatted DHCPv6 Reply message containing a Server Identifier option, the Client Identifier option from the TN2 message, and IA\_NA option with IA Address option.

- *Part C*

**Step 14:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.

**Step 16:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.

**Step 18:** CE-Router must not transmit any DHCPv6 Reply message in the response to the Rebind message or the CE-Router transmits a Reply message containing a Server Identifier option, the Client Identifier option from the TN2 message, and IA\_NA option with IA Address option with PreferredLifetime and ValidLifetime set to 0.

- *Part D*

**Step 20:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.

**Step 22:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.

**Step 24:** CE-Router transmits a properly formatted DHCPv6 Reply message containing a Server Identifier option, the Client Identifier option from the TN2 message, IA\_NA option with IA Address option and DNS Recursive Name Server option.

- *Part E*





**Step 26:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.

**Step 28:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.

**Step 30:** CE-Router transmits a properly formatted DHCPv6 Reply message containing a Server Identifier option, the Client Identifier option from the TN2 message, IA\_NA option with IA Address option and Domain Search List option.

**Possible Problems:**

- None.



## Test CERouter.2.1.14: Reception of Release Messages

**Purpose:** Verify an IPv6 CE Router properly handles the reception of Release messages.

### References:

- [RFC 7084] – L – 8
- [RFC 3315] – Section 18.2.6

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Reception of Release message via unicast*

1. TN2 transmits a DHCPv6 Solicit.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a DHCPv6 Request message to the CE-Router.
4. Observe the packets transmitted by the CE-Router.
5. TN2 transmits a DHCPv6 Release message including an IA\_NA option and IA Address option with unicast destination address to CE-Router.
6. Observe the packets transmitted by the CE-Router.

#### *Part B: Reception of valid Release message*

7. TN2 transmits a DHCPv6 Solicit.
8. Observe the packets transmitted by the CE-Router.
9. TN2 transmits a DHCPv6 Request message to the CE-Router.
10. Observe the packets transmitted by the CE-Router.
11. TN2 transmits a valid DHCPv6 Release message including an IA\_NA option and IA Address option on LAN network.
12. Observe the packets transmitted by the CE-Router.

#### *Part C: Reception of Release message with invalid IA\_NA Identifier and invalid address*

13. TN2 transmits a DHCPv6 Solicit.
14. Observe the packets transmitted by the CE-Router.
15. TN2 transmits a DHCPv6 Request message to the CE-Router.
16. Observe the packets transmitted by the CE-Router.
17. TN2 transmits a valid DHCPv6 Release message including two IA\_NA options with invalid Identifier and IA Address option.
18. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 2:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.
  - Step 4:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.



**Step 6:** CE-Router transmits a DHCPv6 Reply message containing a Status Code option with the value UseMulticast, a Server Identifier option, the Client Identifier option from the TN2 message, and no other options.

- *Part B*

**Step 8:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.

**Step 10:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.

**Step 12:** CE-Router transmits a properly formatted DHCPv6 Reply message containing a Status Code option with the value Success (or without a Status Code option), a Server Identifier option and the Client Identifier option from the TN2 message.

- *Part C*

**Step 14:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.

**Step 16:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.

**Step 18:** CE-Router transmits a DHCPv6 Reply message containing a Status Code option with the value NoBinding in the each IA\_NA option(No other options are included in the IA\_NA option), a Server Identifier option, the Client Identifier option from the TN2 message, and a Status Code option with the value Success.

**Possible Problems:**

- None.



## Test CERouter.2.1.15: Reception of Decline Messages

**Purpose:** Verify an IPv6 CE Router properly handles the reception of Release message.

### References:

- [RFC 7084] – W-1
- [RFC 3315] – Section 18.2.7

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Reception of Decline message via unicast*

1. TN2 transmits a DHCPv6 Solicit.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a DHCPv6 Request message to the CE-Router.
4. Observe the packets transmitted by the CE-Router.
5. TN2 transmits a DHCPv6 Decline message including an IA\_NA option and IA Address option with unicast destination address to CE-Router.
6. Observe the packets transmitted by the CE-Router.

#### *Part B: Reception of valid Decline message*

7. TN2 transmits a DHCPv6 Solicit.
8. Observe the packets transmitted by the CE-Router.
9. TN2 transmits a DHCPv6 Request message to the CE-Router.
10. Observe the packets transmitted by the CE-Router.
11. TN2 transmits a valid DHCPv6 Decline message including an IA\_NA option and IA Address option on LAN network.
12. Observe the packets transmitted by the CE-Router.

#### *Part C: Reception of Decline message with invalid IA\_NA Identifier*

13. TN2 transmits a DHCPv6 Solicit.
14. Observe the packets transmitted by the CE-Router.
15. TN2 transmits a DHCPv6 Request message to the CE-Router.
16. Observe the packets transmitted by the CE-Router.
17. TN2 transmits a valid DHCPv6 Decline message including two IA\_NA options with invalid Identifier and IA Address option.
18. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 2:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.
  - Step 4:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.



**Step 6:** CE-Router transmits a DHCPv6 Reply message containing a Status Code option with the value UseMulticast, a Server Identifier option, the Client Identifier option from the TN2 message, and no other options.

- *Part B*

**Step 8:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.

**Step 10:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.

**Step 12:** CE-Router transmits a properly formatted DHCPv6 Reply message containing a Status Code option with the value Success (or without a Status Code option), a Server Identifier option and the Client Identifier option from the TN2 message.

- *Part C*

**Step 14:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.

**Step 16:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.

**Step 18:** CE-Router transmits a DHCPv6 Reply message containing a Status Code option with the value NoBinding in the each IA\_NA option(No other options are included in the IA\_NA option), a Server Identifier option, the Client Identifier option from the TN2 message.

**Possible Problems:**

- None.



## Test CERouter.2.1.16: Reception of Invalid Solicit Message

**Purpose:** Verify an IPv6 CE Router properly handles the reception of invalid Solicit messages.

### References:

- [RFC 7084] – L – 8
- [RFC 3315] – Sections 15 and 15.2

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

*Part A: Contains Server Identifier Option*

1. TN2 transmits a DHCPv6 Solicit message that contains a Server Identifier option.
2. Observe the packets transmitted by the CE-Router.

*Part B: No Client Identifier Option*

3. TN2 transmits a DHCPv6 Solicit message that does not contain a Client Identifier option.
4. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router must silently discard the DHCPv6 Solicit message. The CE-Router must not send a DHCPv6 Advertise message based on the received DHCPv6 Solicit message.
- *Part B*  
**Step 4:** CE-Router must silently discard the DHCPv6 Solicit message. The CE-Router must not send a DHCPv6 Advertise message based on the received DHCPv6 Solicit message.

### Possible Problems:

- None.



## Test CERouter.2.1.17: Reception of Invalid Request Message

**Purpose:** Verify an IPv6 CE Router properly handles the reception of invalid Request messages.

### References:

- [RFC 7084] – L – 8
- [RFC 3315] – Sections 15 and 15.4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: No Server Identifier Option*

1. TN2 transmits a valid DHCPv6 Solicit message.
2. After the reception of an DHCPv6 Advertise message from the CE-Router, TN2 transmits a Request message that does not contain a Server Identifier option.
3. Observe the packets transmitted by the CE-Router.

#### *Part B: No Client Identifier Option*

4. TN2 transmits a valid DHCPv6 Solicit message.
5. After the reception of an DHCPv6 Advertise message from the CE-Router, TN2 transmits a Request message that does not contain a Server Identifier option
6. Observe the packets transmitted by the CE-Router.

#### *Part C: Server Identifier that does not match the DUID of the server*

7. TN2 transmits a valid DHCPv6 Solicit message.
8. After the reception of a DHCPv6 Advertise message from the CE-Router, TN2 transmits a properly formatted DHCPv6 Request message containing a Server Identifier option whose value does not match the CE-Router's DUID.
9. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 3:** CE-Router must silently discard the DHCPv6 Request message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Request message.
- *Part B*  
**Step 6:** CE-Router must silently discard the DHCPv6 Request message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Request message.
- *Part C*  
**Step 9:** CE-Router must silently discard the DHCPv6 Request message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Request message.

### Possible Problems:

- None.



## Test CERouter.2.1.18: Reception of Invalid Confirm Message

**Purpose:** Verify an IPv6 CE Router properly handles the reception of invalid Confirm messages.

### References:

- [RFC 7084] –L -8
- [RFC 3315] – Section 15 and 15.5

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Contains Server Identifier Option*

1. TN2 transmits a DHCPv6 Solicit.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a DHCPv6 Request message to the CE-Router.
4. Observe the packets transmitted by the CE-Router.
5. TN2 transmits a DHCPv6 Confirm message including an IA\_NA option with an IA Address option and a Server Identifier option.
6. Observe the packets transmitted by the CE-Router.

#### *Part B: No Client Identifier Option*

7. TN2 transmits a DHCPv6 Solicit.
8. Observe the packets transmitted by the CE-Router.
9. TN2 transmits a DHCPv6 Request message to the CE-Router.
10. Observe the packets transmitted by the CE-Router.
11. TN2 transmits a DHCPv6 Confirm message including an IA\_NA option with an IA Address option and without a Client Identifier option.
12. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 2:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.
  - Step 4:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.
  - Step 6:** CE-Router must silently discard the DHCPv6 Confirm message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Confirm message.
- *Part B*
  - Step 8:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.
  - Step 10:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.
  - Step 12:** CE-Router must silently discard the DHCPv6 Confirm message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Confirm message.





**Possible Problems:**

- None.



## Test CERouter.2.1.19: Reception of Invalid Renew Message

**Purpose:** Verify an IPv6 CE Router properly handles the reception of invalid Renew message.

### References:

- [RFC 7084] – W-1

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: No Server Identifier Option*

1. TN2 transmits a DHCPv6 Solicit.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a DHCPv6 Request message to the CE-Router.
4. Observe the packets transmitted by the CE-Router.
5. TN2 transmits a DHCPv6 Renew message including an IA\_NA option with an IA Address option without a Server Identifier option.
6. Observe the packets transmitted by the CE-Router.

#### *Part B: No Client Identifier Option*

7. TN2 transmits a DHCPv6 Solicit.
8. Observe the packets transmitted by the CE-Router.
9. TN2 transmits a DHCPv6 Request message to the CE-Router.
10. Observe the packets transmitted by the CE-Router.
11. TN2 transmits a DHCPv6 Renew message including an IA\_NA option with an IA Address option and without a Client Identifier option.
12. Observe the packets transmitted by the CE-Router.

#### *Part C: Server Identifier that does not match the DUID of the server*

13. TN2 transmits a DHCPv6 Solicit.
14. Observe the packets transmitted by the CE-Router.
15. TN2 transmits a DHCPv6 Request message to the CE-Router.
16. Observe the packets transmitted by the CE-Router.
17. TN2 transmits a DHCPv6 Renew message including an IA\_NA option with an IA Address option and Server Identifier whose value does not match the server's DUID.
18. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 2:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.
  - Step 4:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.
  - Step 6:** CE-Router must silently discard the DHCPv6 Renew message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Renew message.
- *Part B*



**Step 8:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.

**Step 10:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.

**Step 12:** CE-Router must silently discard the DHCPv6 Renew message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Renew message.

- *Part C*

**Step 14:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.

**Step 16:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.

**Step 18:** CE-Router must silently discard the DHCPv6 Renew message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Renew message.

**Possible Problems:**

- None.



## Test CERouter.2.1.20: Reception of Invalid Rebind Message

**Purpose:** Verify an IPv6 CE Router properly handles the reception of invalid Rebind messages.

### References:

- [RFC 7084] – L- 8
- [RFC 3315] – Sections 15 and 15.7

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Contains Server Identifier Option*

1. TN2 transmits a DHCPv6 Solicit.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a DHCPv6 Request message to the CE-Router.
4. Observe the packets transmitted by the CE-Router.
5. TN2 transmits a DHCPv6 Rebind message including an IA\_NA option with an IA Address option and a Server Identifier option.
6. Observe the packets transmitted by the CE-Router.

#### *Part B: No Client Identifier Option*

7. TN2 transmits a DHCPv6 Solicit.
8. Observe the packets transmitted by the CE-Router.
9. TN2 transmits a DHCPv6 Request message to the CE-Router.
10. Observe the packets transmitted by the CE-Router.
11. TN2 transmits a DHCPv6 Rebind message including an IA\_NA option with an IA Address option and without a Client Identifier option.
12. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 2:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.
  - Step 4:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.
  - Step 6:** CE-Router must silently discard the DHCPv6 Rebind message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Rebind message.
- *Part B*
  - Step 8:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.
  - Step 10:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.
  - Step 12:** CE-Router must silently discard the DHCPv6 Rebind message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Rebind message.



**Possible Problems:**

- None.



## Test CERouter.2.1.21: Reception of Invalid Release Message

**Purpose:** Verify an IPv6 CE Router properly handles the reception of invalid Release messages.

### References:

- [RFC 7084] – L-8
- [RFC 3315] – Sections 15 and 15.6

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: No Server Identifier Option*

1. TN2 transmits a DHCPv6 Solicit.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a DHCPv6 Request message to the CE-Router.
4. Observe the packets transmitted by the CE-Router.
5. TN2 transmits a DHCPv6 Release message including an IA\_NA option with an IA Address option without a Server Identifier option.
6. Observe the packets transmitted by the CE-Router.

#### *Part B: No Client Identifier Option*

7. TN2 transmits a DHCPv6 Solicit.
8. Observe the packets transmitted by the CE-Router.
9. TN2 transmits a DHCPv6 Request message to the CE-Router.
10. Observe the packets transmitted by the CE-Router.
11. TN2 transmits a DHCPv6 Release message including an IA\_NA option with an IA Address option and without a Client Identifier option.
12. Observe the packets transmitted by the CE-Router.

#### *Part C: Server Identifier that does not match the DUID of the server*

13. TN2 transmits a DHCPv6 Solicit.
14. Observe the packets transmitted by the CE-Router.
15. TN2 transmits a DHCPv6 Request message to the CE-Router.
16. Observe the packets transmitted by the CE-Router.
17. TN2 transmits a DHCPv6 Release message including an IA\_NA option with an IA Address option and Server Identifier whose value does not match the server's DUID.
18. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 2:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.
  - Step 4:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.
  - Step 6:** CE-Router must silently discard the DHCPv6 Release message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Release message.



- *Part B*
  - Step 8:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.
  - Step 10:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.
  - Step 12:** CE-Router must silently discard the DHCPv6 Release message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Release message.
- *Part C*
  - Step 14:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.
  - Step 16:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.
  - Step 18:** CE-Router must silently discard the DHCPv6 Release message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Release message.

**Possible Problems:**

- None.



## Test CERouter.2.1.22: Reception of Invalid Decline Messages

**Purpose:** Verify an IPv6 CE Router properly handles the reception of invalid Decline messages.

### References:

- [RFC 7084] – L – 8
- [RFC 3315] – Sections 15 and 15.8

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: No Server Identifier Option*

1. TN2 transmits a DHCPv6 Solicit.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a DHCPv6 Request message to the CE-Router.
4. Observe the packets transmitted by the CE-Router.
5. TN2 transmits a DHCPv6 Decline message including an IA\_NA option with an IA Address option without a Server Identifier option.
6. Observe the packets transmitted by the CE-Router.

#### *Part B: No Client Identifier Option*

7. TN2 transmits a DHCPv6 Solicit.
8. Observe the packets transmitted by the CE-Router.
9. TN2 transmits a DHCPv6 Request message to the CE-Router.
10. Observe the packets transmitted by the CE-Router.
11. TN2 transmits a DHCPv6 Decline message including an IA\_NA option with an IA Address option and without a Client Identifier option.
12. Observe the packets transmitted by the CE-Router.

#### *Part C: Server Identifier that does not match the DUID of the server*

13. TN2 transmits a DHCPv6 Solicit.
14. Observe the packets transmitted by the CE-Router.
15. TN2 transmits a DHCPv6 Request message to the CE-Router.
16. Observe the packets transmitted by the CE-Router.
17. TN2 transmits a DHCPv6 Decline message including an IA\_NA option with an IA Address option and Server Identifier whose value does not match the server's DUID.
18. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 2:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.
  - Step 4:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.
  - Step 6:** CE-Router must silently discard the DHCPv6 Decline message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Decline message.





- *Part B*
  - Step 8:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.
  - Step 10:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.
  - Step 12:** CE-Router must silently discard the DHCPv6 Decline message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Decline message.
- *Part C*
  - Step 14:** CE-Router transmitted a DHCPv6 Advertise message in response to the Solicit message.
  - Step 16:** CE-Router transmitted a DHCPv6 Reply message in response to the Request message.
  - Step 18:** CE-Router must silently discard the DHCPv6 Decline message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Decline message.

**Possible Problems:**

- None.



## Test CERouter.2.1.23: Server Message Validation

**Purpose:** Verify an IPv6 CE Router properly discards all Advertise and Reply messages.

### References:

- [RFC 7084] – L -8
- [RFC 3315] – Section 15.3, 15.10 and 15.14

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

*Part A: Advertise message (type 2)*

1. TN2 transmits an Advertise message to the “All\_DHCP\_Relay\_Agents\_and\_Servers” multicast address (FF02::1:2) port 547.
2. Observe the packets transmitted by the CE-Router.

*Part B: Reply message (type 7)*

3. TN2 transmits an Reply message to the “All\_DHCP\_Relay\_Agents\_and\_Servers” multicast address (FF02::1:2) port 547.
4. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router discards the Advertise message from TN2 and does not transmit any packets.
- *Part B*  
**Step 4:** CE-Router discards the Reply message from TN2 and does not transmit any packets.

### Possible Problems:

- None.



## **Group 2: RFC 3736 - Server Specification**

### **Scope**

The following tests cover specifications for the server implementation of the Stateless Dynamic Host Configuration Protocol for IPv6 (DHCPv6), Request for Comments 3736.

These tests verify the process for receiving a list of available DNS recursive name servers and a domain search list from a server in Stateless Dynamic Host Configuration Protocol for IPv6.

### **Overview**

These tests are designed to verify the readiness of a DHCPv6 server implementation vis-à-vis the Stateless Dynamic Host Configuration Protocol for IPv6 specification (Focus on DNS recursive name servers and Domain search list option).



## Test CERouter.2.2.1: Basic Message Exchange

**Purpose:** Verify an IPv6 CE Router properly handles the reception of DHCPv6 message during a basic exchange.

### References:

- [RFC 7084] – L-8
- [RFC 3315] – Section 5.3
- [DHCP 3736] – Section 5.1, 5.2, and 5.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. TN2 transmits an DHCPv6 Information-Request message.
2. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router transmits a properly formatted DHCPv6 Reply message.

### Possible Problems:

- None.



## Test CERouter.2.2.2: Transaction ID Consistency

**Purpose:** Verify an IPv6 CE Router properly uses the same transaction id as the client.

### References:

- [RFC 7084] – L-8
- [RFC 3315] – Section 15.1
- [RFC 3646] – Section 3
- [DHCP 3736] – Section 5.1, 5.2, and 5.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. TN2 trans a valid DHCPv6 Information-Request message (transaction-id is 100).
2. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router transmitted a DHCPv6 Reply message in response to the Information-Request message from TN2 with matching transaction ids (100).

### Possible Problems:

- None.



### Test CERouter.2.2.3: Implementation of DHCP constants

**Purpose:** Verify an IPv6 CE Router properly listen on the correct UDP port and transmits message to the correct DHCP constant address.

#### References:

- [RFC 7084] – L-8
- [RFC 3646] – Section 3
- [RFC 3315] – Section 5.2
- [DHCP 3736] – Section 5.1, 5.2, and 5.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### Procedure:

##### *Part A: Valid UDP port*

1. TN2 transmits an Information-Request message to UDP destination port 547.
2. Observe the packets transmitted by the CE-Router.

##### *Part B: Invalid UDP port*

3. TN2 transmits an Information-Request message to the UDP destination port 33536.
4. Observe the packets transmitted by the CE-Router.

#### Observable Results:

- *Part A*  
**Step 2:** CE-Router must transmit a DHCPv6 Reply message with a destination UDP port set to 546.
- *Part B*  
**Step 4:** CE-Router should silently ignore the DHCPv6 Information-request message from TN2 and does not send any DHCPv6 messages.

#### Possible Problems:

- None.



## Test CERouter.2.2.4: Server Message Format

**Purpose:** Verify an IPv6 CE Router properly transmits a DHCPv6 message with the proper format.

### References:

- [RFC 7084] – L-8
- [RFC 3315] – Section 6, 7, 7.1, 7.2
- [RFC 3646] – Section 3
- [DHCP 3736] – Section 5.1, 5.2, and 5.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. TN2 transmits an Information-request message to the “All\_DHCP\_Relay\_Agents\_and\_Servers” multicast address (FF02::1:2).
2. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router transmits a properly formatted Reply message containing the following elements:

- The msg-type field was set to the value of 7 (Reply)
- A header containing a non-zero value Transaction ID
- A Server Identifier Option (containing a DUID)
- A Client Identifier Option (containing a DUID)

### Possible Problems:

- None.



## Test CERouter.2.2.5: DHCP Options

**Purpose:** Verify an IPv6 CE Router properly transmits a DHCPv6 options.

### References:

- [RFC 7084] – L-8, L-10
- [RFC 3315] – Section 6, 7, 7.1, 7.2
- [RFC 3646] – Section 3
- [DHCP 3736] – Section 5.1, 5.2, and 5.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Server Identifier Option*

1. TN2 transmits a DHCPv6 Information-Request message.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: DNS Recursive Name Server Option*

3. TN2 transmits a DHCPv6 Information-Request message.
4. Observe the packets transmitted by the CE-Router.

#### *Part C: Domain Search List Option*

5. TN2 transmits a DHCPv6 Information-Request message.
6. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router transmits a properly formatted Reply message containing the following Server Identifier option values:
  - An option-code set to OPTION\_SERVERID (2)
  - An option-length set to the length of DUID in octets
  - DUID Field set to any non-zero number
- *Part B*  
**Step 4:** CE-Router transmits a properly formatted Reply message containing the following DNS Recursive Name Server option values:
  - An option-code set to OPTION\_DNS\_SERVERS (23)
  - An option-length set to the length of the list of DNS recursive name servers in octets; must be a multiple of 16
  - DNS-recursive-name-server set to IPv6 address of DNS recursive name server
- *Part C*  
**Step 6:** CE-Router transmits a properly formatted Reply message containing the following Domain Search List option values:
  - An option-code set to OPTION\_DOMAIN\_LIST (24)
  - An option-length set to the length of the 'searchlist' field in octets





- Domain Search List set to the specification of the list of domain names in the Domain Search List.

**Possible Problems:**

- None



## Test CERouter.2.2.6: DHCP Unique Identifier (DUID) Contents

**Purpose:** Verify an IPv6 CE Router properly transmits the correct DUID contents.

### References:

- [RFC 7084] – L-8
- [RFC 3315] – Section 9, 9.2, 9.3 and 9.4
- [RFC 3646] – Section 3
- [DHCP 3736] – Section 5.1, 5.2, and 5.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: DUID Format*

1. TN2 transmits a DHCPv6 Information-Request message.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: DUID Consistency*

3. TN2 transmits a DHCPv6 Information-Request message.
4. Observe the packets transmitted by the CE-Router.
5. Reboot the CE-Router. Perform [Common Test Setup](#).
6. TN2 transmits a DHCPv6 Information-Request message.
7. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*

**Step 2:** The CE-Router transmits a properly formatted DHCPv6 Reply message containing one of the following DUID options:

#### **DUID-LLT**

- An option-code set to OPTION\_SERVERID(2)
- An option-length set to the length of DUID in octets
- The type field was set to the value of 0x01
- A hardware type set to the IANA-assigned value
- A time value of DUID
- A link-layer address

#### **DUID-EN**

- An option-code set to OPTION\_SERVERID(2)
- An option-length set to the length of DUID in octets
- The type field was set to the value of 0x02
- An Enterprise Number of DUID, IANA value
- A non-zero identifier number of the DUID

#### **DUID-LL**

- An option-code set to OPTION\_SERVERID(2)
- An option-length set to the length of DUID in octets



- The type field was set to the value of 0x03
- A hardware type set to the IANA-assigned value
- A link-layer address of DUID

- *Part B*

**Step 4:** The CE-Router transmits a properly formatted DHCPv6 Reply message containing the following DUID-LLT option:

**DUID-LLT**

- An option-code set to OPTION\_SERVERID(2)
- An option-length set to the length of DUID in octets
- The type field was set to the value of 0x01
- A hardware type set to the IANA-assigned value
- A time value of DUID
- A link-layer address

**DUID-EN**

- An option-code set to OPTION\_SERVERID(2)
- An option-length set to the length of DUID in octets
- The type field was set to the value of 0x02
- An Enterprise Number of DUID, IANA value
- A non-zero identifier number of the DUID

**DUID-LL**

- An option-code set to OPTION\_SERVERID(2)
- An option-length set to the length of DUID in octets
- The type field was set to the value of 0x03
- A hardware type set to the IANA-assigned value
- A link-layer address of DUID

**Step 7:** The CE-Router transmits a properly formatted DHCPv6 Solicit message with the DUID option containing the same values as in Step 4.

**Possible Problems:**

- None.



## Test CERouter.2.2.7: Creation and Transmission of Reply Messages

**Purpose:** Verify an IPv6 CE Router properly transmits the correct DUID contents.

### References:

- [RFC 7084] – L-8, L-10
- [RFC 3315] – Section 9, 9.2, 9.3 and 9.4
- [RFC 3646] – Section 3
- [DHCP 3736] – Section 5.1, 5.2, and 5.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Reply message transmission*

1. TN2 transmits an Information-Request message.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Reply message in response to Information-request message with an ORO (DNS Recursive Name Server Option)*

3. TN2 transmits a valid Information-request message with an Option Request Option (DNS Recursive Name Server option).
4. Observe the packets transmitted by the CE-Router.

#### *Part C: Reply message in response to Information-request message with an ORO (Domain Search List Option)*

5. TN2 transmits a valid Information-request message with an Option Request Option (Domain Search List option).
6. Observe the packets transmitted by the CE-Router.

### Observable Results:

#### • *Part A*

**Step 2:** CE-Router transmits a properly formatted DHCPv6 Reply message containing the following elements:

- Destination address set to TN2's unicast address same as the Information-request message's source address.
- A msg-type field set to REPLY (7)
- A transaction-id set to the same as Information-request message's transaction-id
- A Server Identifier option (containing a DUID)
- A Client Identifier option set to the same as Information-request message's Client Identifier option

#### • *Part B*

**Step 4:** CE-Router transmits a properly formatted DHCPv6 Reply message containing the following elements:

- Destination address set to TN2's unicast address same as the Information-request message's source address.
- A msg-type field set to REPLY (7)



- A transaction-id set to the same as Information-request message's transaction-id
- A Server Identifier option (containing a DUID)
- A Client Identifier option set to the same as Information-request message's Client Identifier option
- A DNS Recursive Name Server option set to the following values:
  - An option-code set to OPTION\_DNS\_SERVERS (23)
  - An option-length set to the length of the list of DNS recursive name servers in octets; must be a multiple of 16.
  - DNS-recursive-name-server set to IPv6 address of DNS recursive name server
- *Part C*

**Step 6:** CE-Router transmits a properly formatted DHCPv6 Reply message containing the following elements:

  - Destination address set to TN2's unicast address same as the Information-request message's source address.
  - A msg-type field set to REPLY (7)
  - A transaction-id set to the same as Information-request message's transaction-id
  - A Server Identifier option (containing a DUID)
  - A Client Identifier option set to the same as Information-request message's Client Identifier option
  - A Domain Search List option set to the following values:
    - An option-code set to OPTION\_DOMAIN\_LIST (24).
    - An option-length set to the length of the 'searchlist' field in octets
    - Domain Search List set to the specification of the list of domain names in the Domain Search List.

**Possible Problems:**

- None.



## Test CERouter.2.2.8: Reception of Invalid Information-request message

**Purpose:** Verify an IPv6 CE Router properly handles the reception of invalid Information-request messages.

### References:

- [RFC 7084] – L-8, L-10
- [RFC 3315] – Section 15 and 15.12
- [RFC 3646] – Section 3 and 4
- [DHCP 3736] – Section 5.1, 5.2, and 5.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

*Part A: Reception of Information-request message via unicast*

1. TN2 transmits an Information-Request message with a unicast destination address to the CE-Router.
2. Observe the packets transmitted by the CE-Router.

*Part B: Contains Server Identifier option*

3. TN2 transmits an Information-Request message that contains a Server Identifier option.
4. Observe the packets transmitted by the CE-Router.

*Part C: Contains IA\_NA option*

5. TN2 transmits an Information-request message that contains an IA\_NA option.
6. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router must silently discard the DHCPv6 Information-request message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Information-request message.
- *Part B*  
**Step 4:** CE-Router must silently discard the DHCPv6 Information-request message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Information-request message.
- *Part C*  
**Step 6:** CE-Router must silently discard the DHCPv6 Information-request message. The CE-Router must not send a DHCPv6 Reply message based on the received DHCPv6 Information-request message.

### Possible Problems:

- None.



## Test CERouter.2.2.9: Server Message Validation

**Purpose:** Verify an IPv6 CE Router properly discards all Advertise and Reply messages.

### References:

- [RFC 7084] – L-8, L-10
- [RFC 3315] – Section 15 and 15.12
- [RFC 3646] – Section 3 and 4
- [DHCP 3736] – Section 5.1, 5.2, and 5.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

*Part A: Advertise message (type 2)*

1. TN2 transmits an DHCPv6 Advertise message to the “All\_DHCP\_Relay\_Agents\_and\_Servers” multicast address (FF02::1:2) port 547.
2. Observe the packets transmitted by the CE-Router.

*Part B: Reply message (type 7)*

3. TN2 transmits a DHCPv6 Reply message to the “All\_DHCP\_Relay\_Agents\_and\_Servers” multicast address (FF02::1:2) port 547.
4. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router discards the Advertise message from TN2 and does not transmit any packets in response.
- *Part B*  
**Step 4:** CE-Router discards the Advertise message from TN2 and does not transmit any packets in response.

### Possible Problems:

- None.



## **Group 3: RFC 2460**

### **Scope**

The following tests cover the base specification for Internet Protocol version 6, Request For Comments 2460. The base specification specifies the basic IPv6 header and the initially defined IPv6 extension headers and options. It also discusses packet size issues, the semantics of flow labels and traffic classes, and the effects of IPv6 on upper-layer protocols.

### **Overview**

These tests are designed to verify the readiness of an IPv6 implementation vis-à-vis the IPv6 Base specification.





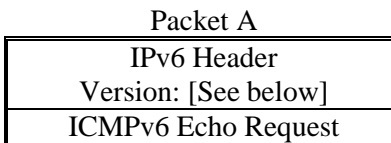
### Test CERouter.2.3.1: Version Field

**Purpose:** Verify an IPv6 CE Router properly processes the Version Field of received packets.

**References:**

- [RFC 7084] –G-1
- [IPv6-SPEC] – Section 3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.



**Procedure:**

1. TN2 transmits Packet A to the CE-Router, which has an IPv6 header with Version field of 4.
2. TN2 transmits an Echo Request to the CE-Router.
3. Observe the packets transmitted by the CE-Router.
4. Repeat Steps 1 and 2 with a Version field of 0, 5, 7 and 15.

**Observable Results:**

**Step 3:** CE-Router must not crash or generate invalid packets. In Step 2, the CE-Router must respond to the second Echo Request from TN2.

**Possible Problems:**

- None.



## Test CERouter.2.3.2: Flow Label Non-Zero

**Purpose:** Verify an IPv6 CE Router properly process the Flow Label field of received packets and generates a valid value in transmitted packets.

### References:

- [RFC 7084] – G-1
- [IPv6-SPEC] – Section 6, Appendix A

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A
IPv6 Header
Flow Label: 214375
Next Header: 58
ICMPv6 Echo Request

### Procedure:

1. TN2 transmits Packet A, an Echo Request with a Flow Label of 0x34567 to the CE-Router.
2. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router must generate an Echo Reply. If the CE-Router supports use of the Flow Label field, the Flow Label in the Echo Reply may be non-zero. Otherwise, the Flow Label field must be zero.

### Possible Problems:

- None.



### Test CERouter.2.3.3: Payload Length

**Purpose:** Verify an IPv6 CE Router properly process the Payload Length field of received packets.

#### References:

- [RFC 7084] – G-1
- [IPv6-SPEC] – Section 3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A
IPv6 Header
Payload Length: [See below]
Next Header: 58
ICMPv6 Echo Request

#### Procedure:

##### *Part A: Payload Length Odd*

1. TN2 transmits Packet A to the CE-Router, an Echo Request that has an IPv6 header with a Payload Length of 0x33 (51).
2. Observe the packets transmitted by the CE-Router.

##### *Part B: Payload Length Even*

3. TN2 transmits Packet A to the CE-Router, an Echo Request that has an IPv6 header with a Payload Length of 0x32 (50).
4. Observe the packets transmitted by the CE-Router.

#### Observable Results:

- *Part A and B*  
**Step 2 and 4:** CE-Router must generate an Echo Reply, indicating successful processing of the packet.

#### Possible Problems:

- None.



## Test CERouter.2.3.4: No Next Header after IPv6 Header

**Purpose:** Verify an IPv6 CE Router properly when it encounters a Next Header value of 59 (no next header).

### References:

- [RFC 7084] – G-1
- [IPv6-SPEC] – Section 4.7

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A
IPv6 Header
Next Header: 59
ICMPv6 Echo Request

### Procedure:

1. TN2 transmits Packet A to the CE-Router, which contains an IPv6 header with a Next Header of 59. Following the IPv6 header is an ICMPv6 Echo Request Header.
2. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router must not send any packets in response to Packet A.

### Possible Problems:

- None.



## Test CERouter.2.3.5: Hop Limit Zero – End Node

**Purpose:** Verify an IPv6 CE Router properly processes the Hop Limit field of received packets and generates a valid value in transmitted packets.

### References:

- [RFC 7084] – G-1
- [IPv6-SPEC] – Sections 3 and 8.2

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A
IPv6 Header
Hop Limit: 0
Next Header: 58
ICMPv6 Echo Request

### Procedure:

1. TN2 transmits Packet A to the CE-Router, an Echo Request with a Hop Limit field of zero.
2. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router must generate an Echo Reply with a Hop Limit field value of greater than zero.

### Possible Problems:

- None.



## Test CERouter.2.3.6: No Next Header after Extension Header

**Purpose:** Verify an IPv6 CE Router properly processes a Next Header value of 59 (no next header).

### References:

- [RFC 7084] – G-1
- [IPv6-SPEC] – Section 4,4.1, 4.2, and 4.5

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

IPv6 Header Next Header: 60
Destination Options Header Next Header: 59 (None) Header Ext. Length: 0 Option: PadN Opt Data Len: 4
ICMPv6 Echo Request

### Procedure:

1. TN2 transmits Packet A to the CE-Router, which contains a Destination Options header with a Next Header of 59. Following the Destination Options header is an ICMPv6 Echo Request header.
2. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router must not send any packets in response to Packet A.

### Possible Problems:

- None.



## Test CERouter.2.3.7: Extension Header Processing Order

**Purpose:** Verify an IPv6 CE Router properly processes the headers of an IPv6 packet in the correct order.

**References:**

- [RFC 7084] – G-1
- [IPv6-SPEC] – Section 4,4.1, 4.2, and 4.5

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A	Packet B
IPv6 Header Next Header: 0 Payload Length: 37	IPv6 Header Next Header: 0 Payload Length: 37
Hop-by-Hop Options Header Next Header: 60 Header Ext. Length: 0 Option: PadN Opt Data Len: 4	Hop-by-Hop Options Header Next Header: 60 Header Ext. Length: 0 Option: PadN Opt Data Len: 4
Destination Options Header Next Header: 44 Header Ext. Length: 0 Option: 135 (unknown, msb: 10 <sub>b</sub> ) Opt Data Len: 4	Destination Options Header Next Header: 44 Header Ext. Length: 0 Option: 7 (unknown, msb: 00 <sub>b</sub> ) Opt Data Len: 4
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 1	Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 1
ICMPv6 Echo Request Data Length: 5	ICMPv6 Echo Request Data Length: 5

Packet C	Packet D
IPv6 Header Next Header: 0 Payload Length: 37	IPv6 Header Next Header: 0 Payload Length: 37
Hop-by-Hop Options Header Next Header: 44 Header Ext. Length: 0 Option: PadN Opt Data Len: 4	Hop-by-Hop Options Header Next Header: 44 Header Ext. Length: 0 Option: PadN Opt Data Len: 4
Fragment Header Next Header: 60 Fragment Offset: 0 More Fragments flag: 1	Fragment Header Next Header: 60 Fragment Offset: 0 More Fragments flag: 0



Destination Options Header Next Header: 58 Header Ext. Length: 0 Option: 135 (unknown, msb: 10 <sub>b</sub> ) Opt Data Len: 4	Destination Options Header Next Header: 58 Header Ext. Length: 0 Option: 135 (unknown, msb: 10 <sub>b</sub> ) Opt Data Len: 4
ICMPv6 Echo Request Data Length: 5	ICMPv6 Echo Request Data Length: 5

**Procedure:**

*Part A: Destination Options Header precedes Fragment Header, Error from Destination Options Header*

1. TN2 transmits Packet A, an Echo Request that has a Hop-by-Hop Options header, Destination Options header, and Fragment header, in that order. The Destination Options header has an unknown Option Type of 135. The IPv6 header has a Payload Length that is not a multiple of 8 octets, and the Fragment header has the M-bit set.
2. Observe the packets transmitted by the CE-Router.

*Part B: Destination Options Header precedes Fragment Header, Error from Fragment Header*

3. TN2 transmits Packet B, an Echo Request that has a Hop-by-Hop Options header, Destination Options header, and Fragment header, in that order. The Destination Options header has an unknown Option Type of 7. The IPv6 header has a Payload Length that is not a multiple of 8 octets, and the Fragment header has the M-bit set.
4. Observe the packets transmitted by the CE-Router.

*Part C: Fragment Header precedes Destination Options Header, Error from Fragment Header*

5. TN2 transmits Packet C, an Echo Request that has a Hop-by-Hop Options header, Fragment header, and Destination Options header, in that order. The IPv6 header has a Payload Length that is not a multiple of 8 octets, and the Fragment header has the M-bit set. The Destination Options header has an unknown Option Type of 135.
6. Observe the packets transmitted by the CE-Router.

*Part D: Fragment Header precedes Destination Options Header, Error from Destination Options Header*

7. TN2 transmits Packet D, an Echo Request that has a Hop-by-Hop Options header, Fragment header, and Destination Options header, in that order. The IPv6 header has a Payload Length that is not a multiple of 8 octets, and the Fragment header does not have the M-bit set. The Destination Options header has an unknown Option Type of 135.
8. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*  
**Step 2:** CE-Router must discard the Echo Request from TN2.
- *Part B*  
**Step 4:** CE-Router must discard the Echo Request from TN2.
- *Part C*  
**Step 6:** CE-Router must discard the Echo Request from TN2.
- *Part D*  
**Step 8:** CE-Router must discard the Echo Request from TN2.





**Possible Problems:**

- None.



## Test CERouter.2.3.8: Option Processing Order

**Purpose:** Verify an IPv6 CE Router properly processes the options in a single header in the order of occurrence.

### References:

- [RFC 7084] – G-1
- [IPv6-SPEC] – Section 4.2

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A	Packet B
IPv6 Header Next Header: 60	IPv6 Header Next Header: 60
Destination Options Header Next Header: 58 Header Ext. Length: 3 Option: 7 (unknown, msb: 00 <sub>b</sub> ) Opt Data Len: 4 Option: 71 (unknown, msb: 01 <sub>b</sub> ) Opt Data Len: 6 Option: 135 (unknown, msb: 10 <sub>b</sub> ) Opt Data Len: 6 Option: 199 (unknown, msb: 11 <sub>b</sub> ) Opt Data Len: 6	Destination Options Header Next Header: 58 Header Ext. Length: 3 Option: 7 (unknown, msb: 00 <sub>b</sub> ) Opt Data Len: 4 Option: 135 (unknown, msb: 10 <sub>b</sub> ) Opt Data Len: 6 Option: 199 (unknown, msb: 11 <sub>b</sub> ) Opt Data Len: 6 Option: 71 (unknown, msb: 01 <sub>b</sub> ) Opt Data Len: 6
ICMPv6 Echo Request	ICMPv6 Echo Request

Packet C
IPv6 Header Next Header: 60
Destination Options Header Next Header: 58 Header Ext. Length: 3 Option: 7 (unknown, msb: 00 <sub>b</sub> ) Opt Data Len: 4 Option: 199 (unknown, msb: 11 <sub>b</sub> ) Opt Data Len: 6 Option: 71 (unknown, msb: 01 <sub>b</sub> ) Opt Data Len: 6 Option: 135 (unknown, msb: 10 <sub>b</sub> ) Opt Data Len: 6
ICMPv6 Echo Request

### Procedure:



*Part A: First Option has Most Significant Bits 00<sub>b</sub>, Next has Most Significant Bits 01<sub>b</sub>*

1. TN2 transmits Packet A to the CE-Router, an Echo Request that has a Destination Options header with four unknown Options. The Option Types are 7, 71, 135, and 199.
2. Observe the packets transmitted by the CE-Router.

*Part B: First Option has Most Significant Bits 00<sub>b</sub>, Next has Most Significant Bits 10<sub>b</sub>*

3. TN2 transmits Packet B to the CE-Router, an Echo Request that has a Destination Options header with four unknown Options. The Option Types are 7, 135, 199, and 71.
4. Observe the packets transmitted by the CE-Router.

*Part C: First Option has Most Significant Bits 00<sub>b</sub>, Next has Most Significant Bits 11<sub>b</sub>*

5. TN2 transmits Packet C to the CE-Router's link-local address, an Echo Request that has a Destination Options header with four unknown Options. The Option Types are 7, 199, 71, and 135.
6. Observe the packets transmitted by the CE-Router.

#### **Observable Results:**

- *Part A*  
**Step 2:** CE-Router must silently discard the ICMPv6 Echo Request and not send any packets to TN2.
- *Part B*  
**Step 4:** CE-Router must discard the Echo Request sent by TN2 and must not send a Reply.
- *Part C*  
**Step 6:** CE-Router must discard the Echo Request sent by TN2 and must not send a Reply.

#### **Possible Problems:**

- None.



### Test CERouter.2.3.9: Options Processing, Hop-by-Hop Options Header – End Node

**Purpose:** Verify an IPv6 CE Router properly processes the headers of an IPv6 packet in the correct order.

**References:**

- [RFC 7084] – G-1
- [IPv6-SPEC] – Sections 4.2 and 4.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A	Packet B
IPv6 Header Next Header: 0	IPv6 Header Next Header: 0
Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: Pad1 Option: Pad1 Option: Pad1 Option: Pad1 Option: Pad1 Option: Pad1	Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: PadN Opt Data Len: 4
ICMPv6 Echo Request	ICMPv6 Echo Request

Packet C	Packet D
IPv6 Header Next Header: 0	IPv6 Header Next Header: 0
Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 7 (unknown, msb: 00 <sub>b</sub> ) Opt Data Len: 4 bytes	Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 71 (unknown, msb: 01 <sub>b</sub> ) Opt Data Len: 4 bytes
ICMPv6 Echo Request	ICMPv6 Echo Request

Packet E	Packet F
IPv6 Header Next Header: 0	IPv6 Header Next Header: 0
Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 135 (unknown, msb: 10 <sub>b</sub> ) Opt Data Len: 4 bytes	Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 199 (unknown, msb: 11 <sub>b</sub> ) Opt Data Len: 4 bytes
ICMPv6 Echo Request	ICMPv6 Echo Request

Packet G	Packet H
----------	----------



IPv6 Header Destination Address: All Nodes Link-local Multicast Next Header: 0	IPv6 Header Destination Address: All Nodes Link-local Multicast Next Header: 0
Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 135 (unknown, msb: 10 <sub>b</sub> ) Opt Data Len: 4 bytes	Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 199 (unknown, msb: 11 <sub>b</sub> ) Opt Data Len: 4 bytes
ICMPv6 Echo Request	ICMPv6 Echo Request

### Procedure:

#### Part A: Pad1 Option

1. TN2 transmits Packet A to the CE-Router, an Echo Request that has a Hop-by-Hop Options header with six Pad1 Options.
2. Observe the packets transmitted by the CE-Router.

#### Part B: PadN Option

3. TN2 transmits Packet B to the CE-Router, an Echo Request that has a Hop-by-Hop Options header with a 6 byte PadN Option.
4. Observe the packets transmitted by the CE-Router.

#### Part C: Most Significant Bits 00<sub>b</sub>

5. TN2 transmits Packet C to the CE-Router, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 7.
6. Observe the packets transmitted by the CE-Router.

#### Part D: Most Significant Bits 01<sub>b</sub>

7. TN2 transmits Packet D to the CE-Router, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 71.
8. Observe the packets transmitted by the CE-Router.

#### Part E: Most Significant Bits 10<sub>b</sub>, unicast destination

9. TN2 transmits Packet E to the CE-Router, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 135.
10. Observe the packets transmitted by the CE-Router.

#### Part F: Most Significant Bits 11<sub>b</sub>, unicast destination

11. TN2 transmits Packet F to the CE-Router, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 199.
12. Observe the packets transmitted by the CE-Router.

#### Part G: Most Significant Bits 10<sub>b</sub>, multicast destination

13. TN2 transmits Packet G, an Echo Request sent to a local multicast address that has a Hop-by-Hop Options header with an unknown Option Type of 135.
14. Observe the packets transmitted by the CE-Router.

#### Part H: Most Significant Bits 11<sub>b</sub>, multicast destination

15. TN2 transmits Packet H, an Echo Request sent to a local multicast address that has a Hop-by-Hop Options header with an unknown Option Type of 199.
16. Observe the packets transmitted by the CE-Router.

### Observable Results:



- *Part A*  
**Step 2:** CE-Router must send an Echo Reply to TN2.
- *Part B*  
**Step 4:** CE-Router must send an Echo Reply to TN2.
- *Part C*  
**Step 6:** CE-Router is skipped and the header is processed. The CE-Router must send an Echo Reply to TN2.
- *Part D*  
**Step 8:** CE-Router must not generate any packets sent to TN2. The Echo Request is discarded.
- *Part E*  
**Step 10:** CE-Router must discard the Echo Request and not send an Echo Reply.
- *Part F*  
**Step 12:** CE-Router must discard the Echo Request and not send an Echo Reply.
- *Part G*  
**Step 14:** CE-Router must discard the Echo Request and not send an Echo Reply.
- *Part H*  
**Step 16:** CE-Router must discard the Echo Request and not send an Echo Reply.

**Possible Problems:**

- None.



## Test CERouter.2.3.10: Options Processing, Destination Options Header

**Purpose:** Verify an IPv6 CE Router properly processes both known and unknown options, and acts in accordance with the highest order two bits of the option.

### References:

- [RFC 7084] – G-1
- [IPv6-SPEC] – Sections 4.2 and 4.6

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A	Packet B
IPv6 Header Next Header: 60	IPv6 Header Next Header: 60
Destination Options Header Next Header: 58 Header Ext. Length: 0 Option: Pad1 Option: Pad1 Option: Pad1 Option: Pad1 Option: Pad1 Option: Pad1	Destination Options Header Next Header: 58 Header Ext. Length: 0 Option: PadN Opt Data Len: 4
ICMPv6 Echo Request	ICMPv6 Echo Request

Packet C	Packet D
IPv6 Header Next Header: 60	IPv6 Header Next Header: 60
Destination Options Header Next Header: 58 Header Ext. Length: 0 Option: 7 (unknown, msb: 00 <sub>b</sub> ) Opt Data Len: 4	Destination Options Header Next Header: 58 Header Ext. Length: 0 Option: 71 (unknown, msb: 01 <sub>b</sub> ) Opt Data Len: 4
ICMPv6 Echo Request	ICMPv6 Echo Request

Packet E	Packet F
IPv6 Header Next Header: 60	IPv6 Header Next Header: 60
Destination Options Header Next Header: 58 Header Ext. Length: 0 Option: 135 (unknown, msb: 10 <sub>b</sub> ) Opt Data Len: 4	Destination Options Header Next Header: 58 Header Ext. Length: 0 Option: 199 (unknown, msb: 11 <sub>b</sub> ) Opt Data Len: 4
ICMPv6 Echo Request	ICMPv6 Echo Request



Packet G	Packet H
IPv6 Header Destination Address: All Nodes Link-local Multicast Next Header: 60	IPv6 Header Destination Address: All Nodes Link-local Multicast Next Header: 60
Destination Options Header Next Header: 58 Header Ext. Length: 0 Option: 135 (unknown, msb: 10 <sub>b</sub> ) Opt Data Len: 4	Destination Options Header Next Header: 58 Header Ext. Length: 0 Option: 199 (unknown, msb: 11 <sub>b</sub> ) Opt Data Len: 4
ICMPv6 Echo Request	ICMPv6 Echo Request

### Procedure:

#### Part A: Pad1 Option

1. TN2 transmits Packet A to the CE-Router an Echo Request that has a Destination Options header with six Pad1 Options.
2. Observe the packets transmitted by the CE-Router.

#### Part B: PadN Option

3. TN2 transmits Packet B to the CE-Router, an Echo Request that has a Destination Options header with a 4 byte PadN Option.
4. Observe the packets transmitted by the CE-Router.

#### Part C: Most Significant Bits 00<sub>b</sub>

5. TN2 transmits Packet C to the CE-Router, an Echo Request that has a Destination Options header with an unknown Option Type of 7.
6. Observe the packets transmitted by the CE-Router.

#### Part D: Most Significant Bits 01<sub>b</sub>

7. TN2 transmits Packet D to the CE-Router, an Echo Request that has a Destination Options header with an unknown Option Type of 71.
8. Observe the packets transmitted by the CE-Router.

#### Part E: Most Significant Bits 10<sub>b</sub>, unicast destination

9. TN2 transmits Packet E to the CE-Router, an Echo Request that has a Destination Options header with an unknown Option Type of 135.
10. Observe the packets transmitted by the CE-Router.

#### Part F: Most Significant Bits 11<sub>b</sub>, unicast destination

11. TN2 transmits Packet F to the CE-Router, an Echo Request that has a Destination Options header with an unknown Option Type of 199.
12. Observe the packets transmitted by the CE-Router.

#### Part G: Most Significant Bits 10<sub>b</sub>, multicast destination

13. TN2 transmits Packet G, an Echo Request sent to a local multicast address that has a Destination Options header with an unknown Option Type of 135.
14. Observe the packets transmitted by the CE-Router.

#### Part H: Most Significant Bits 11<sub>b</sub>, multicast destination

15. TN2 transmits Packet H, an Echo Request sent to a local multicast address that has a Destination Options header with an unknown Option Type of 199.
16. Observe the packets transmitted by the CE-Router.

### Observable Results:





- *Part A*  
**Step 2:** CE-Router must send an Echo Reply to TN2.
- *Part B*  
**Step 4:** CE-Router must send an Echo Reply to TN2.
- *Part C*  
**Step 6:** The unknown option is skipped and the header is processed. The CE-Router must send an Echo Reply to TN2.
- *Part D*  
**Step 8:** CE Router must not generate any packets sent to TN2. The Echo Request is discarded.
- *Part E*  
**Step 10:** CE Router must discard the Echo Request and not send a Reply.
- *Part F*  
**Step 12:** CE Router must discard the Echo Request and not send a Reply.
- *Part G*  
**Step 14:** CE Router must discard the Echo Request and not send a Reply.
- *Part H*  
**Step 16:** The CE-Router must not generate any packets sent to TN2. The Echo Request is discarded, as the destination address is multicast. The CE-Router must not send an ICMPv6 Parameter Problem message. The CE-Router must discard the Echo Request and not send a Reply.

**Possible Problems:**

- None.



## Test CERouter.2.3.11: Fragment Reassembly

**Purpose:** Verify an IPv6 CE Router properly correctly reassembles fragmented packets and distinguishes between packet fragments using the Source Address, Destination Address, and Fragment ID.

### References:

- [RFC 7084] – G-1
- [IPv6-SPEC] – Sections 4.5 and 5

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Fragment A.1	Fragment A.2	Fragment A.3
IPv6 Header Next Header: 44 Source Address: [See below] Destination Address: [See below]	IPv6 Header Next Header: 44 Source Address: [See below] Destination Address: [See below]	IPv6 Header Next Header: 44 Source Address: [See below] Destination Address: [See below]
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 1 ID: [See below]	Fragment Header Next Header: 58 Fragment Offset: (4) 32 bytes More Fragments flag: 1 ID: [See below] Fragment Data: 32 Bytes	Fragment Header Next Header: 58 Fragment Offset: (8) 64 bytes More Fragments flag: 0 ID: [See below] Fragment Data: 24 Bytes
ICMPv6 Echo Request		

### Procedure:

#### *Part A: All Fragments are Valid*

1. TN2 transmits Fragments A.1, A.2, and A.3 in order. All fragments have the same Source Address, Destination Address, and Fragment ID.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: All Fragments are Valid, reverse order*

3. TN2 transmits Fragments A.3, A.2, and A.1, in that order. All fragments have the same Source Address, Destination Address, and Fragment ID.
4. Observe the packets transmitted by the CE-Router.

#### *Part C: Fragment IDs Differ Between Fragments*

5. TN2 transmits Fragments A.1, A.2, and A.3 in order. Fragments A.1 and A.3 have a Fragment ID of 2999. Fragment A.2 has a Fragment ID of 3000. The Source and Destination Addresses for all fragments are the same.
6. Observe the packets transmitted by the CE-Router.

#### *Part D: Source Addresses Differ Between Fragments*

7. TN2 transmits Fragments A.1, A.2, and A.3 in order. Fragments A.1 and A.3 have a Source Address of the link-local address of TN1. Fragment A.2 has a Source Address of a different link-local address. The Destination Addresses and Fragment Ids for all fragments are the same.
8. Observe the packets transmitted by the CE-Router.

#### *Part E: Destination Address Differ Between Fragments*



9. TN1 transmits Fragments A.1, A.2, and A.3 in order. Fragments A.1 and A.3 have a Destination Address of the link-local address of the CE-Router. Fragment A.2 has a Destination Address of the global address of the CE-Router. The Source Addresses and Fragment Ids for all fragments are the same.
10. Observe the packets transmitted by the CE-Router.

*Part F: Reassemble to 1500*

11. TN2 transmits an Echo Request to the CE-Router. TN1 answers any Neighbor Solicitation with a Neighbor Advertisement.
12. Observe the packets transmitted by the CE-Router.
13. TN2 transmits Fragments A.1, A.2, and A.3 in order. All fragments have the same Source Address, Destination Address, and Fragment ID, however, the payloads of each fragment are modified so that the reassembled packet size is 1500.
14. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*  
**Step 2:** CE-Router must transmit an Echo Reply to TN2 in response to the reassembled Echo Request.
- *Part B*  
**Step 4:** CE-Router must transmit an Echo Reply to TN2 in response to the reassembled Echo Request.
- *Part C*  
**Step 6:** CE-Router must not transmit an Echo Reply to TN2, as the Echo Request could not be reassembled due to differences in the Fragment ID.
- *Part D*  
**Step 8:** CE-Router must not transmit an Echo Reply to TN2, as the Echo Request could not be reassembled due to differences in the Source Address.
- *Part E*  
**Step 10:** CE-Router must not transmit an Echo Reply to TN2, as the Echo Request could not be reassembled due to differences in the Destination Address.
- *Part F*  
**Step 12:** CE-Router must respond to the Echo Request from TN2.  
**Step 14:** CE-Router must respond to the Echo Request from TN2.

**Possible Problems:**

- None.



## Test CERouter.2.3.12: Reassembly Time Exceeded

**Purpose:** Verify an IPv6 CE Router takes the proper action when the reassembly time has been exceeded for a packet.

### References:

- [RFC 7084] – G-1
- [IPv6-SPEC] – Sections 4.5

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A		
Fragment A.1	Fragment A.2	Fragment A.3
IPv6 Header Next Header: 44 Source Address: TN2's Global Address Destination Address: CE-Router's Global Address	IPv6 Header Next Header: 44 Source Address: TN2's Global Address Destination Address: CE-Router's Global Address	IPv6 Header Next Header: 44 Source Address: TN2's Global Address Destination Address: CE-Router's Global Address
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 1	Fragment Header Next Header: 58 Fragment Offset: (4) 32 bytes More Fragments flag: 1 Fragment Data: 32 Bytes	Fragment Header Next Header: 58 Fragment Offset: (8) 64 bytes More Fragments flag: 0 Fragment Data: 24 Bytes
ICMPv6 Echo Request		

### Procedure:

*Part A: Time Elapsed Between Fragments less than Sixty Seconds*

1. TN2 transmits Fragments A.1, A.2 and A.3 in order. There is a 55-second delay between the transmission of Fragment A.1 and Fragments A.2 and A.3.
2. Observe the packets transmitted by the CE-Router.

*Part B: Time Exceeded Before Last Fragments Arrive*

3. TN2 transmits Fragments A.1, A.2 and A.3 in order. There is a 65-second delay between the transmission of Fragment A.1 and Fragments A.2 and A.3.
4. Observe the packets transmitted by the CE-Router.

*Part C: Time Exceeded (Global), Only First Fragment Received*

5. TN2 transmits Fragment A.1.
6. Observe the packets transmitted by the CE-Router.

*Part D: Time Exceeded (Link-local), Only First Fragment Received*



7. TN2 transmits Fragment A.1 with a source address of TN2's Link-local address and a destination address set to the CE-Router's Link-local address.
8. Observe the packets transmitted by the CE-Router.

*Part E: Time Exceeded, Only Second Fragment Received*

9. TN2 transmits Fragment A.2 with a source address of TN2's Link-local address and a destination address set to the CE-Router's Link-local address
10. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*  
**Step 2:** Fragments A.2 and A.3 arrive just before the CE-Router's reassembly timer expires for Fragment A.1. The CE-Router must transmit an Echo Reply to TN2 in response to the reassembled Echo Request.
- *Part B*  
**Step 4:** Fragments A.2 and A.3 arrive after the CE-Router's reassembly timer expires for Fragment A.1. The CE-Router must not transmit an Echo Reply to TN2, as the Echo Request could not be reassembled in time.
- *Part C and D*  
**Step 6, 8:** The CE-Router must not transmit an Echo Reply to TN2, as the Echo Request was not complete.
- *Part E*  
**Step 10:** The CE-Router must not transmit an Echo Reply or a Time Exceeded Message to TN2.

**Possible Problems:**

- None.



### Test CERouter.2.3.13: Stub Fragment Header

**Purpose:** Verify an IPv6 CE Router properly accepts the offset zero fragment with the More Fragments flag clear.

**References:**

- [RFC 7084] – G-1
- [IPv6-SPEC] – Sections 4.5 and 5

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A

IPv6 Header Next Header: 44
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 0
ICMPv6 Echo Request

**Procedure:**

1. TN2 transmits Packet A, an Echo Request that has a Fragment header with a Fragment Offset of 0 and the More Fragments flag clear.
2. Observe the packets transmitted by the CE-Router.

**Observable Results:**

**Step 13:** CE-Router must transmit an Echo Reply to TN2. The Echo Reply must not include a Fragment header.

**Possible Problems:**

- None.



## **Group 4: RFC 4861**

### **Scope**

The following tests cover the Neighbor Discovery Specification for Internet Protocol version 6, Request For Comments 4861. The Neighbor Discovery protocol is used by nodes to determine the link-layer address for neighbors known to reside on attached links as well as to quickly purge cached values that become invalid. Hosts also use Neighbor Discovery to find neighboring routers that are willing to forward packets on their behalf. Finally, nodes use the protocol to actively keep track of neighbors that are reachable and those that are not. When a router or the path to a router fails, a host actively searches for functioning alternates.

### **Overview**

These tests are designed to verify the readiness of an IPv6 implementation vis-à-vis the Neighbor Discovery specification.



## Test CERouter.2.4.1: On-link Determination

**Purpose:** Verify an IPv6 CE Router properly determines that a destination is on-link.

### References:

- [RFC 7084] – L-1
- [ND] – Sections 5.2

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A	Packet B
IPv6 Header Next Header: 58 Source Address: TN2's Link-local Address	IPv6 Header Next Header: 58 Source Address: TN2's Global Address
ICMPv6 Echo Request	ICMPv6 Echo Request

### Router Advertisement

IPv6 Header Next Header: 58
Router Advertisement Prefix Length: 64 L Bit: 1 (on-link) Prefix: TN1's Global Prefix

### Packet C

IPv6 Header Next Header: 58 Source Address: TN2's Global Address Destination Address: CE- Router's Global Address
ICMPv6 Echo Request

### Procedure:

#### Part A: Link-local Address

1. TN2 transmits Packet A an Echo Request with TN2's link-local source address.
2. Observe the packets transmitted by the CE-Router.

#### Part B: Global Address, On-link Prefix covers TN2

3. TN2 transmits Packet B an Echo Request with TN2's global source address
4. Observe the packets transmitted by the CE-Router.

### Observable Results:





- *Part A*  
**Step 2:** CE-Router should send a Neighbor Solicitation with Target Address equal to TN2's link-local address, indicating that the CE-Router has successfully determined that TN2 was on-link.
- *Part B*  
**Step 4:** TN2's global address is covered by the on-link prefix. Hence, the CE-Router should consider TN2's global address as on-link. The CE-Router should send a Neighbor Solicitation with Target Address equal to TN2's global address, indicating that the CE-Router has successfully determined that TN2 was on-link.

**Possible Problems:**

- None.



## Test CERouter.2.4.2: Resolution Wait Queue

**Purpose:** Verify an IPv6 CE Router properly queues packets while waiting for address resolution of the next hop.

### References:

- [RFC 7084] – L-1
- [ND] – Section 3, Section 7.2.2

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### Packet A

IPv6 Header Next Header: 58 Source Address: TN2's Link-local Address
ICMPv6 Echo Request Sequence Number: 3

#### Packet B

IPv6 Header Next Header: 58 Source Address: TN5's Link-local Address
ICMPv6 Echo Request Sequence Number: 4

#### Neighbor Advertisement C

IPv6 Header Next Header: 58 Source Address: TN2's Link-local Address Destination Address: CE- Router's Link-local Address
Neighbor Advertisement Router flag: 0 Solicited flag: 1 Override flag: 1 Target Address: TN2's Link-local Address

#### Neighbor Advertisement D

IPv6 Header Next Header: 58
--------------------------------



Source Address: TN2's Link-local Address Destination Address: CE- Router Link-local Address
Neighbor Advertisement Router flag: 0 Solicited flag: 1 Override flag: 1 Target Address: TN2's Link-local Address

### Procedure:

#### Part A: Single Queue

1. TN2 transmits Packet A, an Echo Request, 3 times. The Sequence number is incremented each time.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits the Neighbor Advertisement C in response to any Neighbor Solicitations from the CE-Router.
4. Observe the packets transmitted by the CE-Router.

#### Part B: Multiple Queues

5. TN2 transmits Packet A, an Echo Request, 3 times. The Sequence number is incremented each time.
6. TN5 transmits Packet A, an Echo Request, 4 times. The Sequence number is incremented each time.
7. Observe the packets transmitted by the CE-Router.
8. TN2 and TN5 transmit the Neighbor Advertisement C and D respectively in response to any Neighbor Solicitations from the CE-Router.
9. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 2:** CE-Router should transmit a Neighbor Solicitation with a Target Address equal to TN2's link-local address. The CE-Router should send Echo Replies to TN2 in response to Packet A.
  - Step 4:** The Echo Replies should correspond to the last 3 Echo Requests sent by TN2 to the CE-Router, indicating successful queuing of packets while waiting for address resolution to complete. The number of Echo Replies MUST be no less than 1.
- *Part B*
  - Step 7:** CE-Router should transmit a Neighbor Solicitation with a Target Address equal to TN2's link-local address. The CE-Router should send Echo Replies to TN2 in response to Packet A. The CE-Router should transmit a Neighbor Solicitation with a Target Address equal to TN5's link-local address. The CE-Router should send Echo Replies to TN5 in response to Packet B.



**Step 9:** The Echo Replies should correspond to the last 3 Echo Requests sent by TN2 to the CE-Router, indicating successful queuing of packets while waiting for address resolution to complete. The number of Echo Replies MUST be no less than 1. The Echo Replies should correspond to the last 4 Echo Requests sent by TN5 to the CE-Router, indicating successful queuing of packets while waiting for address resolution to complete. The number of Echo Replies MUST be no less than 1.

**Possible Problems:**

- None.



## Test CERouter.2.4.3: Neighbor Solicitation Origination, Address Resolution

**Purpose:** Verify an IPv6 CE Router properly originates Neighbor Solicitations when trying to resolve the address of a neighbor.

### References:

- [RFC 7084] – L-1
- [ND] – Section 6.2.1, 7.2.2

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A	Packet B
IPv6 Header	IPv6 Header
Next Header: 58	Next Header: 58
Source Address: TN2's Link-local Address	Source Address: TN2's Global Address
Destination Address: CE-Router's Link-local Address	Destination Address: CE-Router's Global Address
ICMPv6 Echo Request	ICMPv6 Echo Request

### Procedure:

*Part A: Neighbor Solicitation Origination, Target Address Being Link-local*

1. TN2 transmits Packet A. The source address is TN2's link-local address and the destination address is the CE-Router's link-local address.
2. Observe the packets transmitted by the CE-Router. TN2 doesn't send any Neighbor Advertisement.

*Part B: Neighbor Solicitation Origination, Target Address Being Global*

3. TN2 transmits Packet B. The source address is TN2's global address and the destination address is the CE-Router's global address
4. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*

**Step 2:** In response to Packet A, the CE-Router should transmit Neighbor Solicitations with a Target Address equal to the TN2's Link-local Address at intervals of Retransmit interval advertised in the Router Advertisement on the LAN. The CE-Router MUST transmit no more than 1 Neighbor Solicitation every Retransmit interval. Each Neighbor Solicitation MUST have a Source Link-Layer Address Option. The maximum number of Neighbor Solicitations should be MAX\_MULTICAST\_SOLICIT, which should be 3.
- *Part B*

**Step 4:** In response to Packet B, the CE-Router should transmit Neighbor Solicitations with a Target Address equal to the TN2's Global Address at intervals of Retransmit interval advertised in the Router Advertisement on the LAN. The CE-Router MUST transmit no more than 1 Neighbor Solicitation every Retransmit interval. Each Neighbor Solicitation



MUST have a Source Link-Layer Address Option. The maximum number of Neighbor Solicitations should be MAX\_MULTICAST\_SOLICIT, which should be 3.

**Possible Problems:**

- None.



## Test CERouter.2.4.4: Neighbor Solicitation Origination, Reachability Confirmation

**Purpose:** Verify an IPv6 CE Router properly originates Neighbor Solicitations when trying to confirm the reachability of a neighbor.

### References:

- [RFC 7084] – L-1
- [ND] – Section 7.3

**Test Setup:** [Common Test Setup 1.1](#) performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A	Packet B
IPv6 Header	IPv6 Header
Next Header: 58	Next Header: 58
Source Address: TN2's Link-local Address	Source Address: TN2's Global Address
Destination Address: CE-Router's Link-local Address	Destination Address: CE-Router's Global Address
ICMPv6 Echo Request	ICMPv6 Echo Request

Packet C	Packet D
IPv6 Header	IPv6 Header
Next Header: 58	Next Header: 58
Source Address: TN2's Link-local Address	Source Address: TN2's Global Address
Destination Address: CE-Router's Global Address	Destination Address: CE-Router's Link-local Address
ICMPv6 Echo Request	ICMPv6 Echo Request

### Procedure:

*Part A: Neighbor Solicitation Origination, Link-local => Link-local*

1. TN2 transmit Packet A. The source address is TN1's link-local address and the destination address is the CE-Router's link-local address.
2. Observe the packets transmitted by the CE-Router. TN2 sends a Neighbor Advertisement upon receiving Neighbor Solicitations from the CE-Router.
3. Wait REACHABLE\_TIME \* MAX\_RANDOM\_FACTOR seconds so that the NCE of TN2 transit to state STALE.
4. TN2 transmits Packet A. The source address is TN2's Link-local address and the destination address is the CE-Router's Link-local address.
5. Observe the packets transmitted by the CE-Router.
6. Wait DELAY\_FIRST\_PROBE\_TIME seconds so that NCE of TN2 transit to state PROBE.
7. Observe the packets transmitted by the CE-Router.



*Part B: Neighbor Solicitation Origination, Global => Global*

8. TN2 transmit Packet B. The source address is TN2's global address and the destination address is the CE-Router's global address.
9. Observe the packets transmitted by the CE-Router. TN2 sends a Neighbor Advertisement upon receiving Neighbor Solicitations from the CE-Router.
10. Wait REACHABLE\_TIME \* MAX\_RANDOM\_FACTOR seconds so that the NCE of TN2 transit to state STALE.
11. TN2 transmits Packet A. The source address is TN2's global address and the destination address is the CE-Router's global address.
12. Observe the packets transmitted by the CE-Router.
13. Wait DELAY\_FIRST\_PROBE\_TIME seconds so that NCE of TN2 transit to state PROBE.
14. Observe the packets transmitted by the CE-Router.

*Part C: Neighbor Solicitation Origination, Link-local => Global*

15. TN2 transmit Packet B. The source address is TN2's link-local address and the destination address is the CE-Router's global address.
16. Observe the packets transmitted by the CE-Router. TN2 sends a Neighbor Advertisement upon receiving Neighbor Solicitations from the CE-Router.
17. Wait REACHABLE\_TIME \* MAX\_RANDOM\_FACTOR seconds so that the NCE of TN2 transit to state STALE.
18. TN2 transmits Packet A. The source address is TN2's link-local address and the destination address is the CE-Router's global address.
19. Observe the packets transmitted by the CE-Router.
20. Wait DELAY\_FIRST\_PROBE\_TIME seconds so that NCE of TN2 transit to state PROBE.
21. Observe the packets transmitted by the CE-Router.

*Part D: Neighbor Solicitation Origination, Global => Link-local*

22. TN2 transmit Packet B. The source address is TN2's global address and the destination address is the CE-Router's link-local address.
23. Observe the packets transmitted by the CE-Router. TN2 sends a Neighbor Advertisement upon receiving Neighbor Solicitations from the CE-Router.
24. Wait REACHABLE\_TIME \* MAX\_RANDOM\_FACTOR seconds so that the NCE of TN2 transit to state STALE.
25. TN2 transmits Packet A. The source address is TN2's global address and the destination address is the CE-Router's link-local address.
26. Observe the packets transmitted by the CE-Router.
27. Wait DELAY\_FIRST\_PROBE\_TIME seconds so that NCE of TN2 transit to state PROBE.
28. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*

**Step 2:** In response to Packet A, the CE-Router should transmit Neighbor Solicitations with a Target Address equal to the TN2's link-local Address at intervals of 1 second. The CE-Router MUST transmit no more than 1 Neighbor Solicitation every 1 second. Once a Neighbor Advertisement is received from TN2, the CE-Router should send an Echo Reply in response to Packet A. The NCE of TN2 is in state REACHABLE.

**Step 5:** In response to Packet A, the CE-Router should transmit an Echo Reply.

**Step 7:** The CE-Router should transmit Neighbor Solicitations with the CE-Router's link-local address being the source address and TN2's link-local address as the destination





address. The maximum number of Neighbor Solicitations that the CE-Router can transmit is 3.

- *Part B*

**Step 9:** In response to Packet B, the CE-Router should transmit Neighbor Solicitations with a Target Address equal to the TN2's global Address at intervals of 1 second. The CE-Router MUST transmit no more than 1 Neighbor Solicitation every 1 second. Once a Neighbor Advertisement is received from TN2, the CE-Router should send an Echo Reply in response to Packet B. The NCE of TN2 is in state REACHABLE.

**Step 12:** In response to Packet B, the CE-Router should transmit an Echo Reply.

**Step 14:** The CE-Router should transmit Neighbor Solicitations with the CE-Router's global or link-local address being the source address and TN2's global address as the destination address. The maximum number of Neighbor Solicitations that the CE-Router can transmit is 3.

- *Part C*

**Step 16:** In response to Packet C, the CE-Router should transmit Neighbor Solicitations with a Target Address equal to the TN2's link-local Address at intervals of 1 second. The CE-Router MUST transmit no more than 1 Neighbor Solicitation every 1 second. Once a Neighbor Advertisement is received from TN2, the CE-Router should send an Echo Reply in response to Packet C. The NCE of TN2 is in state REACHABLE.

**Step 19:** In response to Packet C, the CE-Router should transmit an Echo Reply.

**Step 21:** The CE-Router should transmit Neighbor Solicitations with the CE-Router's global or link-local address being the source address and TN2's link-local address as the destination address. The maximum number of Neighbor Solicitations that the CE-Router can transmit is 3.

- *Part D*

**Step 23:** In response to Packet D, the CE-Router should transmit Neighbor Solicitations with a Target Address equal to the TN2's global Address at intervals of 1 second. The CE-Router MUST transmit no more than 1 Neighbor Solicitation every 1 second. Once a Neighbor Advertisement is received from TN2, the CE-Router should send an Echo Reply in response to Packet D. The NCE of TN2 is in state REACHABLE.

**Step 26:** In response to Packet D, the CE-Router should transmit an Echo Reply.

**Step 28:** The CE-Router should transmit Neighbor Solicitations with the CE-Router's global or link-local address being the source address and TN2's global address as the destination address. The maximum number of Neighbor Solicitations that the CE-Router can transmit is 3.

**Possible Problems:**

- None.



## Test CERouter.2.4.5: Invalid Neighbor Solicitation Handling

**Purpose:** Verify an IPv6 CE Router properly handles the receipt of an invalid Neighbor Solicitation.

### References:

- [RFC 7084] – L-1
- [ND] – Section 7.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Neighbor Sol. A	Neighbor Sol. B	Neighbor Sol. C
IPv6 Header Next Header: 58 Source Address: TN2's Link-local Address Destination Address: CE-Router's Link- local Address Hop Limit: 255	IPv6 Header Next Header: 58 Source Address: Unspecified Address Destination Address: CE-Router's Link-local Address Hop Limit: 255	IPv6 Header Next Header: 58 Source Address: Unspecified Address Destination Address: CE-Router's Solicited- node Multicast Address Hop Limit: 255
Neighbor Sol. Target Address: CE- Router's Link-local Address Source Link-layer Address: TN2's Link- layer address	Neighbor Sol. Target Address: CE- Router's Link-local Address	Neighbor Sol. Target Address: CE- Router's Link-local Address Source Link-layer Address: TN2's Link- layer address

### Procedure:

#### Part A: Invalid Target Address

1. TN2 transmits Neighbor Solicitation A with the Target Address set to the All Nodes Multicast.
2. Observe the packets transmitted by the CE-Router.

#### Part B: Invalid Destination Address

3. TN2 transmits Neighbor Solicitation B.
4. Observe the packets transmitted by the CE-Router.

#### Part C: Invalid Source Link-layer Address Option

5. TN2 transmits Neighbor Solicitation C.
6. Observe the packets transmitted by the CE-Router.

#### Part D: Invalid Hop Limit

7. TN2 transmits Neighbor Solicitation A with the Hop Limit set to 254.
8. Observe the packets transmitted by the CE-Router.

#### Part E: Invalid Checksum

9. TN2 transmits Neighbor Solicitation A with the ICMP checksum set to be invalid.
10. Observe the packets transmitted by the CE-Router.

#### Part F: Invalid ICMP code



11. TN2 transmits Neighbor Solicitation A with the ICMP Code set to 1.
12. Observe the packets transmitted by the CE-Router.

*Part G: Invalid ICMP Length*

13. TN2 transmits Neighbor Solicitation A with the ICMP Length set to 16.
14. Observe the packets transmitted by the CE-Router.

*Part H: Option of Length 0*

15. TN2 transmits Neighbor Solicitation A with an Option Length set to 0.
16. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*  
**Step 2:** CE-Router must not transmit any packets corresponding to Neighbor Solicitation A.
- *Part B*  
**Step 4:** CE-Router must not transmit any packets corresponding to Neighbor Solicitation B.
- *Part C*  
**Step 6:** CE-Router must not transmit any packets corresponding to Neighbor Solicitation C.
- *Part D*  
**Step 8:** CE-Router must not transmit any packets corresponding to Neighbor Solicitation A.
- *Part E*  
**Step 2:** CE-Router must not transmit any packets corresponding to Neighbor Solicitation A.
- *Part F*  
**Step 2:** CE-Router must not transmit any packets corresponding to Neighbor Solicitation A.
- *Part G*  
**Step 2:** CE-Router must not transmit any packets corresponding to Neighbor Solicitation A.
- *Part H*  
**Step 2:** CE-Router must not transmit any packets corresponding to Neighbor Solicitation A.

**Possible Problems:**

- None.



## Test CERouter.2.4.6: Neighbor Solicitation Processing, NCE State INCOMPLETE

**Purpose:** Verify an IPv6 CE Router properly updates its neighbor cache upon receipt of neighbor solicitations when the NCE of the neighbor is in state INCOMPLETE.

### References:

- [RFC 7084] – L-1
- [ND] – Section 7.2.3 and 7.2.4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A

IPv6 Header Next Header: 58 Source Address: TN2's Link-local Address Destination Address: CE-Router's Link-local Address ICMPv6 Echo Request
--

Neighbor Solicitation B	Neighbor Solicitation C
IPv6 Header Next Header: 58 Destination Address: CE-Router's Link-local Address Source Address: TN2's Link-local Address	IPv6 Header Next Header: 58 Destination Address: CE-Router's Solicited-node Multicast Link-local Address Source Address: TN2's Link-local Address
Neighbor Solicitation Target Address: CE-Router's Link-local Address Source Link-Layer Address: TN2's Ethernet address	Neighbor Solicitation Target Address: CE-Router's Link-local Address Source Link-Layer Address: TN2's Ethernet address

### Procedure:

#### Part A: Unicast Neighbor Solicitation

1. TN2 transmits Echo Request A.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits Neighbor Solicitation B.
4. Observe the packets transmitted by the CE-Router.
5. TN2 transmits an Echo Request to the CE-Router.
6. Observe the packets transmitted by the CE-Router.



*Part B: Multicast Neighbor Cache*

7. TN2 transmits Echo Request A.
8. Observe the packets transmitted by the CE-Router.
9. TN2 transmits Neighbor Solicitation C.
10. Observe the packets transmitted by the CE-Router.
11. TN2 transmits an Echo Request to the CE-Router.
12. Observe the packets transmitted by the CE-Router.

*Part C: Unicast Neighbor Solicitation without SLL*

13. TN2 transmits Echo Request A.
14. Observe the packets transmitted by the CE-Router.
15. TN2 transmits Neighbor Solicitation B with the Source Link-layer Address option.
16. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*
  - Step 2:** CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.
  - Step 4:** After receiving TN2's Neighbor Solicitation, the CE-Router should send its queued Echo Reply to TN2. The CE-Router should then update the NCE of TN2 to state **STALE** and update its link-layer address for TN2 accordingly. The CE-Router should reply to Neighbor Solicitation B by sending a Neighbor Advertisement.
  - Step 6:** The CE-Router should respond to the Echo Request by sending an Echo Reply and set the state of the Entry to **DELAY**. After **DELAY\_FIRST\_PROBE\_TIME**, the CE-Router should send a Unicast Neighbor Solicitation to TN2.
- *Part B*
  - Step 8:** CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.
  - Step 10:** After receiving TN2's Neighbor Solicitation, the CE-Router should send its queued Echo Reply to TN2. The CE-Router should then update the NCE of TN2 to state **STALE** and update its link-layer address for TN2 accordingly. The CE-Router should reply to Neighbor Solicitation B by sending a Neighbor Advertisement.
  - Step 12:** The CE-Router should respond to the Echo Request by sending an Echo Reply and set the state of the Entry to **DELAY**. After **DELAY\_FIRST\_PROBE\_TIME**, the CE-Router should send a Unicast Neighbor Solicitation to TN2.
- *Part C*
  - Step 14:** CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.
  - Step 16:** After receiving TN2's Neighbor Solicitation, the CE-Router should not update the NCE of TN2 and remain in state **INCOMPLETE**.

**Possible Problems:**

- None.



## Test CERouter.2.4.7: Neighbor Solicitation Processing, NCE State REACHABLE

**Purpose:** Verify an IPv6 CE Router properly updates its neighbor cache upon receipt of neighbor solicitations when the NCE of the neighbor is in state REACHABLE.

### References:

- [RFC 7084] – L-1
- [ND] – Section 7.2.3 and 7.2.4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### Packet A

IPv6 Header Next Header: 58 Source Address: TN2's Link-local Address Destination Address: CE-Router's Link-local Address ICMPv6 Echo Request
--

#### Neighbor Advertisement B

IPv6 Header Next Header: 58 Source Address: TN2's Link-local Address Destination Address: CE-Router's Link-local Address
Neighbor Advertisement Router flag: 0 Solicited flag: 1 Override flag: 1 Target Address: TN1's Link-local Address

#### Neighbor Solicitation C

IPv6 Header Next Header: 58 Destination Address: CE-Router's Link-local Address Source Address: TN2's Link-local Address Neighbor Solicitation
--

#### Neighbor Solicitation D

Ipv6 Header Next Header: 58 Destination Address: CE-Router's Solicited-node Multicast Link-local Address Source Address: TN2's Link-local Address Neighbor Solicitation
---



Target Address: CE-Router's Link-local Address Source Link-Layer Address: TN2's Ethernet address	Target Address: CE-Router's Link-local Address Source Link-Layer Address: TN2's Ethernet address
---	---

**Procedure:**

*Part A: Unicast Neighbor Solicitation with the same SLLA*

1. TN2 transmits Echo Request A.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a solicited Neighbor Advertisement B.
4. Observe the packets transmitted by the CE-Router.
5. TN2 transmits Echo Request A.
6. Observe the packets transmitted by the CE-Router.
7. TN2 transmits Neighbor Solicitation C.
8. TN2 transmits Echo Request A.
9. Observe the packets transmitted by the CE-Router.

*Part B: Unicast Neighbor Solicitation with a different SLLA*

10. TN2 transmits Echo Request A.
11. Observe the packets transmitted by the CE-Router.
12. TN2 transmits a solicited Neighbor Advertisement B.
13. Observe the packets transmitted by the CE-Router.
14. TN2 transmits Echo Request A.
15. Observe the packets transmitted by the CE-Router.
16. TN2 transmits Neighbor Solicitation C with a different address as the Source Link-layer Address.
17. TN2 transmits Echo Request A.
18. Observe the packets transmitted by the CE-Router.

*Part C: Multicast Neighbor Solicitation with the same SLLA*

19. TN2 transmits Echo Request A.
20. Observe the packets transmitted by the CE-Router.
21. TN2 transmits a solicited Neighbor Advertisement B.
22. Observe the packets transmitted by the CE-Router.
23. TN2 transmits Echo Request A.
24. Observe the packets transmitted by the CE-Router.
25. TN2 transmits Neighbor Solicitation D.
26. TN2 transmits Echo Request A.
27. Observe the packets transmitted by the CE-Router.

*Part D: Multicast Neighbor Solicitation with a different SLLA*

28. TN2 transmits Echo Request A.
29. Observe the packets transmitted by the CE-Router.
30. TN2 transmits a solicited Neighbor Advertisement B.
31. Observe the packets transmitted by the CE-Router.
32. TN2 transmits Echo Request A.
33. Observe the packets transmitted by the CE-Router.
34. TN2 transmits Neighbor Solicitation D with a different address as the Source Link-layer Address.
35. TN2 transmits Echo Request A.



36. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*

**Step 2:** CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.

**Step 4:** After receiving TN2's Neighbor Advertisement, the CE-Router should send its queued Echo Reply to TN2. The CE-Router should then update the NCE of TN2 to state **REACHABLE** and update its link-layer address for TN2 accordingly.

**Step 6:** Because the CE-Router is in state **REACHABLE**, after receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After `DELAY_FIRST_PROBE_TIME`, the CE-Router should not send a unicast Neighbor Solicitation to TN2.

**Step 9:** The CE-Router should not update the NCE of TN2, the CE-Router should reply to Neighbor Solicitation C by sending a Neighbor Advertisement. After responding to the Neighbor Solicitation, the CE-Router should respond to the Echo Request by sending an Echo Reply and should stay in state **REACHABLE**. After `DELAY_FIRST_PROBE_TIME`, the CE-Router should not send a unicast Neighbor Solicitation to TN2.

- *Part B*

**Step 11:** CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.

**Step 13:** After receiving TN2's Neighbor Advertisement, the CE-Router should send its queued Echo Reply to TN2. The CE-Router should then update the NCE of TN2 to state **REACHABLE** and update its link-layer address for TN2 accordingly.

**Step 15:** Because the CE-Router is in state **REACHABLE**, after receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After `DELAY_FIRST_PROBE_TIME`, the CE-Router should not send a unicast Neighbor Solicitation to TN2.

**Step 18:** CE-Router should update the NCE of TN2 to state **STALE** and update TN2's Link-layer address to its new Link-layer address from the received Neighbor Solicitation C. The CE-Router should reply to Neighbor Solicitation C by sending a Neighbor Advertisement. After responding to the Neighbor Solicitation, the CE-Router should respond to the Echo Request by sending an Echo Reply and set the state of the Entry to **DELAY**. After `DELAY_FIRST_PROBE_TIME`, the CE-Router should send a unicast Neighbor Solicitation to TN2 with the Target set the new Link-Layer address of TN2.

- *Part C*

**Step 20:** CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.

**Step 22:** After receiving TN2's Neighbor Advertisement, the CE-Router should send its queued Echo Reply to TN2. The CE-Router should then update the NCE of TN2 to state **REACHABLE** and update its link-layer address for TN2 accordingly.

**Step 24:** Because the CE-Router is in state **REACHABLE**, after receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After





DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TN2.

**Step 27:** The CE-Router should not update the NCE of TN2, the CE-Router should reply to Neighbor Solicitation D by sending a Neighbor Advertisement. After responding to the Neighbor Solicitation, the CE-Router should respond to the Echo Request by sending an Echo Reply and should stay in state **REACHABLE**. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TN2.

- *Part D*

**Step 29:** CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.

**Step 31:** After receiving TN2's Neighbor Advertisement, the CE-Router should send its queued Echo Reply to TN2. The CE-Router should then update the NCE of TN2 to state **REACHABLE** and update its link-layer address for TN2 accordingly.

**Step 33:** Because the CE-Router is in state **REACHABLE**, after receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TN2.

**Step 36:** CE-Router should update the NCE of TN2 to state **STALE** and update TN2's Link-layer address to its new Link-layer address from the received Neighbor Solicitation D. The CE-Router should reply to Neighbor Solicitation D by sending a Neighbor Advertisement. After responding to the Neighbor Solicitation, the CE-Router should respond to the Echo Request by sending an Echo Reply and set the state of the Entry to **DELAY**. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should send a unicast Neighbor Solicitation to TN2 with the Target set to the new Link-Layer address of TN2.

**Possible Problems:**

- None.



## Test CERouter.2.4.8: Neighbor Solicitation Processing, NCE State STALE

**Purpose:** Verify an IPv6 CE Router properly updates its neighbor cache upon receipt of neighbor solicitations when the NCE of the neighbor is in state STALE.

### References:

- [RFC 7084] – L-1
- [ND] – Section 7.2.3 and 7.2.4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### Packet A

IPv6 Header Next Header: 58 Source Address: TN2's Link- local Address Destination Address: CE- Router's Link-local Address
ICMPv6 Echo Request

#### Neighbor Advertisement B

IPv6 Header Next Header: 58 Source Address: TN2's Link-local Address Destination Address: CE- Router's Link-local Address
Neighbor Advertisement Router flag: 0 Solicited flag: 1 Override flag: 1 Target Address: TN2's Link- local Address

#### Neighbor Solicitation C

IPv6 Header Next Header: 58 Destination Address: CE- Router's Link-local Address Source Address: TN2's Link-local Address
Neighbor Solicitation

#### Neighbor Solicitation D

Ipv6 Header Next Header: 58 Destination Address: CE- Router's Solicited-node Multicast Link-local Address Source Address: TN2's Link-local Address
Neighbor Solicitation



Target Address: CE-Router's Link-local Address Source Link-Layer Address: TN2's Ethernet address	Target Address: CE-Router's Link-local Address Source Link-Layer Address: TN2's Ethernet address
---	---

**Procedure:**

*Part A: Unicast Neighbor Solicitation with the same SLLA*

1. TN2 transmits Echo Request A.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a solicited Neighbor Advertisement B.
4. Observe the packets transmitted by the CE-Router.
5. TN2 transmits Echo Request A.
6. Observe the packets transmitted by the CE-Router.
7. Wait (REACHABLE\_TIME \* MAX\_RANDOM\_FACTOR) seconds.
8. Observe the packets transmitted by the CE-Router.
9. TN2 transmits Neighbor Solicitation C.
10. TN2 transmits an Echo Request to the CE-Router.
11. Observe the packets transmitted by the CE-Router.

*Part B: Unicast Neighbor Solicitation with a different SLLA*

12. TN2 transmits Echo Request A.
13. Observe the packets transmitted by the CE-Router.
14. TN2 transmits a solicited Neighbor Advertisement B.
15. Observe the packets transmitted by the CE-Router.
16. TN2 transmits Echo Request A.
17. Observe the packets transmitted by the CE-Router.
18. Wait (REACHABLE\_TIME \* MAX\_RANDOM\_FACTOR) seconds.
19. Observe the packets transmitted by the CE-Router.
20. TN2 transmits Neighbor Solicitation C with a different address as the Source Link-layer Address.
21. TN2 transmits an Echo Request to the CE-Router.
22. Observe the packets transmitted by the CE-Router.

*Part C: Multicast Neighbor Solicitation with the same SLLA*

23. TN2 transmits Echo Request A.
24. Observe the packets transmitted by the CE-Router.
25. TN2 transmits a solicited Neighbor Advertisement B.
26. Observe the packets transmitted by the CE-Router.
27. TN2 transmits Echo Request A.
28. Observe the packets transmitted by the CE-Router.
29. Wait (REACHABLE\_TIME \* MAX\_RANDOM\_FACTOR) seconds.
30. Observe the packets transmitted by the CE-Router.
31. TN2 transmits Neighbor Solicitation D.
32. TN2 transmits an Echo Request to the CE-Router.
33. Observe the packets transmitted by the CE-Router.

*Part D: Multicast Neighbor Solicitation with a different SLLA*

34. TN2 transmits Echo Request A.
35. Observe the packets transmitted by the CE-Router.



36. TN2 transmits a solicited Neighbor Advertisement B.
37. Observe the packets transmitted by the CE-Router.
38. TN2 transmits Echo Request A.
39. Observe the packets transmitted by the CE-Router.
40. Wait ( $REACHABLE\_TIME * MAX\_RANDOM\_FACTOR$ ) seconds.
41. Observe the packets transmitted by the CE-Router.
42. TN2 transmits Neighbor Solicitation D with a different address as the Source Link-layer Address.
43. TN2 transmits an Echo Request to the CE-Router.
44. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*

**Step 2:** CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.

**Step 4:** After receiving TN2's Neighbor Advertisement, the CE-Router should send its queued Echo Reply to TN2. The CE-Router should then update the NCE of TN2 to state **REACHABLE** and update its link-layer address for TN2 accordingly.

**Step 6:** Because the CE-Router is in state **REACHABLE**, after receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After  $DELAY\_FIRST\_PROBE\_TIME$ , the CE-Router should not send a unicast Neighbor Solicitation to TN2.

**Step 8:** The CE-Router should update the NCE of TN2 to state **STALE**.

**Step 11:** CE-Router should not update the NCE of TN2 and should stay in state **STALE**. The CE-Router should reply to the Neighbor Solicitation by sending a Neighbor Advertisement. After responding to the Neighbor Solicitation, the CE-Router should respond to the Echo Request by sending an Echo Reply and set the state of the TN2's Entry to **DELAY**. After  $DELAY\_FIRST\_PROBE\_TIME$ , the CE-Router should send a unicast Neighbor Solicitation to TN2.

- *Part B*

**Step 13:** CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.

**Step 15:** After receiving TN2's Neighbor Advertisement, the CE-Router should send its queued Echo Reply to TN2. The CE-Router should then update the NCE of TN2 to state **REACHABLE** and update its link-layer address for TN2 accordingly.

**Step 17:** Because the CE-Router is in state **REACHABLE**, after receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After  $DELAY\_FIRST\_PROBE\_TIME$ , the CE-Router should not send a unicast Neighbor Solicitation to TN2.

**Step 19:** CE-Router should update the NCE of TN2 to state **STALE**.

**Step 22:** CE-Router should update TN2's Link-layer address to its new link-layer address from the received Neighbor Solicitation C. The CE-Router should not update the NCE of TN2 and should stay in state **STALE**. The CE-Router should reply to the Neighbor Solicitation by sending a Neighbor Advertisement to TN2's new Link-Layer address. After responding to the Neighbor Solicitation, the CE-Router should respond to the Echo Request by sending an Echo Reply and set the state of the TN2's Entry to **DELAY**. After



DELAY\_FIRST\_PROBE\_TIME, the CE-Router should send a unicast Neighbor Solicitation to TN2 using the new link-layer address as the Target.

- *Part C*

**Step 24:** CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.

**Step 26:** After receiving TN2's Neighbor Advertisement, the CE-Router should send its queued Echo Reply to TN2. The CE-Router should then update the NCE of TN2 to state **REACHABLE** and update its link-layer address for TN2 accordingly.

**Step 28:** Because the CE-Router is in state **REACHABLE**, after receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TN2.

**Step 30:** The CE-Router should update the NCE of TN2 to state **STALE**.

**Step 33:** CE-Router should not update the NCE of TN2 and should stay in state **STALE**. The CE-Router should reply to the Neighbor Solicitation by sending a Neighbor Advertisement. After responding to the Neighbor Solicitation, the CE-Router should respond to the Echo Request by sending an Echo Reply and set the state of the TN2's Entry to **DELAY**. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should send a unicast Neighbor Solicitation to TN2.

- *Part D*

**Step 35:** CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.

**Step 37:** After receiving TN2's Neighbor Advertisement, the CE-Router should send its queued Echo Reply to TN2. The CE-Router should then update the NCE of TN2 to state **REACHABLE** and update its link-layer address for TN2 accordingly.

**Step 39:** Because the CE-Router is in state **REACHABLE**, after receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TN2.

**Step 41:** CE-Router should update the NCE of TN2 to state **STALE**.

**Step 44:** CE-Router should update TN2's Link-layer address to its new link-layer address from the received Neighbor Solicitation C. The CE-Router should not update the NCE of TN2 and should stay in state **STALE**. The CE-Router should reply to the Neighbor Solicitation by sending a Neighbor Advertisement to TN2's new Link-Layer address. After responding to the Neighbor Solicitation, the CE-Router should respond to the Echo Request by sending an Echo Reply and set the state of the TN2's Entry to **DELAY**. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should send a unicast Neighbor Solicitation to TN2 using the new link-layer address as the Target.

### Possible Problems:

- None.



## Test CERouter.2.4.9: Neighbor Solicitation Processing, NCE State PROBE

**Purpose:** Verify an IPv6 CE Router properly updates its neighbor cache upon receipt of neighbor solicitations when the NCE of the neighbor is in state PROBE.

### References:

- [RFC 7084] – L-1
- [ND] – Section 7.2.3 and 7.2.4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### Packet A

IPv6 Header Next Header: 58 Source Address: TN2's Link- local Address Destination Address: CE- Router's Link-local Address
ICMPv6 Echo Request

#### Neighbor Advertisement B

IPv6 Header Next Header: 58 Source Address: TN2's Link-local Address Destination Address: CE- Router's Link-local Address
Neighbor Advertisement Router flag: 0 Solicited flag: 0 Override flag: 1 Target Address: TN2's Link- local Address

#### Neighbor Solicitation C

IPv6 Header Next Header: 58 Destination Address: CE- Router's Link-local Address Source Address: TN2's Link-local Address
Neighbor Solicitation

#### Neighbor Solicitation D

Ipv6 Header Next Header: 58 Destination Address: CE- Router's Solicited-node Multicast Link-local Address Source Address: TN2's Link-local Address
Neighbor Solicitation



Target Address: CE-Router's Link-local Address Source Link-Layer Address: TN2's Ethernet address	Target Address: CE-Router's Link-local Address Source Link-Layer Address: TN2's Ethernet address
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**Procedure:**

*Part A: Unicast Neighbor Solicitation with the same SLLA*

1. TN2 transmits Packet A to the CE-Router.
2. TN2 transmits Neighbor Advertisement B to the CE-Router after receiving any Neighbor Solicitations from the CE-Router.
3. Observe the packets transmitted by the CE-Router.
4. Wait (DELAY\_FIRST\_PROBE\_TIME) seconds.
5. Observe the packets transmitted by the CE-Router.
6. TN2 transmits Neighbor Solicitation C.
7. TN2 transmits an Echo Request to the CE-Router.
8. Observe the packets transmitted by the CE-Router.

*Part B: Unicast Neighbor Solicitation with a different SLLA*

9. TN2 transmits Packet A to the CE-Router.
10. TN2 transmits Neighbor Advertisement B to the CE-Router after receiving any Neighbor Solicitations from the CE-Router.
11. Observe the packets transmitted by the CE-Router.
12. Wait (DELAY\_FIRST\_PROBE\_TIME) seconds.
13. Observe the packets transmitted by the CE-Router.
14. TN2 transmits Neighbor Solicitation C with a different address as the Source Link-layer Address.
15. TN2 transmits an Echo Request to the CE-Router.
16. Observe the packets transmitted by the CE-Router.

*Part C: Multicast Neighbor Solicitation with the same SLLA*

17. TN2 transmits Packet A to the CE-Router.
18. TN2 transmits Neighbor Advertisement B to the CE-Router after receiving any Neighbor Solicitations from the CE-Router.
19. Observe the packets transmitted by the CE-Router.
20. Wait (DELAY\_FIRST\_PROBE\_TIME) seconds.
21. Observe the packets transmitted by the CE-Router.
22. TN2 transmits Neighbor Solicitation D.
23. TN2 transmits an Echo Request to the CE-Router.
24. Observe the packets transmitted by the CE-Router.

*Part D: Multicast Neighbor Solicitation with a different SLLA*

25. TN2 transmits Packet A to the CE-Router.
26. TN2 transmits Neighbor Advertisement B to the CE-Router after receiving any Neighbor Solicitations from the CE-Router.
27. Observe the packets transmitted by the CE-Router.
28. Wait (DELAY\_FIRST\_PROBE\_TIME) seconds.
29. Observe the packets transmitted by the CE-Router.
30. TN2 transmits Neighbor Solicitation D with a different address as the Source Link-layer address.
31. TN2 transmits an Echo Request to the CE-Router.



32. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 3:** CE-Router should update the NCE of TN2 to state **STALE**. After receiving the Echo Request from TN2, the CE-Router should send a Reply and enter state **DELAY**.
  - Step 5:** After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should transition to state **PROBE** by sending a unicast Neighbor Solicitation to TN2.
  - Step 8:** The CE-Router should not update the state of TN2's NCE after sending its queued Neighbor Advertisement and Echo Reply and should stay in state **PROBE**. The CE-Router should retransmit its unicast Neighbor Solicitation to TN2.
- *Part B*
  - Step 11:** CE-Router should update the NCE of TN2 to state **STALE**. After receiving the Echo Request from TN2, the CE-Router should send a Reply and enter state **DELAY**.
  - Step 13:** After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should transition to state **PROBE** by sending a unicast Neighbor Solicitation to TN2.
  - Step 16:** The CE-Router should update TN2's Link-layer address to its new link-layer address from the received Neighbor Solicitation C and MUST update the state of TN2's NCE to **STALE**. The CE-Router should reply to the Neighbor Solicitation by sending a Neighbor Advertisement using TN2's new Link-Layer address. After responding to the Neighbor Solicitation, the CE-Router should respond to the Echo Request by sending an Echo Reply and set the state of the TN2's Entry to **DELAY**. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should send a unicast Neighbor Solicitation to TN2 using the new Link-layer address as the Target.
- *Part C*
  - Step 19:** CE-Router should update the NCE of TN2 to state **STALE**. After receiving the Echo Request from TN2, the CE-Router should send a Reply and enter state **DELAY**.
  - Step 21:** After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should transition to state **PROBE** by sending a unicast Neighbor Solicitation to TN2.
  - Step 24:** The CE-Router should not update the state of TN2's NCE after sending its queued Neighbor Advertisement and Echo Reply and should stay in state **PROBE**. The CE-Router should retransmit its unicast Neighbor Solicitation to TN2.
- *Part D*
  - Step 27:** CE-Router should update the NCE of TN2 to state **STALE**. After receiving the Echo Request from TN2, the CE-Router should send a Reply and enter state **DELAY**.
  - Step 29:** After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should transition to state **PROBE** by sending a unicast Neighbor Solicitation to TN2.
  - Step 32:** The CE-Router should update TN2's Link-layer address to its new link-layer address from the received Neighbor Solicitation C and MUST update the state of TN2's NCE to **STALE**. The CE-Router should reply to the Neighbor Solicitation by sending a Neighbor Advertisement using TN2's new Link-Layer address. After responding to the Neighbor Solicitation, the CE-Router should respond to the Echo Request by sending an Echo Reply and set the state of the TN2's Entry to **DELAY**. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should send a unicast Neighbor Solicitation to TN2 using the new Link-layer address as the Target.

### Possible Problems:





- None.



## Test CERouter.2.4.10: Invalid Neighbor Advertisement Handling

**Purpose:** Verify an IPv6 CE Router properly handles the receipt of an invalid Neighbor Advertisement.

### References:

- [RFC 7084] – L-1
- [ND] – Section 7.1.2

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Neighbor Advertisement A
IPv6 Header Next Header: 58 Source Address: TN2's Link-local Address Destination Address: all-nodes multicast address
Neighbor Advertisement ICMP Code: 0 ICMP Checksum: Valid Router flag: 0 Solicited flag: 0 Override flag: 1 Target Address: TN2's link- local address TLLOPT: TN2's MAC address

### Procedure:

*Part A: NUT receives invalid NA (Solicited Flag == 1)*

1. TN2 transmits an Echo Request to the NUT.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits Neighbor Advertisement A with the Solicited flag set to 1.
4. Observe the packets transmitted by the CE-Router.

*Part B: NUT receives invalid NA (Hop Limit == 254)*

5. TN2 transmits an Echo Request to the NUT.
6. Observe the packets transmitted by the CE-Router.
7. TN2 transmits Neighbor Advertisement A with the Hop Limit set to 254.
8. Observe the packets transmitted by the CE-Router.

*Part C: NUT receives invalid NA (Invalid Checksum)*

9. TN2 transmits an Echo Request to the NUT.
10. Observe the packets transmitted by the CE-Router.
11. TN2 transmits Neighbor Advertisement A with an invalid checksum.
12. Observe the packets transmitted by the CE-Router.



*Part D: NUT receives invalid NA (ICMP code != zero)*

13. TN2 transmits an Echo Request to the NUT.
14. Observe the packets transmitted by the CE-Router.
15. TN2 transmits Neighbor Advertisement A with the ICMP code set to 1.
16. Observe the packets transmitted by the CE-Router.

*Part E: NUT receives invalid NA (ICMP length < 24 octets)*

17. TN2 transmits an Echo Request to the NUT.
18. Observe the packets transmitted by the CE-Router.
19. TN2 transmits Neighbor Advertisement A with the ICMP length set to 16.
20. Observe the packets transmitted by the CE-Router.

*Part F: NUT receives invalid NA (target == multicast address)*

21. TN2 transmits an Echo Request to the NUT.
22. Observe the packets transmitted by the CE-Router.
23. TN2 transmits Neighbor Advertisement A with the Target Address set to the solicited multicast of TN1's link-local address.
24. Observe the packets transmitted by the CE-Router.

*Part G: NUT receives invalid NA (option length == zero)*

25. TN2 transmits an Echo Request to the NUT.
26. Observe the packets transmitted by the CE-Router.
27. TN2 transmits Neighbor Advertisement A with the Option length set to 0.
28. Observe the packets transmitted by the CE-Router.

#### **Observable Results:**

- *Part A*
  - Step 2:** CE-Router transmits a Neighbor Solicitation to TN2's solicited-node multicast address.
  - Step 4:** CE-Router transmits a Neighbor Solicitation to TN2's solicited-node multicast address.
- *Part B*
  - Step 6:** CE-Router transmits a Neighbor Solicitation to TN2's solicited-node multicast address.
  - Step 8:** CE-Router ignores the Neighbor Advertisement sent by TN2 and should continue to transmit Neighbor Solicitations to TN2's solicited-node multicast address.
- *Part C*
  - Step 10:** CE-Router transmits a Neighbor Solicitation to TN2's solicited-node multicast address.
  - Step 12:** CE-Router ignores the Neighbor Advertisement sent by TN2 and should continue to transmit Neighbor Solicitations to TN2's solicited-node multicast address.
- *Part D*
  - Step 14:** CE-Router transmits a Neighbor Solicitation to TN2's solicited-node multicast address.
  - Step 16:** CE-Router ignores the Neighbor Advertisement sent by TN2 and should continue to transmit Neighbor Solicitations to TN2's solicited-node multicast address.
- *Part E*
  - Step 18:** CE-Router transmits a Neighbor Solicitation to TN2's solicited-node multicast address.



**Step 20:** CE-Router ignores the Neighbor Advertisement sent by TN2 and should continue to transmit Neighbor Solicitations to TN2's solicited-node multicast address.

- *Part F*

**Step 22:** CE-Router transmits a Neighbor Solicitation to TN2's solicited-node multicast address.

**Step 24:** CE-Router ignores the Neighbor Advertisement sent by TN2 and should continue to transmit Neighbor Solicitations to TN2's solicited-node multicast address.

- *Part G*

**Step 26:** CE-Router transmits a Neighbor Solicitation to TN2's solicited-node multicast address.

**Step 28:** CE-Router ignores the Neighbor Advertisement sent by TN2 and should continue to transmit Neighbor Solicitations to TN2's solicited-node multicast address.

**Possible Problems:**

- None.



## Test CERouter.2.4.11: Neighbor Advertisement Processing, NCE State INCOMPLETE

**Purpose:** Verify an IPv6 CE Router properly updates its neighbor cache from the INCOMPLETE state upon receipt of a Neighbor Advertisement.

### References:

- [RFC 7084] – L-1
- [ND] – Section 7.2.5

Solicited flag	Override flag	New State	Update Link-Layer Address
set	set	REACHABLE	yes
set	clear	REACHABLE	yes
clear	set	STALE	yes
clear	clear	STALE	yes

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### Packet A

IPv6 Header Next Header: 58 Source Address: TN2's Link-local Address Destination Address: CE-Router's Link-local Address ICMPv6 Echo Request
--

Neighbor Adv. B	Neighbor Adv. C	Neighbor Adv. D	Neighbor Adv. E
IPv6 Header Next Header: 58	IPv6 Header Next Header: 58	IPv6 Header Next Header: 58	IPv6 Header Next Header: 58
Neighbor Adv. Solicited flag: 1 Override flag: 1	Neighbor Adv. Solicited flag: 1 Override flag: 0	Neighbor Adv. Solicited flag: 0 Override flag: 1	Neighbor Adv. Solicited flag: 0 Override flag: 0

### Procedure:

*Part A: Receiving NA with S = 1 and O = 1*

1. TN2 transmits Packet A.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits Neighbor Advertisement B.
4. Observe the packets transmitted by the CE-Router.
5. TN2 transmits an Echo Request.
6. Observe the packets transmitted by the CE-Router.

*Part B: Receiving NA with S = 1 and O = 0*



7. TN2 transmits Packet A.
8. Observe the packets transmitted by the CE-Router.
9. TN2 transmits Neighbor Advertisement C.
10. Observe the packets transmitted by the CE-Router.
11. TN2 transmits an Echo Request.
12. Observe the packets transmitted by the CE-Router.

*Part C: Receiving NA with S = 0 and O = 1*

13. TN2 transmits Packet A.
14. Observe the packets transmitted by the CE-Router.
15. TN2 transmits Neighbor Advertisement D.
16. Observe the packets transmitted by the CE-Router.

*Part D: Receiving NA with S = 0 and O = 0*

17. TN2 transmits Packet A.
18. Observe the packets transmitted by the CE-Router.
19. TN2 transmits Neighbor Advertisement E.
20. Observe the packets transmitted by the CE-Router.

*Part E: Receiving NA without Target Link-Layer Address Option*

21. TN2 transmits Packet A.
22. Observe the packets transmitted by the CE-Router.
23. TN2 transmits Neighbor Advertisement A without any Target Link-Layer Address Option.
24. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*

**Step 2:** After receiving the Echo Request from TN2, the CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.

**Step 4:** After receiving the Neighbor Advertisement from TN2, the CE-Router should send the queued Echo Reply to TN2 and update its NCE of TN2 with the received Target Link-layer Address and change the state of the NCE to **REACHABLE**.

**Step 6:** Because the CE-Router is in state **REACHABLE**, after receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After `DELAY_FIRST_PROBE_TIME`, the CE-Router should not send a unicast Neighbor Solicitation to TN2.

- *Part B*

**Step 8:** After receiving the Echo Request from TN2, the CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.

**Step 10:** After receiving the Neighbor Advertisement from TN2, the CE-Router should send the queued Echo Reply to TN2 and update its NCE of TN2 with the received Target Link-layer Address and change the state of the NCE to **REACHABLE**.

**Step 12:** Because the CE-Router is in state **REACHABLE**, after receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After `DELAY_FIRST_PROBE_TIME`, the CE-Router should not send a unicast Neighbor Solicitation to TN2.

- *Part C*



**Step 14:** After receiving the Echo Request from TN2, the CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.

**Step 16:** After receiving the Neighbor Advertisement from TN2, the CE-Router should update its NCE of TN2 with the received Target Link-layer Address and change the state of the NCE to **STALE** and send the queued Echo Reply to TN2. After `DELAY_FIRST_PROBE_TIME`, the CE-Router should send a unicast Neighbor Solicitation to TN2.

- *Part D*

**Step 18:** After receiving the Echo Request from TN2, the CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.

**Step 20:** After receiving the Neighbor Advertisement from TN2, the CE-Router should update its NCE of TN2 with the received Target Link-layer Address and change the state of the NCE to **STALE** and send the queued Echo Reply to TN2. After `DELAY_FIRST_PROBE_TIME`, the CE-Router should send a unicast Neighbor Solicitation to TN2.

- *Part E*

**Step 22:** After receiving the Echo Request from TN2, the CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.

**Step 24:** The NUT should ignore the NA transmitted by TN1. There should be no change in the neighbor cache for TN1 as it should stay in state **INCOMPLETE**. The NUT should continue to send multicast Neighbor Solicitation to TN1.

### Possible Problems:

- None.



## Test CERouter.2.4.12: Neighbor Advertisement Processing, NCE State REACHABLE

**Purpose:** Verify an IPv6 CE Router properly updates its neighbor cache from the REACHABLE state upon receipt of a Neighbor Advertisement.

### References:

- [RFC 7084] – L-1
- [ND] – Section 7.2.5

Destination	Solicited flag	Override flag	TLLA	New State	Update Link-Layer Address	Part
Unicast	clear	clear	none	REACHABLE	no	A
Unicast	clear	set	none	REACHABLE	no	B
Unicast	set	clear	none	REACHABLE	no	C
Unicast	set	set	none	REACHABLE	no	D
Unicast	clear	clear	same	REACHABLE	no	E
Unicast	clear	set	same	REACHABLE	no	F
Unicast	set	clear	same	REACHABLE	no	G
Unicast	set	set	same	REACHABLE	no	H
Unicast	clear	clear	different	STALE	no	I
Unicast	clear	set	different	STALE	yes	J
Unicast	set	clear	different	STALE	no	K
Unicast	set	set	different	REACHABLE	yes	L
Multicast	clear	clear	same	REACHABLE	no	M
Multicast	clear	set	same	REACHABLE	no	N
Multicast	clear	clear	different	STALE	no	O
Multicast	clear	set	different	STALE	yes	P
Multicast	clear	clear	none	REACHABLE	no	Q
Multicast	clear	set	none	REACHABLE	no	R

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. TN2 transmits Echo Request A.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a solicited Neighbor Advertisement to the CE-Router.
4. Observe the packets transmitted by the CE-Router.
5. TN2 transmits Neighbor Advertisement A. The Solicited and Override flags are set according to Part A entry of the table in the discussion above. Similarly, the address in the Target Link Layer Address Option is provided as it is indicated.
6. TN2 transmits an Echo Request.
7. Observe the packets transmitted by the CE-Router.
8. Perform the common cleanup procedures.
9. Repeat Step1 through 8 for Parts B through R.





## Observable Results:

- *Part A through R*

**Step 2:** CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.

**Step 4:** Because the CE-Router is now in state **REACHABLE**, after receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After `DELAY_FIRST_PROBE_TIME`, the CE-Router should not send a unicast Neighbor Solicitation to TN2.

**Step 7:** The CE-Router **MUST** update the state of TN2's NCE and the LLA according to the table in the discussion above. After receiving the Echo Request from TN2 in step 6, the CE-Router should react according to the following:

### **Parts A-H,L-N and Q-R to REACHABLE**

After receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After `DELAY_FIRST_PROBE_TIME`, the CE-Router should not send a unicast Neighbor Solicitation to TN2.

#### **Part L**

The CE-Router's Echo Reply should be sent to the new updated link-layer destination address of TN2.

### **Parts I-K and O-P to STALE**

After receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After `DELAY_FIRST_PROBE_TIME`, the CE-Router should send a unicast Neighbor Solicitation to TN2.

#### **Parts J and P**

The CE-Router's Echo Reply should be sent to the new updated link-layer destination address of TN2. The Neighbor Solicitation should use the new updated link-layer destination address.

## Possible Problems:

- None.



## Test CERouter.2.4.13: Neighbor Advertisement Processing, NCE State STALE

**Purpose:** Verify an IPv6 CE Router properly updates its neighbor cache from the STALE state upon receipt of a Neighbor Advertisement.

### References:

- [RFC 7084] – L-1
- [ND] – Section 7.2.5 and 7.3.3

Destination	Solicit d flag	Override flag	TLLA	New State	Update Link- Layer Address	Part
Unicast	clear	clear	none	STALE	no	A
Unicast	clear	set	none	STALE	no	B
Unicast	set	clear	none	REACHABLE	no	C
Unicast	set	set	none	REACHABLE	no	D
Unicast	clear	clear	same	STALE	no	E
Unicast	clear	set	same	STALE	no	F
Unicast	set	clear	same	REACHABLE	no	G
Unicast	set	set	same	REACHABLE	no	H
Unicast	clear	clear	different	STALE	no	I
Unicast	clear	set	different	STALE	yes	J
Unicast	set	clear	different	STALE	no	K
Unicast	set	set	different	REACHABLE	yes	L
Multicast	clear	clear	same	STALE	no	M
Multicast	clear	set	same	STALE	no	N
Multicast	clear	clear	different	STALE	no	O
Multicast	clear	set	different	STALE	yes	P
Multicast	clear	clear	none	STALE	no	Q
Multicast	clear	set	none	STALE	no	R

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### Echo Request A

IPv6 Header
Next Header: 58
Source Address: TN1's Link- local Address
Destination Address: NUT's Link-local Address
ICMPv6 Echo Request

#### Neighbor Adv. (A-P)

IPv6 Header
Next Header: 58
Source Address: TN1's Link- local Address



Destination Address: see table
Neighbor Adv.
Solicited flag: see table
Override flag: see table
Target LLA Option: see table

### Procedure:

1. TN2 transmits Echo Request A.
2. Observe the packets transmitted by the CE-Router.
3. TN2 transmits a solicited Neighbor Advertisement to the CE-Router.
4. Observe the packets transmitted by the CE-Router.
5. Wait (REACHABLE\_TIME \* MAX\_RANDOM\_FACTOR) seconds.
6. Observe the packets transmitted by the CE-Router.
7. TN2 transmits Neighbor Advertisement A. The Solicited and Override flags are set according to Part A entry of the table in the discussion above. Similarly, the address in the Target Link Layer Address Option is provided as it is indicated.
8. TN2 transmits an Echo Request.
9. Observe the packets transmitted by the CE-Router.
10. Perform the common cleanup procedures.
11. Repeat Step1 through 10 for Parts B through R.

### Observable Results:

- *Part A thru R*

**Step 2:** CE-Router should create a Neighbor Cache Entry for TN2 and set the state of the Entry to **INCOMPLETE**. The CE-Router should send a multicast Neighbor Solicitation to TN2.

**Step 4:** Because the CE-Router is now in state **REACHABLE**, after receiving the Echo Request from TN2, the NUT should send an Echo Reply. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TN2.

**Step 6:** The CE-Router should change the state of TN2's NCE to **STALE**.

**Step 9:** The CE-Router **MUST** update the state of TN2's NCE and the LLA according to the table in the discussion above. After receiving the Echo Request from TN2 in step 8, the CE-Router should react according to the following:

**Parts C,D,G,H and L to REACHABLE**

After receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TN2.

**Part L**

The CE-Router's Echo Reply should be sent to the new updated link-layer destination address of TN2.

**Parts A,B,E,F,I-K, and M-R to STALE**

After receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should send a



unicast Neighbor Solicitation to TN2.

**Parts J and P**

The CE-Router's Echo Reply should be sent to the new updated link-layer destination address of TN2. The Neighbor Solicitation should use the new updated link-layer destination address.

**Possible Problems:**

- None.



## Test CERouter.2.4.14: Neighbor Advertisement Processing, NCE State PROBE

**Purpose:** Verify an IPv6 CE Router properly updates its neighbor cache from the PROBE state upon receipt of a Neighbor Advertisement.

### References:

- [RFC 7084] – L-1
- [ND] – Section 7.2.5 and 7.3.3

Destination	Solicited flag	Override flag	TLLA	New State	Update Link-LayerAddress	Part
Unicast	clear	clear	none	PROBE	no	A
Unicast	clear	set	none	PROBE	no	B
Unicast	set	clear	none	REACHABLE	no	C
Unicast	set	set	none	REACHABLE	no	D
Unicast	clear	clear	same	PROBE	no	E
Unicast	clear	set	same	PROBE	no	F
Unicast	set	clear	same	REACHABLE	no	G
Unicast	set	set	same	REACHABLE	no	H
Unicast	clear	clear	different	PROBE	no	I
Unicast	clear	set	different	STALE	yes	J
Unicast	set	clear	different	PROBE	no	K
Unicast	set	set	different	REACHABLE	yes	L
Multicast	clear	clear	same	PROBE	no	M
Multicast	clear	set	same	PROBE	no	N
Multicast	clear	clear	different	PROBE	no	O
Multicast	clear	set	different	STALE	yes	P
Multicast	clear	clear	none	PROBE	no	Q
Multicast	clear	set	none	PROBE	no	R

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Echo Request A

IPv6 Header
Next Header: 58
Source Address: TN2's Link-local Address
Destination Address: CE-Router's Link-local Address
ICMPv6 Echo Request

### Neighbor Adv. (A-R)

IPv6 Header
-------------



Next Header: 58
Source Address: TN2's Link-local Address
Destination Address: see table
Neighbor Adv.
Solicited flag: see table
Override flag: see table
Target LLA Option: see table

Neighbor Adv. Q

IPv6 Header
Next Header: 58
Source Address: TN2's Link-local Address
Destination Address: CE-Router's Link-local Address
Neighbor Advertisement
Router flag: 0
Solicited flag: 0
Override flag: 1
Target Address: TN2's Link-local Address

**Procedure:**

1. TN2 transmits Echo Request A to the CE-Router.
2. TN2 transmits Neighbor Advertisement Q to the CE-Router.
3. Observe the packets transmitted by the CE-Router.
4. Wait (DELAY\_FIRST\_PROBE\_TIME) seconds.
5. Observe the packets transmitted by the CE-Router.
6. TN2 transmits Neighbor Advertisement A. The Solicited and Override flags are set according to Part A entry of the table in the discussion above. Similarly, the address in the Target Link Layer Address Option is provided as it is indicated.
7. Skip this step for Parts A, B, E, F, I, K, M, N, O, Q and R; TN2 transmits an Echo Request.
8. Observe the packets transmitted by the CE-Router.
9. Perform the common cleanup procedure.
10. Repeat Steps 1 through 9 for Parts B through R.

**Observable Results:**

- *Part A through R*
  - Step 3:** CE-Router changes the state of TN2's NCE to **STALE**. After receiving the Echo Request from TN2, the CE-Router should send a Reply and enter state **DELAY**.
  - Step 5:** CE-Router changes the state of TN2's NCE to **PROBE** by transmitting a unicast Neighbor Solicitation to TN2.
  - Step 8:** CE-Router **MUST** update the state of TN2's NCE and the LLA according to the table in the discussion above. After receiving the Echo Request from TN2 in step 7, the NUT should react according to the following:



**Parts C, D, G, H and L to REACHABLE**

After receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should not send a unicast Neighbor Solicitation to TN2.

**Part L**

The CE-Router's Echo Reply should be sent to the new updated link-layer destination address of TN2.

**Parts J and P to STALE**

After receiving the Echo Request from TN2, the CE-Router should send an Echo Reply. After DELAY\_FIRST\_PROBE\_TIME, the CE-Router should send a unicast Neighbor Solicitation to TN2.

The CE-Router Echo Reply should be sent to the new updated link-layer destination address of TN2. The Neighbor Solicitation should use the new updated link-layer destination address.

**Parts A, B, E, F, I, K, M-O, and Q-R to PROBE**

The CE-Router should send a unicast Neighbor Solicitation to TN2.

**Possible Problems:**

- None.



## Test CERouter.2.4.15: Router Ignores Invalid Router Solicitations

**Purpose:** Verify an IPv6 CE Router properly ignores Router Solicitations.

### References:

- [RFC 7084] – L-1
- [ND] – Section 6.1.1, 6.2.6

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

*Part A: Hop Limit is not 255*

1. TN2 transmits a Router Solicitation with an IPv6 Hop Limit of 254. The Router Solicitation is valid otherwise.
2. Observe the packets transmitted by the CE-Router.

*Part B: ICMPv6 checksum is not valid*

3. TN2 transmits a Router Solicitation with an invalid ICMPv6 checksum. The Router Solicitation is valid otherwise.
4. Observe the packets transmitted by the CE-Router.

*Part C: ICMPv6 code is not 0*

TN2 transmits a Router Solicitation with an ICMPv6 code of 0. The Router Solicitation is valid otherwise.

5. Observe the packets transmitted by the CE-Router.

*Part D: ICMPv6 length is less than 8 Octets*

6. TN2 transmits a Router Solicitation with an ICMPv6 length of 6. The Router Solicitation is valid otherwise.
7. Observe the packets transmitted by the CE-Router.

*Part E: Option has length 0*

8. TN2 transmits a Router Solicitation with an Option of length 0. The Router Solicitation is valid otherwise.
9. Observe the packets transmitted by the CE-Router.

*Part F: Unspecified IP source address and a source link-layer address option*

10. TN2 transmits a Router Solicitation with an unspecified IP source address and a source link-layer address option. The Router Solicitation is valid otherwise.
11. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A through F*

In all Parts, the CE-Router must discard the Router Solicitation from TN2 and must NOT transmit a corresponding Router Advertisement within MAX\_RA\_DELAY\_TIME (0.5) seconds.

### Possible Problems:





- None.



## Test CERouter.2.4.16: Router Sends Valid Router Advertisement

**Purpose:** Verify an IPv6 CE Router properly sends valid Router Advertisement.

### References:

- [RFC 7084] – L-1, L-5, L-6
- [ND] – Section 6.1.2, 6.2.6

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. TN2 transmits a valid Router Solicitation.
2. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router must transmit valid Router Advertisements that satisfy all of the following validity checks:

- IP Source Address is a link-local address.
- The IP Hop Limit field has a value of 255, i.e., the packet could not possibly have been forwarded by a router.
- If the message includes an IP Authentication Header, the message authenticates correctly.
- ICMP Checksum is valid.
- ICMP Code is 0.
- ICMP length (derived from the IP length) is 16 or more octets.
- All included options have a length that is greater than zero.
- The Prefix Information Option must have the A and L flag set to 1 by default.

### Possible Problems:

- None.



## Test CERouter.2.4.17: Processing Router Solicitations

**Purpose:** Verify an IPv6 CE Router properly sends valid Router Advertisement.

### References:

- [RFC 7084] – L-1
- [ND] –6.2.6

**Test Setup:** [Common Test Setup](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Router Solicitation A
IPv6 Header
Next Header: 58
Source Address: TN1's Link
Local Address
Router Solicitation

### Procedure:

1. TN2 transmits Router Solicitation A twice, 3 seconds apart. The Destination Address is the all-routers multicast address.
2. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router MUST transmit a Router Advertisement between 0 and MAX\_RA\_DELAY\_TIME (0.5) seconds after the receipt of each Router Solicitation A.

### Possible Problems:

- None.



## **Group 5: RFC 4862**

### **Scope**

The following tests cover the IPv6 Stateless Address Autoconfiguration specification, Request For Comments 4862. These tests verify the process for generating a link-local address, the process for generating site-local and global addresses via stateless address autoconfiguration, and the Duplicate Address Detection procedure. The following tests also verify that a host correctly processes a Router Advertisement and correctly assigns lifetimes.

### **Overview**

These tests are designed to verify the readiness of an IPv6 implementation vis-à-vis the IPv6 Stateless Address Autoconfiguration specification.



## Test CERouter.2.5.1: Address Autoconfiguration and Duplicate Address Detection

**Purpose:** Verify an IPv6 CE Router properly initialize on a network using address autoconfiguration and communicate with other on-link partners.

### References:

- [RFC 7084] – G-1
- [ADDRCONF] – Sections 1, 5.3, 5.4
- [IPv6-ARCH] – Sections 2.5.1, 2.5.2, 2.7.1

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. Initialize all the devices on LAN.
2. Allow time for all devices on LAN to perform stateless address autoconfiguration and DAD.
3. Configure TN2 to transmit a DAD Neighbor Solicitation from the unspecified address with the Target Address set to the CE-Router's link-local address.
4. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** The CE-Router should perform DAD on its tentative address for its interface on LAN sending DupAddrDetectTransmits Neighbor Solicitations, every RetransTimer. The CE-Router should assign the tentative address to its interface. Interface IDs are required to be 64 bits long and to be constructed in Modified EUI-64 format.

**Step 4:** The CE-Router must transmit a DAD NA for its autoconfigured link-local address.

### Possible Problems:

- The CE-Router may choose to omit the common test setup if the device initializes the LAN interface before the WAN interface.



## Test CERouter.2.5.2: Receiving DAD Neighbor Solicitations and Advertisements

**Purpose:** Verify an IPv6 CE Router properly process neighbor solicitations and advertisements performing Duplicate Address Detection while the node is also performing DAD.

### References:

- [RFC 7084] – G-1
- [ADDRCONF] – Sections 1, 5.4, 5.4.1, 5.4.3, 5.4.4 and 5.4.5

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### Neighbor Solicitation A

IPv6 Header Next Header: 58 Source Address: Unspecified Address Destination Address: Solicited multicast of the CE-Router's tentative Link-local Address Hop Limit: 255
Neighbor Solicitation Target Address: (See Below)

#### Neighbor Advertisement B

IPv6 Header Next Header: 58 Source Address: CE-Router's Link-local Address Destination Address: all-nodes multicast address Hop Limit: 255
Neighbor Advertisement Router flag: 0 Solicited flag: 0 Override flag: 1 Target Address: (See Below) TLLOPT: TN2's MAC address

### Procedure:

*Part A: CE-Router receives DAD NS (target != CE-Router)*

1. Initialize all devices on LAN.
2. After TN2 receives a DAD NS message from the CE-Router. Configure TN2 to transmit DAD Neighbor Solicitation A with the Target Address set to TN2's link-local address.



3. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
4. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
5. Observe the packets transmitted by the CE-Router.
6. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
7. Observe the packets transmitted by the CE-Router.

*Part B: CE-Router receives DAD NS (target == CE-Router)*

8. Initialize all devices on WAN.
9. After TN2 receives a DAD NS message from the CE-Router. Configure TN2 to transmit DAD Neighbor Solicitation A with the Target Address set to the CE-Router's tentative link-local address.
10. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
11. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
12. Observe the packets transmitted by the CE-Router.
13. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
14. Observe the packets transmitted by the CE-Router.

*Part C: CE-Router receives DAD NA (target != CE-Router)*

15. Initialize all devices on LAN.
16. After TN2 receives a DAD NS message from the CE-Router. Configure TN2 to transmit DAD Neighbor Advertisement B with the Target Address set to TN2's link-local address.
17. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
18. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
19. Observe the packets transmitted by the CE-Router.
20. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
21. Observe the packets transmitted by the CE-Router.

*Part D: CE-Router receives DAD NA (target == CE-Router)*

22. Initialize all devices on LAN.
23. After TN2 receives a DAD NS message from the CE-Router. Configure TN2 to transmit DAD Neighbor Advertisement B with the Target Address set to the CE-Router's tentative link-local address.
24. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
25. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address and no TLL Option.
26. Observe the packets transmitted by the CE-Router.
27. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
28. Observe the packets transmitted by the CE-Router.

### **Observable Results:**



- *Part A*
  - Step 3:** The CE-Router should silently ignore the DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 5:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 7:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part B*
  - Step 10:** The CE-Router should receive more DAD NS messages than expected with its tentative link-local address as the Target address. The CE-Router should determine its tentative address is a duplicate and should not assign the tentative address to its interface.
  - Step 12:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.
  - Step 14:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.
- *Part C*
  - Step 17:** The CE-Router should silently ignore the DAD NA. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 19:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 21:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part D*
  - Step 24:** The CE-Router should receive more DAD NA messages than expected with its tentative link-local address as the Target address. The CE-Router should determine its tentative address is a duplicate and should not assign the tentative address to its interface.
  - Step 26:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.
  - Step 28:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

#### **Possible Problems:**

- The CE-Router may choose to omit the common test setup if the device initializes the LAN interface before the WAN interface.





## Test CERouter.2.5.3: Validation of DAD Neighbor Solicitations

**Purpose:** Verify an IPv6 CE Router properly ignore invalid neighbor solicitations while performing Duplicate Address Detection.

### References:

- [RFC 7084] – G-1
- [ADDRCONF] – Sections 5.4.1 and 5.4.5
- [ND] – Section 7.1.1

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### Neighbor Solicitation A

IPv6 Header Next Header: 58 Source Address: Unspecified Address Destination Address: Solicited multicast of the CE-Router tentative Link-local Address Hop Limit: 255
Neighbor Solicitation Target Address: CE-Router's tentative link-local address

### Procedure:

*Part A: CE-Router receives invalid DAD NS (ICMP length < 24 octets)*

1. Initialize all devices on LAN.
2. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Solicitation A with the ICMP length set to 16.
3. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
4. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
5. Observe the packets transmitted by the CE-Router.
6. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
7. Observe the packets transmitted by the CE-Router.

*Part B: CE-Router receives invalid DAD NS (HopLimit != 255)*

8. Initialize all devices on LAN.
9. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Solicitation A with the Hop Limit set to 254.
10. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
11. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.



12. Observe the packets transmitted by the CE-Router.
13. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
14. Observe the packets transmitted by the CE-Router.

*Part C: CE-Router receives invalid DAD NS (Dst = CE-Router's tentative address)*

15. Initialize all devices on LAN.
16. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Solicitation A with the Destination address set to the CE-Router's tentative link-local address.
17. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
18. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
19. Observe the packets transmitted by the CE-Router.
20. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
21. Observe the packets transmitted by the CE-Router.

*Part D: CE-Router receives invalid DAD NS (Dst = allnode)*

22. Initialize all devices on LAN.
23. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Solicitation A with the Destination address set to the all-nodes multicast address.
24. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
25. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
26. Observe the packets transmitted by the CE-Router.
27. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
28. Observe the packets transmitted by the CE-Router.

*Part E: CE-Router Receives invalid DAD NS (ICMP code != zero )*

29. Initialize all devices on LAN.
30. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Solicitation A with the ICMP code set to 1.
31. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
32. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
33. Observe the packets transmitted by the CE-Router.
34. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
35. Observe the packets transmitted by the CE-Router.

*Part F: CE-Router receives invalid DAD NS (Invalid Checksum)*

36. Initialize all devices on LAN.
37. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Solicitation A with an invalid ICMP Checksum.
38. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
39. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.



40. Observe the packets transmitted by the CE-Router.
41. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
42. Observe the packets transmitted by the CE-Router.

*Part G: CE-Router receives invalid DAD NS (target == multicast address)*

43. Initialize all devices on LAN.
44. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Solicitation A with the Target Address set to the solicited multicast of the CE-Router's tentative link-local address.
45. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
46. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
47. Observe the packets transmitted by the CE-Router.
48. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
49. Observe the packets transmitted by the CE-Router.

*Part H: CE-Router receives invalid DAD NS (contains SSL)*

50. Initialize all devices on LAN.
51. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Solicitation A containing a SLL Option set to TN2's MAC address.
52. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
53. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
54. Observe the packets transmitted by the CE-Router.
55. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
56. Observe the packets transmitted by the CE-Router.

*Part I: CE-Router receives valid DAD NS (Reserved Field)*

57. Initialize all devices on LAN.
58. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Solicitation A with the Reserved field set to 0xFFFFFFFF.
59. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
60. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
61. Observe the packets transmitted by the CE-Router.
62. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
63. Observe the packets transmitted by the CE-Router.

*Part J: CE-Router receives valid DAD NS (contains TLL)*

64. Initialize all devices on LAN.
65. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Solicitation A containing a TLL Option set to TN1's MAC address.
66. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.



67. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
68. Observe the packets transmitted by the CE-Router.
69. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
70. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 3:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 5:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 7:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part B*
  - Step 10:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 12:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 14:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part C*
  - Step 17:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 19:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 21:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part D*
  - Step 24:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 26:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 28:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part E*
  - Step 31:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 33:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 35:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part F*
  - Step 38:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.



**Step 40:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

**Step 42:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

- *Part G*

**Step 45:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.

**Step 47:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

**Step 49:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

- *Part H*

**Step 52:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.

**Step 54:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

**Step 56:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

- *Part I*

**Step 59:** The CE-Router should ignore the contents of the Reserved field. The CE-Router should not assign the tentative address to its interface.

**Step 61:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

**Step 63:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

- *Part J*

**Step 66:** The CE-Router should ignore any options they do not recognize and continue processing the message. The CE-Router should not assign the tentative address to its interface.

**Step 68:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

**Step 70:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

### Possible Problems:

- The CE-Router may choose to omit the common test setup if the device initializes the LAN interface before the WAN interface.



## Test CERouter.2.5.4: Validation of DAD Neighbor Advertisements

**Purpose:** Verify an IPv6 CE Router properly ignore invalid neighbor advertisements while performing Duplicate Address Detection.

### References:

- [RFC 7084] – G-1
- [ADDRCONF] – Sections 5.4.1 and 5.4.5
- [ND] – Section 7.1.2

**Test Setup:** [Common Test Setup 1.1](#) performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Neighbor Advertisement A

IPv6 Header Next Header: 58 Source Address: CE-Router's Link-local Address Destination Address: all-nodes multicast address Hop Limit: 255
Neighbor Advertisement Router flag: 0 Solicited flag: 0 Override flag: 1 Target Address: CE-Router's tentative link-local address TLLOPT: TN2's MAC address

### Procedure:

*Part A: CE-Router receives invalid DAD NA (ICMP length < 24 octets)*

1. Initialize all devices on LAN.
2. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Advertisement A with the ICMP length set to 16.
3. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
4. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
5. Observe the packets transmitted by the CE-Router.
6. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
7. Observe the packets transmitted by the CE-Router.

*Part B: CE-Router receives invalid DAD NA (HopLimit != 255)*

8. Initialize all devices on LAN.



9. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Advertisement A with the Hop Limit set to 254.
  10. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
  11. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
  12. Observe the packets transmitted by the CE-Router.
  13. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
  14. Observe the packets transmitted by the CE-Router.
- Part C: CE-Router receives invalid DAD NA (ICMP code != zero)*
15. Initialize all devices on LAN.
  16. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Advertisement A with the ICMP code set to 1.
  17. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
  18. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
  19. Observe the packets transmitted by the CE-Router.
  20. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
  21. Observe the packets transmitted by the CE-Router.
- Part D: CE-Router receives invalid DAD NA (Invalid Checksum)*
22. Initialize all devices on LAN.
  23. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Advertisement A with an invalid ICMP Checksum.
  24. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
  25. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
  26. Observe the packets transmitted by the CE-Router.
  27. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
  28. Observe the packets transmitted by the CE-Router.
- Part E: CE-Router receives invalid DAD NA (Solicited Flag == 1)*
29. Initialize all devices on LAN.
  30. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Advertisement A with the Solicited flag set to 1.
  31. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
  32. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
  33. Observe the packets transmitted by the CE-Router.
  34. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
  35. Observe the packets transmitted by the CE-Router.
- Part F: CE-Router receives invalid DAD NA (target == multicast address)*
36. Initialize all devices on LAN.



37. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Advertisement A with the Target Address set to the solicited multicast of the CE-Router's tentative link-local address.
  38. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
  39. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
  40. Observe the packets transmitted by the CE-Router.
  41. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
  42. Observe the packets transmitted by the CE-Router.
- Part G: CE-Router receives invalid DAD NA (option length == zero)*
43. Initialize all devices on LAN.
  44. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Advertisement A with the TTLOPT length set to 0.
  45. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
  46. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
  47. Observe the packets transmitted by the CE-Router.
  48. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
  49. Observe the packets transmitted by the CE-Router.
- Part H: CE-Router receives valid DAD NA (Reserved Field)*
50. Initialize all devices on LAN.
  51. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Advertisement A with the Reserved field set to 0xFFFFFFFF.
  52. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
  53. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
  54. Observe the packets transmitted by the CE-Router.
  55. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
  56. Observe the packets transmitted by the CE-Router.
- Part I: CE-Router receives valid DAD NA (contains SLL)*
57. Initialize all devices on LAN.
  58. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Advertisement A contacting a SLL Option set to CE-Router's MAC address.
  59. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
  60. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
  61. Observe the packets transmitted by the CE-Router.
  62. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
  63. Observe the packets transmitted by the CE-Router.





## Observable Results:

- *Part A*
  - Step 3:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 5:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 7:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part B*
  - Step 10:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 12:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 14:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part C*
  - Step 17:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 19:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 21:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part D*
  - Step 24:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 26:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 28:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part E*
  - Step 31:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 33:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 35:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part F*
  - Step 38:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 40:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
  - Step 42:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.
- *Part G*
  - Step 45:** The CE-Router should silently ignore the invalid DAD NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.



**Step 47:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

**Step 49:** The CE-Router must transmit a Solicited NA for its autoconfigured link-local address.

- *Part H*

**Step 52:** The CE-Router should ignore the contents of the Reserved field. The CE-Router should not assign the tentative address to its interface.

**Step 54:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

**Step 56:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

- *Part I*

**Step 59:** The CE-Router should ignore any options they do not recognize and continue processing the message. The CE-Router should not assign the tentative address to its interface.

**Step 61:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

**Step 63:** The CE-Router must NOT transmit a Solicited NA for its autoconfigured link-local address.

#### **Possible Problems:**

- The CE-Router may choose to omit the common test setup if the device initializes the LAN interface before the WAN interface.



## Test CERouter.2.5.5: Receiving Neighbor Solicitations for Address Resolution

**Purpose:** Verify an IPv6 CE Router properly ignores neighbor solicitations performing address resolution while performing Duplicate Address Detection.

### References:

- [RFC 7084] – G-1
- [ADDRCONF] – Section 1, 5.4.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Neighbor Solicitation A

IPv6 Header Next Header: 58 Source Address: TN's Link-local Address Destination Address: Solicited multicast of the CE-Router's tentative Link-local Address Hop Limit: 255
Neighbor Solicitation Target Address: CE-Router's tentative link-local address TLLOPT: TN2's MAC address

### Procedure:

*Part A: CE-Router receives NS (src == unicast)*

1. Initialize all devices on LAN.
2. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Solicitation A.
3. Allow time for all devices on LAN to perform stateless address autoconfiguration and Duplicate Address Detection.
4. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
5. Observe the packets transmitted by the CE-Router.
6. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address.
7. Observe the packets transmitted by the CE-Router.

*Part B: CE-Router receives NS (Src == unicast && Dst == CE-Router's tentative address)*

8. Initialize all devices on LAN.
9. After TN2 receives a DAD NS message from the CE-Router, configure TN2 to transmit Neighbor Solicitation A with the Destination Address set to the CE-Router's tentative link-local address.
10. Allow time for all devices on WAN to perform stateless address autoconfiguration and Duplicate Address Detection.



11. Transmit a NS from TN2 to the solicited-node multicast address of the CE-Router's link-local address with the Target Address set to the CE-Router's link-local address.
12. Observe the packets transmitted by the CE-Router.
13. Transmit a NS from TN2 to the link-local address of the CE-Router with the Target Address set to the CE-Router's link-local address
14. Observe the packets transmitted by the CE-Router.

#### Observable Results:

- *Part A*
  - Step 3:** The CE-Router should silently ignore the NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 5:** The CE-Router transmits a Solicited NA for its autoconfigured link-local address.
  - Step 7:** The CE-Router transmits a Solicited NA for its autoconfigured link-local address.
- *Part B*
  - Step 10:** The CE-Router should silently ignore the NS. The CE-Router should complete the DAD process and assign the tentative address to its interface.
  - Step 12:** The CE-Router transmits a Solicited NA for its autoconfigured link-local address.
  - Step 14:** The CE-Router transmits a Solicited NA for its autoconfigured link-local address.

#### Possible Problems:

- The CE-Router may choose to omit the common test setup if the device initializes the LAN interface before the WAN interface.



## Test CERouter.2.5.6: Global Address Autoconfiguration and DAD

**Purpose:** Verify an IPv6 CE Router properly performs DAD on its autoconfigured unicast address.

### References:

- [RFC 7084] – G-1
- [ADDRCONF] – Sections 5.4
- [IPv6-ARCH] – Section 2, 2.5.7

**Test Setup:** No Common Test Setup is performed. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. Initialize all the devices on the LAN.
2. Allow time for the CE-Router's to perform stateless address autoconfiguration and Duplicate Address Detection.
3. Transmit a DAD NS from TN2 with the Target Address set to the CE-Router's global address.
4. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 3:** The CE-Router should perform DAD on its tentative global address for its interface on LAN sending DupAddrDetectTransmits Neighbor Solicitations, every RetransTimer. The CE-Router should assign the tentative global address to its interface.

**Step 5:** The CE-Router must transmit a DAD NA for its autoconfigured global address.

### Possible Problems:

- None.



## Group 6: RFC 4443

### Scope

The following tests cover the Internet Control Message Protocol for IP version 6, Request For Comments 4443.

### Overview

These tests are designed to verify conformance with the Internet Control Message Protocol for the Internet Protocol Version 6 Specification.

### Default Packets

Echo Request  
(Packet Size 1500 bytes)

IPv6 Header Next Header: 58
ICMPv6 Header Type: 128 Code: 0

Packet Too Big message	Redirect message
IPv6 Header Next Header: 58 Source Address: TR1's Link Local Address Destination Address: NUT's Link Local Address	IPv6 Header Next Header: 58 Source Address: TR1's Link Local Address Destination Address: NUT's Link Local Address
ICMPv6 Header Type: 2 Code: 0 MTU: 1280	ICMPv6 Header Type: 137 Code: 0
Invoking Packet	Invoking Packet



## Test CERouter.2.6.1: Replying to Echo Request

**Purpose:** Verify an IPv6 CE Router properly replies to ICMPv6 Echo Requests.

### References:

- [RFC 7084] – G-1
- [ICMPv6] – Section 2.2, 4.2

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Request sent to Link-Local address*

1. TN2 transmits an ICMPv6 Echo Request to the CE-Router's Link-Local address. The source address is TN2's Link-Local address.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Request sent to global address*

3. TN2 transmits an ICMPv6 Echo Request to the CE-Router's global address on the LAN interface. The source address is TN2's Global address.
4. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router must send an Echo Reply to TN2. The Source Address of the Packet must be same as the Link-Local Destination Address of TN2's Echo Request packet, while the Destination Address must be the same as the Link-Local Source Address of TN2's Echo Request packet. The CE-Router must send an Echo Reply to TN2 with a valid checksum.
- *Part B*  
**Step 4:** CE-Router must send an Echo Reply to TN2. The Source Address of the Packet must be same as the Global Destination Address of TN2's Echo Request packet, while the Destination Address must be the same as the Global Source Address of TN2's Echo Request packet. The CE-Router must send an Echo Reply to TN2 with a valid checksum.

### Possible Problems:

- None.



## Test CERouter.2.6.2: Unrecognized Next Header (Parameter Problem Generation)

**Purpose:** Verify an IPv6 CE Router properly generates Parameter Problem Messages when an Unrecognized Next Header type is encountered.

### References:

- [RFC 7084] – G-1
- [ICMPv6] – Section 2.2, 2.4, 3.4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A (Echo Request)
IPv6 Header Payload Length: 64 bytes Next Header: 60
Destination Options Header Next Header: 252 Header Ext. Length: 0 PadN Option
ICMPv6 Header Type: 128 Code: 0

### Procedure:

1. TN2 transmits the Packet A Echo Request to the CE-Router. The Source Address of the Packet is set to TN2's Global address. The Destination Address of the packet is set to the CE-Router's Global address.
2. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router must discard the ICMPv6 Echo Request from TN2. Therefore, it must not send an Echo Reply. The NUT should send a Parameter Problem Message to TN2 with a code field value of 1 (Unrecognized Next Header type encountered).

- The Pointer Field should be 0x28 (offset of the Payload Length field).
- The Source Address of the Packet must be the same as the Global Destination Address of TN2's Echo Request packet.
- The Destination Address should be the same as the Global Source Address of TN2's Echo Request packet.
- The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU.

### Possible Problems:

- None.





## Test CERouter.2.6.3: Unknown Informational Message Type

**Purpose:** Verify an IPv6 CE Router properly handles the reception of an ICMPv6 Packet with an Unknown Informational Message Type value.

### References:

- [RFC 7084] – G-1
- [ICMPv6] – Section 2.4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. TN2 transmits an ICMPv6 Information Message with a type field value of 254 to the CE-Router.
2. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router must silently discard the ICMPv6 Informational Message from TN2.

### Possible Problems:

- None.



## Test CERouter.2.6.4: Error Condition With Multicast Destination

**Purpose:** Verify an IPv6 CE Router properly handles the reception of an error condition caused by a packet with a Multicast Destination Address.

### References:

- [RFC 7084] – G-1
- [ICMPv6] – Section 2.4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: UDP Port Unreachable*

1. TN2 transmits a UDP packet on LAN with the Destination Address set to the all-nodes link-local multicast address. The destination port is set to 9000. (Make sure the CE-Router is not listening on port 9000.)
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Echo Request Reassembly Timeout*

3. TN2 transmits an ICMPv6 Echo Request Fragment to the all-nodes link-local multicast address. The offset of the fragment is 0 (the first fragment) and the More Fragments Flag is set.
4. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router must not send a Destination Unreachable Error Message to TN2 when it receives a UDP packet for an unreachable port.
- *Part B*  
**Step 4:** CE-Router must not send a Time Exceeded Error Message to TN2 60 seconds after it receives the first fragment of an ICMPv6 Echo Request.

### Possible Problems:

- None.



## Test CERouter.2.6.5: Error Condition With Non-Unique Source - Unspecified

**Purpose:** Verify an IPv6 CE Router properly handles the reception of an error condition caused by a packet with a source address that does not uniquely identify a single node.

### References:

- [RFC 7084] – G-1
- [ICMPv6] – Section 2.4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: UDP Port Unreachable*

1. TN2 transmits a UDP Packet to the CE-Router's Global address with a Source Address set to the unspecified address (::). The destination port is set to 9000. (Make sure the CE-Router is not listening on port 9000.)
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Echo Request Reassembly Timeout*

3. TN2 transmits an ICMPv6 Echo Request Fragment to the CE-Router. The offset of the fragment is 0 (the first fragment) and the More Fragments Flag is set. The Source Address is set to the unspecified address (::).
4. Observe the packets transmitted by the CE-Router.

#### *Part C: Echo Request with Unknown Option in Destination Options*

5. TN2 transmits an ICMPv6 Echo Request to the CE-Router. The Source Address is set to the unspecified address (::). It includes a Destination Options Header with the unrecognized Option of type 135. (Highest Order bits set to 10<sub>b</sub>.)
6. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router must not send a Destination Unreachable Error Message to TN2 when it receives a UDP packet for an unreachable port.
- *Part B*  
**Step 4:** CE-Router must not send a Time Exceeded Error Message to TN2 60 seconds after it receives the first fragment of an ICMPv6 Echo Request.
- *Part C*  
**Step 6:** CE-Router must not send a Parameter Problem Error Message when it receives an ICMPv6 Echo Request with an unknown option with highest bits 10<sub>b</sub>.

### Possible Problems:

- None.



## Test CERouter.2.6.6: Error Condition With Non-Unique Source - Multicast

**Purpose:** Verify an IPv6 CE Router properly handles the reception of an error condition caused by a packet with a source address that does not uniquely identify a single node.

### References:

- [RFC 7084] – G-1
- [ICMPv6] – Section 2.4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: UDP Port Unreachable*

7. TN2 transmits a UDP Packet to the CE-Router's Global address with a Source Address set to TN2's Solicited-Node Multicast address. The destination port is set to 9000. (Make sure the CE-Router is not listening on port 9000.)
8. Observe the packets transmitted by the CE-Router.

#### *Part B: Echo Request Reassembly Timeout*

9. TN2 transmits an ICMPv6 Echo Request Fragment to the CE-Router. The offset of the fragment is 0 (the first fragment) and the More Fragments Flag is set. The Source Address is set to TN2's Solicited-Node Multicast address.
10. Observe the packets transmitted by the CE-Router.

#### *Part C: Echo Request with Unknown Option in Destination Options*

11. TN2 transmits an ICMPv6 Echo Request to the CE-Router. The Source Address is set to TN2's Solicited-Node Multicast address. It includes a Destination Options Header with the unrecognized Option of type 135. (Highest Order bits set to 10<sub>b</sub>).
12. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router must not send a Destination Unreachable Error Message to TN2 when it receives a UDP packet for an unreachable port.
- *Part B*  
**Step 4:** CE-Router must not send a Time Exceeded Error Message to TN2 60 seconds after it receives the first fragment of an ICMPv6 Echo Request.
- *Part C*  
**Step 6:** CE-Router must not send a Parameter Problem Error Message when it receives an ICMPv6 Echo Request with an unknown option with highest bits 10<sub>b</sub>.

### Possible Problems:

- None.



## Test CERouter.2.6.7: Error Condition With Non-Unique Source - Anycast

**Purpose:** Verify an IPv6 CE Router properly handles the reception of an error condition caused by a packet with a source address that does not uniquely identify a single node.

### References:

- [RFC 7084] – G-1
- [ICMPv6] – Section 2.4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: UDP Port Unreachable*

13. TN2 transmits a UDP Packet to the CE-Router's Global address with a Source Address set to the CE-Router's Subnet-Router Anycast Address. The destination port is set to 9000. (Make sure the CE-Router is not listening on port 9000.)
14. Observe the packets transmitted by the CE-Router.

#### *Part B: Echo Request Reassembly Timeout*

15. TN2 transmits an ICMPv6 Echo Request Fragment to the CE-Router. The offset of the fragment is 0 (the first fragment) and the More Fragments Flag is set. The Source Address is set to the CE-Router's Subnet-Router Anycast Address.
16. Observe the packets transmitted by the CE-Router.

#### *Part C: Echo Request with Unknown Option in Destination Options*

17. TN2 transmits an ICMPv6 Echo Request to the CE-Router. The Source Address is set to the CE-Router's Subnet-Router Anycast Address. It includes a Destination Options Header with the unrecognized Option of type 135. (Highest Order bits set to 10<sub>b</sub>).
18. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router must not send a Destination Unreachable Error Message to TN2 when it receives a UDP packet for an unreachable port.
- *Part B*  
**Step 4:** CE-Router must not send a Time Exceeded Error Message to TN2 60 seconds after it receives the first fragment of an ICMPv6 Echo Request.
- *Part C*  
**Step 6:** CE-Router must not send a Parameter Problem Error Message when it receives an ICMPv6 Echo Request with an unknown option with highest bits 10<sub>b</sub>.

### Possible Problems:

- None.



## **Group 7: RFC 7084**

### **Scope**

The following tests cover specifications

### **Overview**

These tests are designed to verify the IPv6 CE-Router distributes configuration information obtained during the WAN interface provisioning to the IPv6 hosts and assists IPv6 hosts in obtaining IPv6 addresses. It also tests the connectivity of these devices in the absence of any working WAN interface.



## Test CERouter.2.7.1: 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
- [DHCP 3633] – Section 10

**Test Setup:** The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Prefix Length of /64*

1. [Common Test Setup 1.1](#) is performed with TN1 assigning an IA\_PD with a prefix length of 64.
2. TN2 transmits a Router Solicitation.
3. Observe the packets transmitted by the CE-Router.

#### *Part B: Prefix Length of /60*

4. [Common Test Setup 1.1](#) is performed with TN1 assigning an IA\_PD with a prefix length of 60.
5. TN2 transmits a Router Solicitation.
6. Observe the packets transmitted by the CE-Router.

#### *Part C: Preferred lifetime greater than valid lifetime*

7. [Common Test Setup 1.1](#) is performed with TN1 assigning an IA\_PD with a preferred lifetime of 90 and a valid lifetime of 30.
8. TN2 transmits a Router Solicitation.
9. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 3:** 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.
- *Part B*  
**Step 6:** CE-Router must transmit Router Advertisements with a Prefix Information Option with a /64 prefix from the /60 prefix assigned in Step 4. The preferred and valid lifetimes in the Prefix Information Option must not be more than the preferred and valid lifetimes from the IA\_PD.
- *Part C*  
**Step 9:** CE-Router must not transmit a Router Advertisement with a Prefix Information Option with /64 prefix assigned in Step 7.

### Possible Problems:

- None.



## Test CERouter.2.7.2: Route Information Option

**Purpose:** Verify an IPv6 CE Router properly advertises itself as a router for the delegated prefixes using the Route Information Option.

### References:

- [RFC 7084] – L-3
- [RFC 4191] – Section 2.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The prefix size The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: /64 Prefix*

1. [Common Test Setup 1.1](#) is performed with TN1 assigning an IA\_PD with a prefix length of 64.
2. TN2 transmits a Router Solicitation.
3. Observe the packets transmitted by the CE-Router.

#### *Part B: /60 Prefix*

4. [Common Test Setup 1.1](#) is performed with TN1 assigning an IA\_PD with a prefix length of 60.
5. TN2 transmits a Router Solicitation.
6. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 3:** CE-Router must transmit Router Advertisements with a Route Information Option with a /64 prefix assigned in Step 1. The Prefix Length must match the value supplied in the IA\_PD in Common Test Setup. The Route Lifetime in the Route Information Option must not be more then lifetime supplied in the IA\_PD in Common Test Setup.
- *Part B*  
**Step 6:** CE-Router must transmit Router Advertisements with a Route Information Option with a /60 prefix assigned in Step 4. The Prefix Length must match the value supplied in the IA\_PD in Common Test Setup. The Route Lifetime in the Route Information Option must not be more then lifetime supplied in the IA\_PD in Common Test Setup.

### Possible Problems:

- None.





## Test CERouter.2.7.3: No Prefixes Delegated

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

### References:

- [RFC 7084] – L-4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning Part C. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: No Prefixes Delegated*

1. [Common Test Setup 1.1](#) is performed with the exception that no IA\_PD is assigned to the CE-Router.
2. TN2 transmits a Router Solicitation.
3. Observe the packets transmitted by the CE-Router.

#### *Part B: IA\_PD Prefix times out*

4. [Common Test Setup 1.1](#) is performed with TN1 assigning an IA\_PD with a preferred and valid lifetime of 30 seconds and a T1 timer of 120 seconds.
5. Wait 35 seconds.
6. TN2 transmits a Router Solicitation.
7. Observe the packets transmitted by the CE-Router.

#### *Part C: IA\_PD Not renewed*

8. TN1 stops responding to DHCPv6 messages.
9. Wait valid lifetime.
10. TN2 transmits a Router Solicitation.
11. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 3:** CE-Router must not transmit Router Advertisements with a router lifetime greater zero on LAN1.
- *Part B*  
**Step 7:** CE-Router must not transmit Router Advertisements with a router lifetime greater zero on LAN1.
- *Part C*  
**Step 11:** CE-Router must not transmit Router Advertisements with a router lifetime greater zero on LAN1.

### Possible Problems:

- None.



## Test CERouter.2.7.4: DNS Information in Router Advertisement

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

### References:

- [RFC 7084] – L-11

**Test Setup:** [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. TN2 transmits a Router Solicitation.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: DNS Search List*

3. TN2 transmits a Router Solicitation.
4. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router must transmit a Router Advertisement containing Recursive DNS Server Option.
- *Part B*  
**Step 4:** CE-Router must transmit a Router Advertisement containing Recursive DNS Server Option and DNS Search List Option.

### Possible Problems:

- None.



## Test CERouter.2.7.5: Prefix Change

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

### References:

- [RFC 7084] – L-13
- [RFC 7084] – L-14

**Test Setup:** The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Lifetimes set to zero*

1. [Common Test Setup 1.1](#) is performed.
2. TN2 transmits a Router Solicitation.
3. Observe the packets transmitted by the CE-Router.
4. TN2 transmits an ICMPv6 Echo Request to CE-Router global address on the LAN interface.
5. Observe the packets transmitted by the CE-Router.
6. TN1 responds to the DHCPv6 Renew message on WAN interface with a DHCPv6 Reply with two IA\_PDs. The first IA\_PD is the IA\_PD from common test setup with a valid and preferred lifetime of 0. The second IA\_PD has a new valid IA\_PD prefix.
7. TN2 transmits a Router Solicitation.
8. Observe the packets transmitted by the CE-Router.

#### *Part B: Prefix Timeout*

9. [Common Test Setup 1.1](#) is performed with IA\_PD with a T1 timer set to 30 and a IA\_PD Prefix having a valid and preferred lifetime of 60 seconds.
10. TN2 transmits a Router Solicitation.
11. Observe the packets transmitted by the CE-Router.
12. TN2 transmits an ICMPv6 Echo Request to CE-Router global address on the LAN interface.
13. Observe the packets transmitted by the CE-Router.
14. TN1 responds to DHCPv6 Renew messages with a DHCPv6 Reply message with new IA\_PD.
15. Wait 60 seconds.
16. TN2 transmits a Router Solicitation.
17. Observe the packets transmitted by the CE-Router.

#### *Part C: Reconfigure*

18. [Common Test Setup 1.1](#) is performed.
19. TN2 transmits a Router Solicitation.
20. Observe the packets transmitted by the CE-Router.
21. TN2 transmits an ICMPv6 Echo Request to CE-Router global address on the LAN interface.
22. Observe the packets transmitted by the CE-Router.
23. TN1 transmits a DHCPv6 Reconfigure to CE-Router.
24. Observe the packets transmitted by the CE-Router.
25. TN1 responds to the DHCPv6 Renew message with DHCPv6 Reply with a DHCPv6 Reply with two IA\_PDs. The first IA\_PD is the IA\_PD from Step 26 with a valid and preferred lifetime of 0. The second IA\_PD has a new valid IA\_PD prefix.
26. TN2 transmits a Router Solicitation.
27. Observe the packets transmitted by the CE-Router.



*Part D: Change Prefix Length*

28. [Common Test Setup 1.1](#) is performed.
29. TN2 transmits a Router Solicitation.
30. Observe the packets transmitted by the CE-Router.
31. TN2 transmits an ICMPv6 Echo Request to CE-Router global address on the LAN interface.
32. Observe the packets transmitted by the CE-Router.
33. TN1 transmits a DHCPv6 Reconfigure to CE-Router.
34. Observe the packets transmitted by the CE-Router.
35. TN1 responds to the DHCPv6 Renew message with DHCPv6 Reply with a DHCPv6 Reply with an IA\_PD containing the same prefix but using a different prefix length then step 40.
36. TN2 transmits a Router Solicitation.
37. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*
  - Step 3:** The CE-Router must transmit a Router Advertisement that contains a PIO with a prefix from the IA\_PD from Step 1 on the LAN network.
  - Step 5:** The CE-Router must transmit an Echo Reply to TN2.
  - Step 8:** The CE-Router must transmit a Router Advertisement that contains a PIO with a prefix from the second IA\_PD from Step 6. The Router Advertisement must not contain the prefix from IA\_PD from Step 1 or the preferred lifetime of the prefix from the IA\_PD must be zero. The valid lifetime in the PIO must not be greater then the valid lifetime in the IA\_PD.
- *Part B*
  - Step 11:** The CE-Router must transmit a Router Advertisement that contains a PIO with a prefix from the IA\_PD from Step 9 on the LAN network.
  - Step 13:** The CE-Router must transmit an Echo Reply to TN2.
  - Step 17:** The CE-Router must transmit a Router Advertisement that contains a PIO with a prefix from the second IA\_PD from Step 14. The Router Advertisement must not contain the prefix from IA\_PD from Step 9 or the preferred lifetime of the prefix from the IA\_PD must be zero.
- *Part C*
  - Step 20:** The CE-Router must transmit a Router Advertisement that contains a PIO with a prefix from the IA\_PD from Step 18 on the LAN network.
  - Step 22:** The CE-Router must transmit an Echo Reply to TN2.
  - Step 24:** The CE-Router must transmit a DHCPv6 Renew message.
  - Step 27:** The CE-Router must transmit a Router Advertisement that contains a PIO with a prefix from the second IA\_PD from Step 25. The Router Advertisement must not contain the prefix from IA\_PD from Step 18 or the preferred lifetime of the prefix from the IA\_PD must be zero. The valid lifetime in the PIO must not be greater then the valid lifetime in the IA\_PD.
- *Part D*
  - Step 30:** The CE-Router must transmit a Router Advertisement that contains a PIO with a prefix from the IA\_PD from Step 28 on the LAN network.
  - Step 32:** The CE-Router must transmit an Echo Reply to TN2.
  - Step 34:** The CE-Router must transmit a DHCPv6 Renew message.



**Step 36:** The CE-Router must transmit a Router Advertisement that contains a PIO with a prefix from the IA\_PD from Step 35.

**Step 37:** The CE-Router must transmit a Router Advertisement that contains a RIO with an updated prefix length in Step 35.

**Possible Problems:**

- None.



## Test CERouter.2.7.6: Unknown Prefix

**Purpose:** Verify an IPv6 CE Router properly transmits ICMPv6 Destination Unreachable messages for packets forwarded to it that use an address from a prefix that has been invalidated.

### References:

- [RFC 7084] – L-14

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. TN2 transmits an ICMPv6 Echo Request to TN1 using a source address that is not advertised by the CE-Router.
2. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router must not forward the ICMPv6 Echo Request from TN2 to TN1. The CE-Router must send an ICMPv6 Destination Unreachable message with code 5 to TN2.

### Possible Problems:

- None.



## Test CERouter.2.7.7: Unique Local Address Prefix

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

### References:

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

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of part A and B. 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 by the CE-Router.

#### *Part B: Reboot*

3. Configure CE-Router to generate ULA prefix.
4. Observe the packets transmitted by the CE-Router.
5. Reboot the CE-Router.
6. Observe the packets transmitted by the CE-Router.

#### *Part C: Only ULA address*

7. Reboot the CE-Router.
8. Configure the CE-Router to generate ULA prefix.
9. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** The CE-Router must transmit a Router Advertisement that contains a PIO with a valid Unique Local Address.
- *Part B*  
**Step 4:** The CE-Router must transmit a Router Advertisement that contains a PIO with a valid Unique Local Address.  
**Step 6:** The CE-Router must transmit a Router Advertisement that contains a PIO with the same Unique Local Address as Step 4.
- *Part C*  
**Step 9:** The CE-Router must transmit a Router Advertisement with a Router Lifetime of zero.

### Possible Problems:

- The device may not support generation of Unique Local Addresses.



## **Section 3: Forwarding**

### **Scope**

The following tests cover IPv6 CE Router forwarding packets between the LAN and WAN interfaces.

### **Overview**

The tests in this group verify that a node properly forwards IPv6 traffic between the LAN and WAN interfaces.





## **Group 1: RFC 2460, 4861, 4443**

### **Scope**

The following tests cover the base specification for Internet Protocol version 6, Request For Comments 2460. The base specification specifies the basic IPv6 header and the initially defined IPv6 extension headers and options. It also discusses packet size issues, the semantics of flow labels and traffic classes, and the effects of IPv6 on upper-layer protocols.

The following tests cover the Neighbor Discovery Specification for Internet Protocol version 6, Request For Comments 4861. The Neighbor Discovery protocol is used by nodes to determine the link-layer address for neighbors known to reside on attached links as well as to quickly purge cached values that become invalid. Hosts also use Neighbor Discovery to find neighboring routers that are willing to forward packets on their behalf. Finally, nodes use the protocol to actively keep track of neighbors that are reachable and those that are not. When a router or the path to a router fails, a host actively searches for functioning alternates.

### **Overview**

These tests are designed to verify the readiness of an IPv6 implementation vis-à-vis the Neighbor Discovery specification.



## Test CERouter.3.1.1: IP Forwarding – Source and Destination Address

**Purpose:** Verify an IPv6 CE Router properly node properly forwards the ICMPv6 Echo Request.

### References:

- [RFC 7084] – G-1
- [ICMPv6] – Section 2.2, 4.2

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Request sent to Global Unicast Address*

1. TN2 transmits an ICMPv6 Echo Request to TN1's Global unicast address with a first hop through the CE-Router. The source address is TN2's Global address.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Request sent from unspecified address*

3. TN2 transmits an ICMPv6 Echo Request to TN1 with a first hop through the CE-Router. The source address is the unspecified address (0:0:0:0:0:0).
4. Observe the packets transmitted by the CE-Router.

#### *Part C: Request sent to Loopback address*

5. TN2 transmits an ICMPv6 Echo Request to the Loopback address (0:0:0:0:0:0:1) with a first hop through the CE-Router. The source address is TN2's Global address.
6. Observe the packets transmitted by the CE-Router.

#### *Part D: Request sent from Link-Local address*

7. TN2 transmits an ICMPv6 Echo Request to TN1's Global unicast address with a first hop through the CE-Router. The source address is TN2's Link Local address.
8. Observe the packets transmitted by the CE-Router.

#### *Part E: Request to Link-Local Address*

9. TN2 transmits an ICMPv6 Echo Request to TN1's Link-Local unicast address with a first hop through the CE-Router. The source address is TN2's Global address.
10. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router must forward the Echo Request to TN1.
- *Part B*  
**Step 4:** CE-Router must not forward the Echo Request to TR1.
- *Part C*  
**Step 6:** CE-Router must not forward the Echo Request to TR1.
- *Part D*  
**Step 8:** CE-Router must not forward the Echo Request to TR1.
- *Part E*  
**Step 10:** CE-Router must not forward the Echo Request to TR1.



**Possible Problems:**

- None.



### Test CERouter.3.1.2: Flow Label Non-Zero

**Purpose:** Verify an IPv6 CE Router properly forwards the Flow Label field of received packets.

**References:**

- [RFC 7084] – G-1
- [IPv6-SPEC] – Section 6, Appendix A

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A
IPv6 Header
Flow Label: 214375
Next Header: 58
ICMPv6 Echo Request

**Procedure:**

1. TN2 transmits Packet A, an Echo Request with a Flow Label 0x34567 to TN1’s Global address with a first hop through the CE-Router.
2. Observe the packets transmitted by the CE-Router.

**Observable Results:**

**Step 5:** CE-Router must forward the Echo Request from TN2 to TN1. If the CE-Router does not support the use of the Flow Label field, it must be unchanged in the forwarded packet.

**Possible Problems:**

- None.



### Test CERouter.3.1.3: Payload Length

**Purpose:** Verify an IPv6 CE Router properly forwards the Payload Length field of received packets.

**References:**

- [RFC 7084] – G-1
- [IPv6-SPEC] – Section 3

**Test Setup:** [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: Forward Payload Length Odd*

1. TN2 transmits Packet A, an Echo Request with a destination to TN1 and has an IPv6 header with a Payload Length of 0x33 (51) with a first hop through the CE-Router.
2. Observe the packets transmitted by the CE-Router.

*Part B: Forward Payload Length Even*

3. TN2 transmits Packet A, an Echo Request with a destination to TN1 and has an IPv6 header with a Payload Length of 0x32 (50) with a first hop through the CE-Router
4. Observe the packets transmitted by the CE-Router.

**Observable Results:**

- *Part A*  
**Step 5:** CE-Router must forward the Echo Request from TN2 to TN1.
- *Part B*  
**Step 13:** CE-Router must forward the Echo Request from TN2 to TN1.

**Possible Problems:**

- None.



### **Test CERouter.3.1.4: No Next Header After IPv6 Header**

**Purpose:** Verify an IPv6 CE Router properly process when it encounters a Next Header value of 59 (no next header).

#### **References:**

- [RFC 7084] – G-1
- [IPv6-SPEC] – Section 4.7

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### **Procedure:**

1. TN2 transmits Packet A, an Echo Request containing an IPv6 header with a Next Header of 59 to TN1's Global address with a first hop through the CE-Router.
2. Observe the packets transmitted by the CE-Router.

#### **Observable Results:**

**Step 5:** CE-Router must forward Packet A to TN1. The octets after the IPv6 header with a Next Header field of 59 (the ICMPv6 Request octets) must be unchanged.

#### **Possible Problems:**

- None.



## Test CERouter.3.1.5: Hop Limit Decrement

**Purpose:** Verify an IPv6 CE Router properly process the Hop Limit Field of received packets.

### References:

- [RFC 7084] – G-1
- [IPv6-SPEC] – Sections 3 and 8.2

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. TN2 transmits Packet A to TN1's Global Address with a first hop through the CE-Router. The Hop Limit field is set to 15.
2. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router should forward Packet A to TN1. The Hop Limit field must be decremented to 14.

### Possible Problems:

- None.



## Test CERouter.3.1.6: No Next Header after Extension Header

**Purpose:** Verify an IPv6 CE Router properly handle a Next Header value of 59 (no next header).

### References:

- [RFC 7084] – G-1
- [IPv6-SPEC] – Section 4.7

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. TN2 transmits Packet A to TN1 with a first hop through the CE-Router. Packet A contains a Destination Options header with a Next Header of 59. Following the Destination Options header is an ICMPv6 Echo Request header
2. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 2:** CE-Router must forward Packet A to TN2 on WAN. The octets past the end of the header whose Next Header field contains 59 must be unchanged.

### Possible Problems:

- None.





### Test CERouter.3.1.7: Options Processing Hop-by-Hop Options Header

**Purpose:** Verify an IPv6 CE Router properly process both known and unknown options, and acts in accordance with the highest order two bits of the option.

**References:**

- [RFC 7084] – W-1

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

Packet A	Packet B
IPv6 Header Next Header: 0	IPv6 Header Next Header: 0
Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: Pad1 Option: Pad1 Option: Pad1 Option: Pad1 Option: Pad1 Option: Pad1	Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: PadN Opt Data Len: 4
ICMPv6 Echo Request	ICMPv6 Echo Request

Packet C	Packet D
IPv6 Header Next Header: 0	IPv6 Header Next Header: 0
Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 7 (unknown, msb: 00 <sub>b</sub> ) Opt Data Len: 4	Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 71 (unknown, msb: 01 <sub>b</sub> ) Opt Data Len: 4
ICMPv6 Echo Request	ICMPv6 Echo Request

Packet E	Packet F
IPv6 Header Next Header: 0	IPv6 Header Next Header: 0
Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 135 (unknown, msb: 10 <sub>b</sub> ) Opt Data Len: 4	Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 199 (unknown, msb: 11 <sub>b</sub> ) Opt Data Len: 4
ICMPv6 Echo Request	ICMPv6 Echo Request

Packet G	Packet H
----------	----------



IPv6 Header Destination Address: Global Scope Multicast Next Header: 0	IPv6 Header Destination Address: Global Scope Multicast TR1 Next Header: 0
Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 135 (unknown, msb: 10 <sub>b</sub> ) Opt Data Len: 4	Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 199 (unknown, msb: 11 <sub>b</sub> ) Opt Data Len: 4
ICMPv6 Echo Request	ICMPv6 Echo Request

### Procedure:

#### Part A: Pad1 Option

1. TN2 transmits Packet A to TN1 with a first hop through the CE-Router, an Echo Request that has a Hop-by-Hop Options header with six Pad1 Options.
2. Observe the packets transmitted by the CE-Router.

#### Part B: PadN Option

3. TN2 transmits Packet B to TN1 with a first hop through the CE-Router, an Echo Request that has a Hop-by-Hop Options header with a 4 byte PadN Option.
4. Observe the packets transmitted by the CE-Router.

#### Part C: Most Significant Bits 00<sub>b</sub>

5. TN2 transmits Packet C to TN1 with a first hop through the CE-Router, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 7.
6. Observe the packets transmitted by the CE-Router.

#### Part D: Most Significant Bits 01<sub>b</sub>

7. TN2 transmits Packet D to TN1 with a first hop through the CE-Router, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 71.
8. Observe the packets transmitted by the CE-Router.

#### Part E: Most Significant Bits 10<sub>b</sub>, unicast destination

9. TN2 transmits Packet E to TN1 with a first hop through the CE-Router, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 135.
10. Observe the packets transmitted by the CE-Router.

#### Part F: Most Significant Bits 11<sub>b</sub>, unicast destination

11. TN2 transmits Packet F to TN1 with a first hop through the CE-Router, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 199.
12. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router must forward the Echo Request to TN1.
- *Part B*  
**Step 4:** CE-Router must forward the Echo Request to TN1.
- *Part C*



**Step 6:** The unknown option is skipped and the header is processed. CE-Router must forward the Echo Request to TN1.

- *Part D*

**Step 8:** CE-Router must not forward the Echo Request to TN1.

- *Part E*

**Step 10:** CE-Router must discard and not forward the Echo Request to TN1.

- *Part F*

**Step 12:** CE-Router must discard and not forward the Echo Request to TN1.

**Possible Problems:**

- None.



## Test CERouter.3.1.8: Packet Too Big Message Generation

**Purpose:** Verify an IPv6 CE Router properly generates a Packet Too Big Message.

### References:

- [RFC 7084] – W-1

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. Configure CE-Router's WAN1 to have an MTU of 1280.
2. TN2 transmits an Echo Request to TN1 using the CE-Router as the first-hop with a packet size of 1500 octets.
3. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 3:** CE-Router must transmit a Packet Too Big message to TN2, as it could not forward the Echo Request due to PMTU limitations.

- The MTU field of Packet Too Big Message should be set to 1280.
- The Source Address of the Packet should be one of the RUT's unicast addresses.
- The Destination Address should be the same as the Source Address in TN2's Echo Request packet. The Code field should be set to "0".
- The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU.

### Possible Problems:

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



### Test CERouter.3.1.9: Hop Limit Exceeded (Time Exceeded Generation)

**Purpose:** Verify an IPv6 CE Router properly generates Time Exceeded Message when the Hop Limit was exceeded in transit.

#### References:

- [RFC 7084] – G-1
- [ICMPv6] – Section 2.2, 2.4, 3.3

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

#### Packet A (Echo Request)

IPv6 Header Payload Length: 64 bytes Next Header: 58 Hop Limit: 0
ICMPv6 Header Type: 128 Code: 0

#### Packet B (Echo Request)

IPv6 Header Payload Length: 64 bytes Next Header: 58 Hop Limit: 1
ICMPv6 Header Type: 128 Code: 0

#### Procedure:

##### *Part A: Receive Hop Limit 0*

1. TN2 transmits the Packet A Echo Request to TN1 with a first hop of the CE-Router.
2. Observe the packets transmitted by the CE-Router.

##### *Part B: Decrement Hop Limit to 0*

3. TN2 transmits the Packet A Echo Request to TN1 with a first hop of the CE-Router.
4. Observe the packets transmitted by the CE-Router.

#### Observable Results:

- *Part A*

**Step 2:** CE-Router must discard the ICMPv6 Echo Request from TN2. Therefore, it must not forward the Echo Request to TN1. The CE-Router should send a Time Exceeded Message to TN2 with a code field value of 0 (Hop Limit Exceeded in transit).

- The unused field must be initialized to zero.



- The Source Address of the Packet should be one of the CE-Router's unicast addresses used for packet forwarding.
  - The Destination Address should be the same as TN2's Source Address.
  - The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU.
- *Part B*
    - Step 4:** CE-Router must discard the ICMPv6 Echo Request from TN2. Therefore, it must not forward the Echo Request to TN1. The CE-Router should decrement the Hop Limit to 0 and send a Time Exceeded Message to TN2 with a code field value of 0 (Hop Limit Exceeded in transit).
      - The unused field must be initialized to zero.
      - The Source Address of the Packet should be one of the CE-Router's unicast addresses used for packet forwarding.
      - The Destination Address should be the same as TN2's Source Address.
      - The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU.

**Possible Problems:**

- None.



## Test CERouter.3.1.10: Error Condition With ICMPv6 Error Message

**Purpose:** Verify an IPv6 CE Router properly handles the reception and processing of an ICMPv6 Error message that invokes an error.

### References:

- [RFC 7084] – G-1
- [ICMPv6] – Section 2.4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of this test part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: Reception of Flawed Destination Unreachable Code 0 with Address Unreachable*

1. TN2 transmits a Destination Unreachable Error Message for “No Route To Destination” to the CE-Router with the Destination Address set to an on-link address that does not exist.
2. Observe the packets transmitted by the CE-Router.

#### *Part B: Reception of Flawed Destination Unreachable Code 3 with Hop Limit = 0*

3. TN2 transmits a Destination Unreachable Error Message for “Address Unreachable” to the CE-Router with the Hop Limit set to Zero in the IPv6 header and with a Destination Address set to an off-link address.
4. Observe the packets transmitted by the CE-Router.

#### *Part C: Reception of Flawed Time Exceeded Code 0 with No Route To Destination*

5. TN2 transmits a Time Exceeded Error Message for “Hop Limit Exceeded in Transit” to the CE-Router with the Destination Address set to a WAN off-link address that does not exist.
6. Observe the packets transmitted by the CE-Router.

#### *Part D: Reception of Flawed Time Exceeded Code 1 with No Route To Destination*

7. TN2 transmits a Time Exceeded Error Message for “Fragment Reassembly Time Exceeded” to the CE-Router with the Destination Address set to a WAN off-link address that does not exist.
8. Observe the packets transmitted by the CE-Router.

#### *Part E: Reception of Flawed Packet Too Big with Address Unreachable*

9. TN2 transmits a Packet Too Big Error Message to the CE-Router with the Destination Address set to an on-link address that does not exist.
10. Observe the packets transmitted by the CE-Router.

#### *Part F: Reception of Flawed Parameter Problem with Hop Limit = 0*

11. TN2 transmits a Parameter Problem Error Message to the CE-Router with the Hop Limit set to Zero in the IPv6 header and with a Destination Address set to an off-link address.
12. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 2:** CE-Router must not send a Destination Unreachable Error Message with Code 3 to TN2 when it receives a Destination Unreachable Message with Code 0 for which it cannot resolve a destination address.
- *Part B*



**Step 4:** CE-Router must not send a Time Exceeded message with Code 0 to TN2 when it receives a Destination Unreachable Message with Code 3 that contains a Hop Limit of 0.

- *Part C*

**Step 6:** CE-Router must not send a Destination Unreachable Error Message with code 0 to TN1 when it receives a Time Exceeded Message with Code 0 for which it cannot route.

- *Part D*

**Step 8:** CE-Router must not send a Destination Unreachable Error Message with code 0 to TN1 when it receives a Time Exceeded Message with Code 1 for which it cannot route.

- *Part E*

**Step 10:** CE-Router must not send a Destination Unreachable Error Message with code 3 to TN1 when it receives a Packet Too Big Message for which it cannot resolve a destination address.

- *Part F*

**Step 12:** CE-Router must not send a Time Exceeded Error Message with code 0 to TN1 when it receives a Parameter Problem Message that contains a Hop Limit of 0.

**Possible Problems:**

- None.





## **Group 2: 7084**

### **Scope**

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.

### **Overview**

These tests are designed to verify the readiness of an IPv6 implementation vis-à-vis the Neighbor Discovery specification.



## Test CERouter.3.2.1: IPv6 Forwarding before Address Acquisition

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

### References:

- [RFC 7084] – G-3

**Test Setup:** [Common Test Setup 1.1](#) 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. TN2 continuously transmits ICMPv6 Echo Request to TN1.
2. Power cycle the CE-Router.
3. [Common Test Setup 1.1](#) is performed.
4. Observe the packets transmitted by the CE-Router.

#### *Part B: WAN to LAN*

5. TN1 continuously transmits an ICMPv6 Echo Request to TN2.
6. Power cycle the CE-Router.
7. [Common Test Setup 1.1](#) is performed.
8. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*  
**Step 4:** CE-Router must not forward the ICMPv6 Echo Request to TN1 until it's received an IA\_PD.
- *Part B*  
**Step 8:** CE-Router must not forward the ICMPv6 Echo Request to TN2 until it's received an IA\_PD.

### Possible Problems:

- None.



## Test CERouter.3.2.2: No Default Route

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

### References:

- [RFC 7084] – G-4
- [RFC 7084] – G-5

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning part B. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

#### *Part A: No Default Route*

1. [Common Test Setup 1.1](#) is performed with the exception that TR1 transmits Router Advertisement with a Router Lifetime of 0.
2. TN2 transmits a Router Solicitation.
3. Observe the packets transmitted by the CE-Router.
4. TN2 transmits ICMPv6 Echo Request to TN3.
5. Observe the packets transmitted by the CE-Router.

#### *Part B: Loses Default Route*

6. TN2 transmits a Router Solicitation.
7. Observe the packets transmitted by the CE-Router.
8. TN2 transmits ICMPv6 Echo Request to TN3.
9. Observe the packets transmitted by the CE-Router.
10. TR1 transmits a Router Advertisement with a lifetime of 0.
11. TN2 transmits a Router Solicitation.
12. Observe the packets transmitted by the CE-Router.
13. TN2 transmits ICMPv6 Echo Request to TN3.
14. Observe the packets transmitted by the CE-Router.

### Observable Results:

- *Part A*
  - Step 3:** CE-Router must not transmit Router Advertisements with a Router Lifetime greater than zero.
  - Step 5:** CE-Router must not forward the Echo Request from TN2 to TN3.
- *Part B*
  - Step 7:** CE-Router must transmit a Router Advertisement with a Router Lifetime greater than zero.
  - Step 9:** CE-Router must forward the Echo Request from TN2 to TN3.
  - Step 12:** CE-Router must not transmit Router Advertisements with a Router Lifetime greater than zero.
  - Step 14:** CE-Router must not forward the Echo Request from TN2 to TN3.

### Possible Problems:



- None.



### Test CERouter.3.2.3: 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:** [Common Test Setup 1.1](#) is performed at the beginning of each part. TN1 to delegate a prefixes larger than CE-Router can delegate. The [Common Test Cleanup](#) procedure is performed after each part.

#### Procedure:

1. TN2 transmits ICMPv6 Echo Request to an address that was not assigned to a LAN interface.
2. Observe the packets transmitted on WAN.
3. TR1 transmits ICMPv6 Echo Request to an address that was not assigned to a LAN interface.
4. Observe the packets transmitted on LAN.

#### Observable Results:

**Step 2:** CE-Router should not transmit any ICMPv6 Echo Request to TR1. CE-Router should transmit an ICMPv6 Destination Unreachable message to TN2.

**Step 4:** CE-Router should not transmit any ICMPv6 Echo Request to LAN or TR1. CE-Router should transmit an ICMPv6 Destination Unreachable message to TR1.

#### Possible Problems:

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



## Test CERouter.3.2.4: Unique Local Address Forwarding

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

### References:

- [RFC 7084] – ULA- 4

**Test Setup:** [Common Test Setup 1.1](#) is performed at the beginning of each part. The [Common Test Cleanup](#) procedure is performed after each part.

### Procedure:

1. Configure CE-Router to generate ULA prefix.
2. TN2 transmits ICMPv6 Echo Request to TN1 using a Unique Local Address source address assigned by the CE-Router.
3. Observe the packets transmitted by the CE-Router.

### Observable Results:

**Step 3:** CE-Router should not transmit any ICMPv6 Echo Request to TN1.

### Possible Problems:

- The Device may not support generation of Unique local addresses.