IPv6 Ready

Core Protocols Test Specification

Technical Document
Revision 5.1.4

IPv6 Forum *http://www.ipv6forum.org*
Converged Test Specification *http://www.ipv6ready.org*
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Table of Contents

Acknowledgements

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Introduction

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. It is also a clear indication that the technology will still be used in the future. This logo program contributes to the feeling that IPv6 is available and ready to be used.

Definitions

DAD	Duplicate Address Detection
HUT	Host Under Test
MTU	Maximum Transmission Unit
NCE	Neighbor Cache Entry
NUT	Node Under Test
RUT	Router Under Test
TLLA	Target Link-layer Address
TN	Test Node
TR	Test Router

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** is the first line of the test page. It will have the following form: IP.IOP.A.B Where each component indicates the following: IP – Test Suite Identifier IOP – Interoperability Test Suite A – Group Number B – Test Number Scripts implementing this test suite should follow this convention, and may also append a character in the set [a-z] indicating a particular test part.
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.
Advanced Functionality	The **Advanced Functionality** gives an indication of whether the test case is covered by one or more optional functions as defined in the Advanced Functionality Tests. These tests may be omitted if the functionality is not supported by the Node Under Test. If this is not in a test case, there are no advanced functionalities listed.
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 for that parameter.
Procedure and Expected Behavior	The **Procedure and Expected Behavior** table 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 of expected behavior, as needed, as not all steps require observation of results. If any behavior is expected for a procedure, it is to be observed prior to continuing to the next step. Failure to observe any behavior prior to continuing constitutes a failed test. Note, that while test numbers continue between test parts, each test part is to be executed independently (Following Common Test Setup and Cleanup as indicated), and are not cascaded from the previous part.
Possible Problems	The **Possible Problems** section contains a description of known issues with the test procedure, which may affect test results in certain situations.

References

The following documents are referenced in these texts:

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

[DS-FIELD] Nichols, K., S. Blake, F. Baker, and D. Black, Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers, RFC 2474, December 1998.

[ECN] Ramakrishnan, K., S. Floyd, and D. Black, The Addition of Explicit Congestion Notification (ECN) to IP, RFC 3168, September 2001.

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

[IPv6-ARCH] Hinden, R., S. Deering, Internet Protocol, Version 6 Addressing Architecture, RFC 4291, February 2006.

[IPv6-SPEC] Hinden, R., S. Deering, Internet Protocol, Version 6 (IPv6) Specification, RFC 8200, July 2017.

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

[PMTU] McCann, J., S. Deering, J. Mogul, and R. Hinden, Path MTU Discovery for IPv6, RFC 8201, July 2017.

[RFC-4191] R. Draves, D. Thaler, Default Router Preferences and More-Specific Routes, RFC 4191, November 2005.

[RFC-6980] F. Gont, Security Implications of IPv6 Fragmentation with IPv6 Neighbor Discovery, RFC 6980, August 2013.

[STABLE-ID] F. Gont, A Method for Generating Semantically Opaque Interface Identifiers with IPv6 Stateless Address Autoconfiguration (SLAAC), RFC 7217, April 2014.

[RA-DNS] J.Jeong, S. Park, L.Beloeil, and S.Mandadapalli, IPv6 Router Advertisement Options for DNS Configuration, RFC 8106, March 2017.

[RFC-7608] M.Boucadair, A.Petrescu, F.Baker. "IPv6 Prefix Length Recommendation for Forwarding". RFC 7608, July 2015.

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. If the NUT is a Router, the NUT must set the IsRouter flag to true for each interface.

Common Test Setup 1.1

Summary: This minimal setup procedure provides the NUT with a default router TR1, a global prefix, and ensures that the NUT can communicate with TR1.

1. If the NUT is a host, TR1 transmits a Router Advertisement to the all-nodes multicast address. The Router Advertisement includes a Prefix Advertisement with a global prefix and the L and A bits set. This should cause the NUT to add TR1 to its Default Router List, configure a global address, and compute Reachable Time. The Router and Prefix Lifetimes are long enough such that they do not expire during the test.
2. If the NUT is a router, configure a default route with TR1 as the next hop.
3. 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.

Common Test Setup 1.2

Summary: This minimal setup procedure provides the NUT with two routers TR1 and TR2, a global prefix, and ensures that the NUT can communicate with TR1 and TR2.

1. TR1 and TR2 each transmit a Router Advertisement to the all-nodes multicast address. The Router Advertisements include a Prefix Advertisement with a global prefix and the L and A bits set. This should cause the NUT to add TR1 and TR2 to its Default Router List, configure a global address, and compute Reachable Time. The Router and Prefix Lifetimes are long enough such that they do not expire during the test. (If the NUT is a router, configure it to have an address with the advertised prefix.)
2. TR1 and TR2 each transmit an Echo Request to the NUT and respond to Neighbor Solicitations from the NUT. Wait for Echo Replies from the NUT. This should cause the NUT to resolve the addresses of TR1 and TR2 and create a Neighbor Cache entry for each router in state REACHABLE.

Common Test Setup 1.3

Summary: This minimal setup procedure provides the NUT with three default routers TR1, TR2, and TR3, a global prefix, and ensures that the NUT can communicate with TR1, TR2, and TR3.

1. TR1, TR2, and TR3 each transmit a Router Advertisement to the all-nodes multicast address. The Router Advertisements include a Prefix Advertisement with a global prefix and the L and A bits set. This should cause the NUT to add all three routers to its Default Router List, configure a global address, and compute Reachable Time. The Router and Prefix Lifetimes are long enough such that they do not expire during the test.
2. TR1, TR2, and TR3 each transmit an Echo Request to the NUT and respond to Neighbor Solicitations from the NUT. Wait for Echo Replies from the NUT. This should cause the NUT to resolve the addresses of all three routers and create a Neighbor Cache entry for each router in state REACHABLE.

Common Test Cleanup

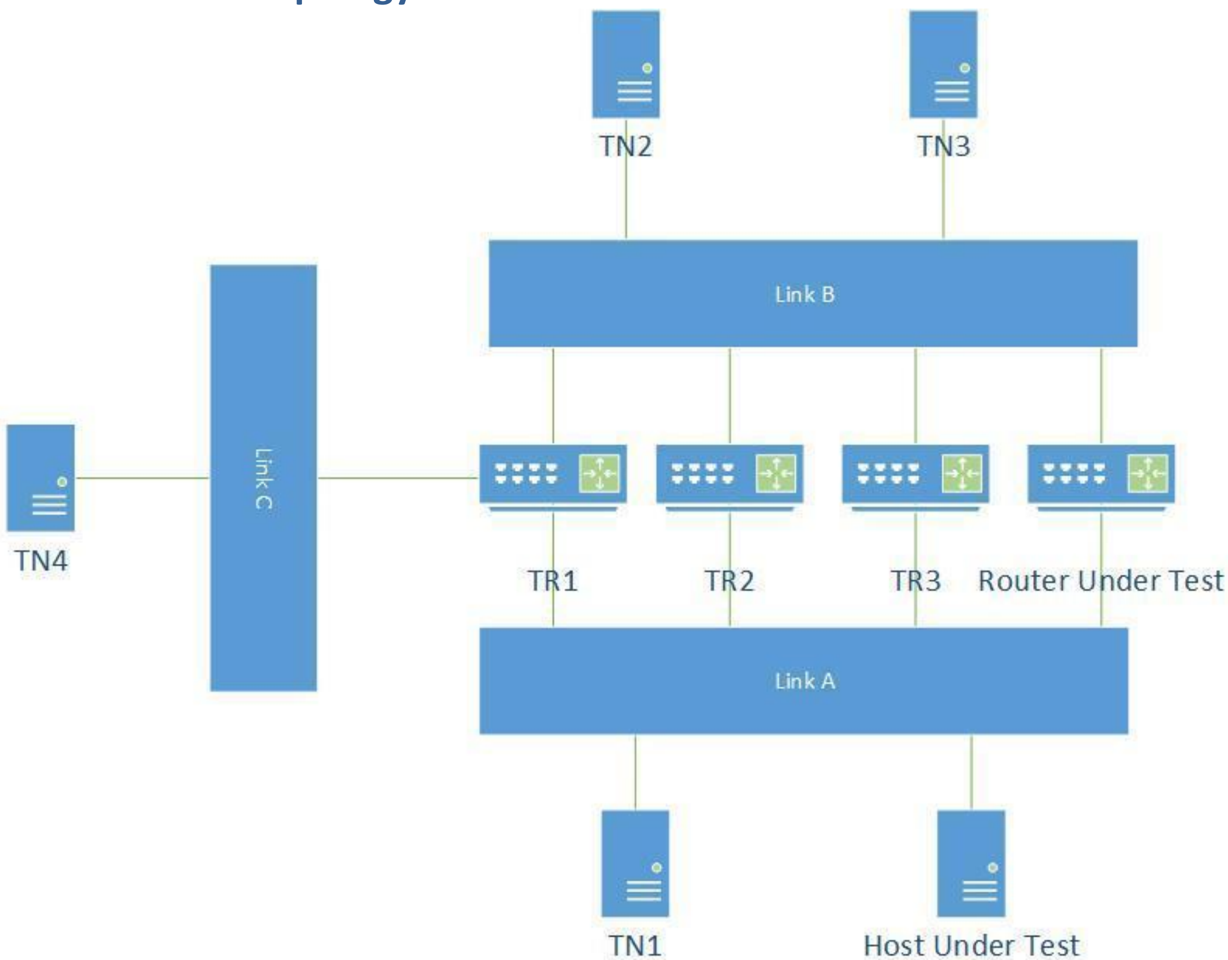
Summary: The Cleanup procedure should cause the NUT to transition Neighbor Cache entries created in this test to state No NCE and remove any entries from its Default Router and Prefix Lists.

1. If a TR transmitted a Router Advertisement in the Test Setup or Procedure, that TR transmits a Router Advertisement with the Router Lifetime and each Prefix Lifetime, if applicable, set to zero.
2. Each TR or TN in the test transmits a Neighbor Advertisement for each Neighbor Cache Entry with a Target Link-layer Address Option containing a different cached address. The Override flag should be set.
3. Each TR or TN transmits an Echo Request to the NUT and waits for an Echo Reply.
4. Each TR or TN does not respond to further Neighbor Solicitations.

Common Defaults (for all tests)

Link MTU set to the associated media type default MTU for all nodes on all interfaces. If the NUT is a Router configure a global address on its interface on Link A associated with prefix X and Link B associated with prefix Y.

Common Test Topology



Advanced Functionality Tests

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

Transmitting Echo Requests (Passive Node):

- v6LC.2.2.25
- v6LC.4.1.10
- v6LC.4.1.11
- v6LC.5.1.1

Configuring Multicast Packet Size:

- v6LC.4.1.10
- v6LC.4.1.11

Multicast Routing:

- v6LC.1.1.10 H, I, J, K
- v6LC.1.2.7 G, H
- v6LC.5.1.4 B

Processing Route Information Options (RFC 4191 Type C Host):

- v6LC.2.2.23

Router Advertisement DNS (Host Only):

- v6LC.2.2.25

Duplicate Overlapping Fragments:

- v6LC.1.3.5 C, G

Beyond Scope of Source Address:

- v6LC.5.1.3 E

Tracking Connections for ICMPv6:

- v6LC.4.1.12

Possible Problem Summary

The following test cases have documented possible problems that allow for altered or omitted steps in their procedures. Please see each specific test case listed for more information:

- v6LC.1.2.6: Options Processing, Hop-by-Hop Options Header – End Node
- v6LC.1.2.7: Options Processing, Hop-by-Hop Options Header – Intermediate Node
- v6LC.2.1.1: On-link Determination
- v6LC.2.1.11: Neighbor Solicitation Processing: NCE State STALE
- v6LC.2.1.19: Neighbor Advertisement Processing: NCE State STALE
- v6LC.2.2.1: Router Solicitations
- v6LC.2.2.2: Router Solicitations, Solicited Router Advertisement
- v6LC.2.2.7: Sending Unsolicited Router Advertisements
- v6LC.2.2.24: Router Advertisement DNS
- v6LC.4.1.10: Multicast Destination – One Router
- v6LC.4.1.11: Multicast Destination – Two Router

Section 1: IPv6 Standard

Overview: The following tests cover the base specification for Internet Protocol version 6, Request For Comments 8200. 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.

Default Packets

IPv6 Header
Version: 6 Traffic Class: 0 Flow Label: 0 Next Header: 59 (None) Hop Limit: 255 Destination Address: NUT's Link-local Address

Echo Request
IPv6 Header Payload Length: 16 Next Header: 58
ICMPv6 Header Type: 128 Code: 0

Neighbor Advertisement
IPv6 Header Next Header: 58 Destination Address: NUT
Neighbor Advertisement Router flag: 0 for TN1, 1 for TR1 Solicited flag: 1 Override flag: 1 Target Address: TN1/TR1's Link-local Address

Group 1: IPv6 Header

Scope

The following tests cover the fields in the basic IPv6 header.

Overview

Tests in this group verify that a node properly processes and generates the Version, Traffic Class, Flow Label, Payload Length, Next Header, and Hop Limit fields in the IPv6 header. These tests also verify a node transmits the appropriate ICMPv6 Parameter Problem messages in response to invalid or unknown fields.

Test v6LC.1.1.1: Version Field

Purpose: Verify that a node properly processes the Version field of received packets.

Reference:

- [IPv6-SPEC] – Section 3

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Packet A
IPv6 Header Version: [See below]
ICMPv6 Echo Request

Procedure:

Step	Action	Expected Behavior
1.	TN1 transmits Packet A to the NUT, which has an IPv6 header with Version field of 4.	
2.	TN1 transmits an Echo Request to the NUT.	The NUT must not crash or generate invalid packets. In Step 2, the NUT must respond to the second Echo Request from TN1.
3.	Repeat Steps 1 and 2 with a Version Field of 0, 5, 7, 15.	

Possible Problems: None.

Test v6LC.1.1.2: Traffic Class Non-Zero – End Node

Purpose: Verify that a node properly processes the Traffic Class field of received packets and generates a valid value in transmitted packets.

Reference:

- [IPv6-SPEC] – Section 7
- [DS-FIELD] – Section 3
- [ECN] – Section 5

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Packet A
IPv6 Header Traffic Class: 32 Next Header: 58
ICMPv6 Echo Request

Procedure:

Step	Action	Expected Behavior
1.	TN1 transmits Packet A to the NUT, an Echo Request with a Traffic Class field of 32, which is non-zero.	The NUT must generate an Echo Reply. If the NUT supports a specific use of the Traffic Class field, the Traffic Class in the Echo Reply may be non-zero. Otherwise, the Traffic Class field should be zero.

Possible Problems: None.

Test v6LC.1.1.3: Traffic Class Non-Zero – Intermediate Node (Routers Only)

Purpose: Verify that a router properly processes the Traffic Class field of received packets and generates a valid value in transmitted packets.

Reference:
- [IPv6-SPEC] – Section 7
- [DS-FIELD] – Section 3
- [ECN] – Section 5

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Packet A
IPv6 Header Traffic Class: 32 Next Header: 58
ICMPv6 Echo Request

Procedure:

Step	Action	Expected Behavior
1.	TN1 transmits Packet A to TN2's Global Address with a first hop through the RUT, an Echo Request with a Traffic Class field of 32, which is non-zero.	The RUT must forward the Echo Request. If the RUT supports a specific use of the Traffic Class field, the Traffic Class in the Echo Request may be non-zero. Otherwise, the Traffic Class field should be passed on to TN2 unchanged.

Possible Problems: None.

Test v6LC.1.1.4: Flow Label Non-Zero

Purpose: Verify that a node properly processes the Flow Label field of received packets and generates a valid value in transmitted packets.

Reference:

- [IPv6-SPEC] – Section 6, Appendix A

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Packet A

Packet A
IPv6 Header Flow Label: 214375 Next Header: 58
ICMPv6 Echo Request

Procedure:

Part A: NUT receives Non-Zero Flow Label

Step	Action	Expected Behavior
1.	TN1 transmits Packet A, an Echo Request with a Flow Label of 0x34567 to the NUT.	The NUT must generate an Echo Reply. If the NUT 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.

Part B: RUT forwards Non-Zero Flow Label (Routers Only)

Step	Action	Expected Behavior
2.	TN1 transmits Packet A, an Echo Request with a Flow Label 0x34567 to TN2's Global address with a first hop through the RUT.	The RUT must forward the Echo Request from TN1 to TN2. If the RUT does not support the use of the Flow Label field, it must be unchanged in the forwarded packet.

Possible Problems: None.

Test v6LC.1.1.5: Payload Length

Purpose: Verify that a node properly processes the Payload Length field of received packets.

Reference:

- [IPv6-SPEC] – Section 3

Test Setup: No Common Test Setup is performed. 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

Step	Action	Expected Behavior
1.	TN1 transmits Packet A to the NUT, an Echo Request that has an IPv6 header with a Payload Length of 0x33 (51).	The NUT must generate an Echo Reply, indicating successful processing of the packet.

Part B: RUT forwards Payload Length Odd (Routers Only)

Step	Action	Expected Behavior
2.	TN1 transmits Packet A, an Echo Request with a destination to TN2 and has an IPv6 header with a Payload Length of 0x33 (51) with a first hop through the RUT.	The RUT must forward the Echo Request from TN1 to TN2.

Part C: Payload Length Even

Step	Action	Expected Behavior
3.	TN1 transmits Packet A to the NUT, an Echo Request that has an IPv6 header with a Payload Length of 0x32 (50).	The NUT must generate an Echo Reply, indicating successful processing of the packet.

Possible Problems: None.

Test v6LC.1.1.6: No Next Header after IPv6 Header

Purpose: Verify proper behavior of a node when it encounters a Next Header value of 59 (no next header).

Reference:
- [IPv6-SPEC] – Section 4.7

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Packet A

IPv6 Header Next Header: 59
ICMPv6 Echo Request

Procedure:

Part A: NUT Receives No Next Header

Step	Action	Expected Behavior
1.	TN1 transmits Packet A to the NUT, which contains an IPv6 header with a Next Header of 59. Following the IPv6 header is an ICMPv6 Echo Request Header.	The NUT must not send any packets in response to Packet A.

Part B: RUT Forwards No Next Header – (Routers Only)

Step	Action	Expected Behavior
2.	TN1 transmits Packet A, an Echo Request containing an IPv6 header with a Next Header of 59 to TN2's Global address with a first hop through the RUT.	The RUT must forward Packet A to TN2. The octets after the IPv6 header with a Next Header field of 59 (the ICMPv6 Request octets) must be unchanged

Possible Problems: None.

Test v6LC.1.1.7: Unrecognized Next Header

Purpose: Verify that a node generates the appropriate response to an unrecognized or unexpected Next Header field.

Reference:
- [IPv6-SPEC] – Section 4
- [ICMPv6] – Section 3.4

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Packet A

IPv6 Header Next Header: [See below]

Packet B

IPv6 Header Next Header: 60
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 0 ID: 135
ICMPv6 Echo Request

Procedure:

Part A: Unrecognized Next Header in IPv6 Header (Multiple Values)

Step	Action	Expected Behavior
1.	TN1 transmits Packet A to the NUT, which has an IPv6 header with a Next Header field of 146.	The NUT should send an ICMPv6 Parameter Problem message to TN1. The ICMPv6 Code field should be 1 (unrecognized Next Header type encountered). The ICMPv6 Pointer field should be 0x06 (offset of the Next Header field).
2.	TN1 transmits a valid Echo Request to the NUT.	The NUT must respond to the Echo Request from TN1.
3.	Repeat Steps 1 and 2 with all unrecognized Next Header values between 147 and 252 in Step 1.	

Part B: Unexpected Next Header in IPv6 Header

Step	Action	Expected Behavior
4.	TN1 transmits Packet B to the NUT, which has an IPv6 header with a Next Header field of 60. The actual extension header that follows is a Fragment header. The Fragment ID is 135.	The NUT would interpret the Fragment header as a Destination Options header. Thus, the Fragment ID would be interpreted as if it were an Option Type. The NUT should send an ICMPv6 Parameter Problem message to TN1. The Code field should be 2 (unrecognized IPv6 Option encountered). The Pointer field should be 0x2e (offset of the Fragment ID in the Fragment header). The NUT should discard Packet B and should not send an Echo Reply to TN1.

Possible Problems: None.

Test v6LC.1.1.8: Hop Limit Zero – End Node

Purpose: Verify that a node correctly processes the Hop Limit field of received packets and generates a valid value in transmitted packets.

Functionality Tag: Mandatory

Reference:

- [IPv6-SPEC] – Section 3 and 8.2

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Packet A
IPv6 Header Hop Limit: 0 Next Header: 58
ICMPv6 Echo Request

Procedure:

Step	Action	Expected Behavior
1.	TN1 transmits Packet A to the NUT, an Echo Request with a Hop Limit field of zero.	The NUT must generate an Echo Reply with a Hop Limit field value of greater than zero.

Possible Problems: None.

Test v6LC.1.1.9: Hop Limit Decrement – Intermediate Node (Routers Only)

Purpose: Verify that a router correctly processes the Hop Limit field of received packets and generates a valid value in transmitted packets.

Functionality Tag: Mandatory

Reference:

- [IPv6-SPEC] – Section 3 and 8.2

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Packet A
IPv6 Header Hop Limit: 15 Next Header: 58
ICMPv6 Echo Request

Procedure:

Step	Action	Expected Behavior
1.	TN1 transmits Packet A to TN2's Global Address with a first hop through the RUT. The Hop Limit field is set to 15.	The RUT should forward Packet A to TN2. The Hop Limit field should be decremented to 14.

Possible Problems: None.

Test v6LC.1.1.10: IP Forwarding –Source and Destination Address –Intermediate Node (Routers-Only)

Purpose: Verify that a router properly forwards the ICMPv6 Echo Requests.

Advanced Functionality:
- Multicast Routing

Reference:
- [IPv6-SPEC] – Section 2.2, 4.2.
- [IPv6-ARCH] – Section 2.1, 2.5.2, 2.5.6, 2.7, 2.7.1, 2.8

Test Setup: Common Test Setup 1.1 is performed. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Request sent to Global Unicast address

Step	Action	Expected Behavior
1.	TN2 transmits an ICMPv6 Echo Request to TN1's Global unicast address with a first hop through the RUT. The source address is TN2's Global address.	The RUT must forward the Echo Request to TN1.

Part B: Request sent to Global Unicast address (prefix end in zero-valued fields)

Step	Action	Expected Behavior
2.	TN2 transmits an ICMPv6 Echo Request to TN1's Global unicast address (prefix 8000:0000::/64) with a first hop through the RUT. The source address is TN2's Global address.	The RUT must forward the Echo Request to TR1.

Part C: Request sent from unspecified address

Step	Action	Expected Behavior
3.	TN2 transmits an ICMPv6 Echo Request to TN1 with a first hop through the RUT. The source address is the unspecified address (0:0:0:0:0:0:0:0).	The RUT must not forward the Echo Request to TR1.

Part D: Request sent to Loopback address

Step	Action	Expected Behavior
4.	TN2 transmits an ICMPv6 Echo Request to the Loopback address (0:0:0:0:0:0:0:1) with a first hop through the RUT. The source address is TN2's Global address.	The RUT must not forward the Echo Request to TR1.

Part E: Request sent from Link Local address

Step	Action	Expected Behavior
5.	TN2 transmits an ICMPv6 Echo Request to TN1 with a first hop through the RUT. The source address is TN2's Link Local address.	The RUT must not forward the Echo Request to TR1.

Part F: Request sent to Link Local address

Step	Action	Expected Behavior
6.	TN2 transmits an ICMPv6 Echo Request to TN1's Link Local address with a first hop through the RUT. The source address is TN2's Global address.	The RUT must not forward the Echo Request to TR1.

Part G: Request sent to Site-Local address

Step	Action	Expected Behavior
7.	TN2 transmits an ICMPv6 Echo Request to TN1's Site-local address with a first hop through the RUT. The source address is TN2's Global address.	The RUT must forward the Echo Request to TR1.

Part H: Request sent to Global Scope multicast address

Step	Action	Expected Behavior
8.	Configure multicast routing on the RUT.	
9.	TN2 is an MLD Listener for the multicast group FF1E::0:2.	
10.	TN1 transmits an ICMPv6 Echo Request to TN2's Global Scope multicast address (FF1E::0:2) with a first hop through the RUT. The source address is TN1's Global address.	The RUT must forward the Echo Request to Link B.

Part I: Request sent to Link-local Scope multicast address

Step	Action	Expected Behavior
11.	Configure multicast routing on the RUT.	
12.	TN2 is an MLD Listener for the multicast group FF12::0:2.	
13.	TN1 transmits an ICMPv6 Echo Request to TN2's Link-Local Scope multicast address (FF12::0:2) with a first hop through the RUT. The source address is TN1's Global address.	The RUT must not forward the Echo Request to Link B.

Part J: Request sent to Multicast address (Reserved Value = 0)

Step	Action	Expected Behavior
14.	Configure multicast routing on the RUT.	
15.	TN2 is an MLD Listener for the multicast group FF10::0:2.	
16.	TN1 transmits an ICMPv6 Echo Request to a multicast address with a reserved field set to zero (FF10::0:2) with a first hop through the RUT. The source address is TN1's Global address.	The RUT must not forward the Echo Request to Link B.

Part K: Request sent to Multicast address (Reserved Value = F)

Step	Action	Expected Behavior
17.	Configure multicast routing on the RUT.	
18.	TN2 is an MLD Listener for the multicast group FF1F::1:2.	
19.	TN1 transmits an ICMPv6 Echo Request to TN2's multicast address with a reserved field set to F (FF1F::0:2) with a first hop through the RUT. The source address is TN1's Global address.	The RUT must forward the Echo Request to Link B.

Possible Problems: For Parts H-K, PIM-SM may need to be enabled on routers that perform RPF lookups.

Test v6LC.1.1.11: IP Forwarding – Routing prefixes greater than 64 bits (Routers-only)

Purpose: Verify that a router properly routes prefixes greater than 64-bits.

Reference:
- [RFC-7608] Section 2

Test Setup: The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Prefix Route /65

Step	Action	Expected Behavior
1.	Configure the RUT to have a route with a prefix length of /65 for Link C with a next-hop router of TR2. A default route should be configured to TR1.	
2.	TN4 has an address which matches the /65 prefix for Link C for the first 64 bits.	
3.	TN2 transmits an ICMPv6 Echo Request to TN4's address with a first hop through the RUT. The source address is TN2's Global address.	The RUT must forward the Echo Request to TR1. The destination MAC address must be TR1's MAC address.
4.	TN4 has an address in the /65 prefix for Link C.	
5.	TN2 transmits an ICMPv6 Echo Request to TN4's address with a first hop through the RUT. The source address is TN2's Global address.	The RUT must forward the Echo Request to TR2. The destination MAC address must be TR2's MAC address.
6.	TN4 has an address in the /65 prefix for Link C and has the 66^{th} bit set to 1.	
7.	TN2 transmits an ICMPv6 Echo Request to TN4's address with a first hop through the RUT. The source address is TN2's Global address.	The RUT must forward the Echo Request to TR2. The destination MAC address must be TR2's MAC address.

Part B: Prefix Route /96

Step	Action	Expected Behavior

8.	Configure the RUT to have a route with a prefix length of /96 for Link C with a next-hop router of TR2. A default route should be configured to TR1.	
9.	TN4 has an address which matches the /96 prefix for Link C for the first 95 bits.	
10.	TN2 transmits an ICMPv6 Echo Request to TN4's address with a first hop through the RUT. The source address is TN2's Global address.	The RUT must forward the Echo Request to TR1. The destination MAC address must be TR1's MAC address.
11.	TN4 has an address in the /96 prefix for Link C.	
12.	TN2 transmits an ICMPv6 Echo Request to TN4's address with a first hop through the RUT. The source address is TN2's Global address.	The RUT must forward the Echo Request to TR2. The destination MAC address must be TR2's MAC address.
13.	TN4 has an address in the /96 prefix for Link C and has the 97th bit set to 1.	
14.	TN2 transmits an ICMPv6 Echo Request to TN4's address with a first hop through the RUT. The source address is TN2's Global address.	The RUT must forward the Echo Request to TR2. The destination MAC address must be TR2's MAC address.

Part C: Prefix Route /127

Step	Action	Expected Behavior
15.	Configure the RUT to have a route with a prefix length of /127 for Link C with a next-hop router of TR2. A default route should be configured to TR1.	
16.	TN4 has an address which matches the /127 prefix for Link C for the first 126 bits.	
17.	TN2 transmits an ICMPv6 Echo Request to TN4's address with a first hop through the RUT. The source address is TN2's Global address.	The RUT must forward the Echo Request to TR1. The destination MAC address must be TR1's MAC address.
18.	TN4 has an address in the /127 prefix for Link C.	
19.	TN2 transmits an ICMPv6 Echo Request to TN4's address with a first hop through the RUT. The	The RUT must forward the Echo Request to TR2. The destination MAC address must be TR2's MAC address.

	source address is TN2's Global address.	
20.	TN4 has an address in the /127 prefix for Link C and has the 128^{th} bit set to 1.	
21.	TN2 transmits an ICMPv6 Echo Request to TN4's address with a first hop through the RUT. The source address is TN2's Global address.	The RUT must forward the Echo Request to TR2. The destination MAC address must be TR2's MAC address.

Possible Problems: None.

Group 2: Extension Headers and Options

Scope

The following tests cover the processing of options and extension headers, particularly the Hop-by-Hop Options, Destination Options, and Routing headers.

Overview

Tests in this group verify that a node properly processes and generates the Header Extension Length field in extension headers, and the Option Type and Option Data Length fields in IPv6 options. These tests also verify that a node correctly processes header options in order, packets with a routing header destined for the node, and many extension headers or options in a single packet. In addition, these tests ensure a node generates the proper ICMPv6 message in response to invalid or unknown fields.

Test v6LC.1.2.1: Next Header Zero

Purpose: Verify that a node discards a packet that has a Next Header field of zero in a header other than an IPv6 header and generates an ICMPv6 Parameter Problem message to the source of the packet.

Reference:
- [IPv6-SPEC] – Section 4
- [ICMPv6] – Section 3.4

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Packet A
IPv6 Header Next Header: 0
Hop-by-Hop Options Header Next Header: 0 Header Ext. Length: 0 Option: PadN Opt Data Len: 4
Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: PadN Opt Data Len: 4
ICMPv6 Echo Request

Procedure:

Step	Action	Expected Behavior
1.	TN1 transmits Packet A to the NUT, which has a Hop-by-Hop Options header with a Next Header field of zero.	The NUT should send an ICMPv6 Parameter Problem message to TN1. The ICMPv6 Code field should be 1 (unrecognized Next Header type encountered). The ICMPv6 Pointer field should be 0x28 (offset of the Next Header field of the Hop-by-Hop Options header). The NUT should discard the Echo Request and not send an Echo Reply to TN1.

Possible Problems: None.

Test v6LC.1.2.2: No Next Header after Extension Header

Purpose: Verify proper behavior of a node when it encounters a Next Header value of 59 (no next header).

Reference:

- [IPv6-SPEC] – Section 4.7

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Packet A
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:

Part A: End Node

Step	Action	Expected Behavior
1.	TN1 transmits Packet A to the NUT, which contains a Destination Options header with a Next Header of 59. Following the Destination Options header is an ICMPv6 Echo Request header.	The NUT must not send any packets in response to Packet A.

Part B: Intermediate Node (Routers Only)

Step	Action	Expected Behavior
2.	TN1 transmits Packet A to TN2 with a first hop through the RUT. Packet A contains a Destination Options header with a Next Header of 59. Following the Destination Options header is an ICMPv6 Echo Request header.	The RUT should forward Packet A to TN2 on Link A. The octets past the end of the header whose Next Header field contains 59 must be unchanged.

Possible Problems: None.

Test v6LC.1.2.3: Unrecognized Next Header in Extension Header – End Node

Purpose: Verify that a node discards a packet with an unrecognized or unexpected next header in an extension header and transmits an ICMPv6 Parameter Problem message to the source of the packet.

Reference:

- [IPv6-SPEC] – Section 4
- [ICMPv6] – Section 3.4

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Packet A
IPv6 Header Next Header: 60
Destination Options Header Next Header: [See below] Header Ext. Length: 0 Option: PadN Opt Data Len: 4

Packet B
IPv6 Header Next Header: 60
Destination Options Header Next Header: 60 Header Ext. Length: 0 Option: PadN Opt Data Len: 4
Fragment Header Next Header: 58 Reserved: 0 Fragment Offset: 0x10E0 (First 8 bits = 135) Res: 0x2 More Fragments flag: 0
ICMPv6 Echo Request

Procedure:

Part A: Unrecognized Next Header in Extension Header (Multiple Values)

Step	Action	Expected Behavior

1.	TN1 transmits Packet A, which has a Destination Options header with a Next Header field of 146.	The NUT should send an ICMPv6 Parameter Problem message to TN1. The ICMPv6 Code field should be 1 (unrecognized Next Header type encountered). The ICMPv6 Pointer field should be 0x28 (offset of the Next Header field).
2.	TN1 transmits a valid Echo Request to the NUT.	The NUT should send an Echo Reply in response to the Echo Request sent by TN1.
3.	Repeat Steps 1 and 2 with all unrecognized Next Header values between 147 and 252 in Step 1.	

Part B: Unexpected Next Header in Extension Header

Step	Action	Expected Behavior
4.	TN1 transmits Packet B, which has a Destination Options header with a Next Header field of 60. The actual extension header that follows is a Fragment header. The Fragment Offset is 0x10E0 (so that the first 8 bits of this 13 bit field would be 135). The second reserved field is 0x2 and the more bit is clear. (If processed as a Destination Options header, this would be processed as Option Data Length equals 4.)	From the Next Header field in the Destination Options header, the NUT expects the Fragment header to be a Destination Options header. Thus, the Fragment Offset would be interpreted as if it were an Option Type. The NUT should send an ICMPv6 Parameter Problem message to TN1. The Code field should be 2 (unrecognized IPv6 Option encountered). The Pointer field should be 0x32 (offset of the Fragment Offset in the Fragment header). The NUT should discard Packet B and should not send an Echo Reply to TN1.

Possible Problems: None.

Test v6LC.1.2.4: Extension Header Processing Order

Purpose: Verify that a node properly processes the headers of an IPv6 packet in the correct order.

Reference:

- [IPv6-SPEC] – Section 4, 4.1, 4.2, and 4.5
- [ICMPv6] – Section 3.4

Test Setup: No Common Test Setup is performed. 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_b) Opt Data Len: 4	Destination Options Header Next Header: 44 Header Ext. Length: 0 Option: 17 (unknown, msb: 00_b) 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_b) Opt Data Len: 4	Destination Options Header Next Header: 58 Header Ext. Length: 0 Option: 135 (unknown, msb: 10_b) 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

Step	Action	Expected Behavior
1.	TN1 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.	The NUT must send an ICMPv6 Parameter Problem message to TN1. The Code field must be 2 (unrecognized IPv6 Option encountered). The Pointer field must be 0x32 (offset of the Option type field in the Destination Options header). The NUT must discard the Echo Request from TN1.

Part B: Destination Options Header precedes Fragment Header, Error from Fragment Header

Step	Action	Expected Behavior
2.	TN1 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 17. 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 NUT should send an ICMPv6 Parameter Problem message to TN1. The Code field should be 0 (erroneous header field encountered). The Pointer field should be 0x04 (offset of the Payload Length field in the IPv6 header). The NUT must discard the Echo Request from TN1.

Part C: Fragment Header precedes Destination Options Header, Error from Fragment Header

Step	Action	Expected Behavior

3.	TN1 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.	NUT should send an ICMPv6 Parameter Problem message to TN1. The Code field should be 0 (erroneous header field encountered). The Pointer field should be 0x04 (offset of the Payload Length field in the IPv6 header). The NUT must discard the Echo Request from TN1.

Part D: Fragment Header precedes Destination Options Header, Error from Destination Options Header

Step	Action	Expected Behavior
4.	TN1 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.	The NUT must send an ICMPv6 Parameter Problem message to TN1. The Code field must be 2 (unrecognized IPv6 Option encountered). If the IPv6 Parameter Problem message includes a Fragment Header, the Pointer field must be 0x3A (offset of the Option type field in the Destination Options header). If the IPv6 Parameter Problem message does not include a Fragment Header, the Pointer field must be 0x32 (offset of the Option type field in the Destination Options header). The NUT must discard the Echo Request from TN1.

Possible Problems: None.

Test v6LC.1.2.5: Option Processing Order

Purpose: Verify that a node properly processes the options in a single header in the order of occurrence.

Reference:

- [IPv6-SPEC] – Section 4.2
- [ICMPv6] – Section 3.4

Test Setup: No Common Test Setup is performed. 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: 17 (unknown, msb: 00_b) Opt Data Len: 4 Option: 71 (unknown, msb: 01_b) Opt Data Len: 6 Option: 135 (unknown, msb: 10_b) Opt Data Len: 6 Option: 199 (unknown, msb: 11_b) Opt Data Len: 6	Destination Options Header Next Header: 58 Header Ext. Length: 3 Option: 17 (unknown, msb: 00_b) Opt Data Len: 4 Option: 135 (unknown, msb: 10_b) Opt Data Len: 6 Option: 199 (unknown, msb: 11_b) Opt Data Len: 6 Option: 71 (unknown, msb: 01_b) 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: 17 (unknown, msb: 00_b) Opt Data Len: 4 Option: 199 (unknown, msb: 11b) Opt Data Len: 6

Option: 71 (unknown, msb: 01_b) Opt Data Len: 6 Option: 135 (unknown, msb: 10b) Opt Data Len: 6
ICMPv6 Echo Request

Procedure:

Part A: First Option has Most Significant Bits 00_b, Next has Most Significant Bits 01_b

Step	Action	Expected Behavior
1.	TN1 transmits Packet A to the NUT, an Echo Request that has a Destination Options header with four unknown Options. The Option Types are 17, 71, 135, and 199.	The NUT must silently discard the ICMPv6 Echo Request and not send any packets to TN1.

Part B: First Option has Most Significant Bits 00_b, Next has Most Significant Bits 10_b

Step	Action	Expected Behavior
2.	TN1 transmits Packet B to the NUT, an Echo Request that has a Destination Options header with four unknown Options. The Option Types are 17, 135, 199, and 71.	The NUT must send an ICMPv6 Parameter Problem message to TN1. The Code field must be 2 (unrecognized IPv6 Option encountered). The Pointer field must be 0x30 (offset of the Option Type field of the second option). The NUT must discard the Echo Request sent by TN1 and must not send a Reply.

Part C: First Option has Most Significant Bits 00_b, Next has Most Significant Bits 11_b

Step	Action	Expected Behavior
3.	TN1 transmits Packet C to the NUT's link-local address, an Echo Request that has a Destination Options header with four unknown Options. The Option Types are 17, 199, 71, and 135.	The NUT must send an ICMPv6 Parameter Problem message to TN1. The Code field must be 2 (unrecognized IPv6 Option encountered). The Pointer field must be 0x30 (offset of the Option Type field of the second option). The NUT must discard the Echo Request sent by TN1 and must not send a Reply.

Possible Problems: None.

Test v6LC.1.2.6: Options Processing, Hop-by-Hop Options Header - End Node

Purpose: Verify that a node properly processes both known and unknown options, and acts in accordance with the highest order two bits of the option.

Reference:

- [IPv6-SPEC] – Section 4.2 and 4.3
- [ICMPv6] – Section 2.2, 2.4 and 3.4

Test Setup: No Common Test Setup is performed. 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: 17 (unknown, msb: 00_b) Opt Data Len: 4 bytes	Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 71 (unknown, msb: 01_b) 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	Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0

Option: 135 (unknown, msb: 10_b) Opt Data Len: 4 bytes	Option: 199 (unknown, msb: 11_b) 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_b) Opt Data Len: 4 bytes	Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 199 (unknown, msb: 11_b) Opt Data Len: 4 bytes
ICMPv6 Echo Request	ICMPv6 Echo Request

Procedure:

Part A: Pad1 Option

Step	Action	Expected Behavior
1.	TN1 transmits Packet A to the NUT, an Echo Request that has a Hop-by-Hop Options header with six Pad1 Options.	The NUT must send an Echo Reply to TN1.

Part B: PadN Option

Step	Action	Expected Behavior
2.	TN1 transmits Packet B to the NUT, an Echo Request that has a Hop-by-Hop Options header with a PadN Option with 4 bytes of Option Data.	The NUT must send an Echo Reply to TN1.

Part C: Most Significant Bits 00_b

Step	Action	Expected Behavior
3.	TN1 transmits Packet C to the NUT, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 17.	The unknown option is skipped and the header is processed. The NUT must send an Echo Reply to TN1.

Part D: Most Significant Bits 01_b

Step	Action	Expected Behavior

4.	TN1 transmits Packet D to the NUT, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 71.	The NUT must not generate any packets sent to TN1. The Echo Request is discarded.

Part E: Most Significant Bits 10_b, unicast destination

Step	Action	Expected Behavior
5.	TN1 transmits Packet E to the NUT, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 135.	The NUT must send an ICMPv6 Parameter Problem message to TN1. The Code field must be 2 (unrecognized IPv6 Option encountered). The Pointer field must be 0x2A (offset of the option field of Hop-by-Hop Options header). The NUT must discard the Echo Request and not send a Reply. The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU. The Source Address of the Parameter Problem Message must be the same as the Destination Address in TN1's Echo Request Packet. The Destination Address should be the same as the Source Address in TN1's Echo Request Packet.

Part F: Most Significant Bits 11_b, unicast destination

Step	Action	Expected Behavior
6.	TN1 transmits Packet F to the NUT, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 199.	The NUT must send an ICMPv6 Parameter Problem message to TN1. The Code field must be 2 (unrecognized IPv6 Option encountered). The Pointer field must be 0x2A (offset of the option field of Hop-by-Hop Options header). The NUT must discard the Echo Request and not send a Reply. The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU. The Source Address of the Parameter Problem Message must be the same as the Destination Address in TN1's Echo Request Packet. The Destination Address should be the same as the Source Address in TN1's Echo Request Packet.

Part G: Most Significant Bits 10_b, multicast destination

Step	Action	Expected Behavior
7.	TN1 transmits Packet G, an Echo Request sent to a local multicast address that has a Hop-by-Hop	The NUT must send an ICMPv6 Parameter Problem message to TN1. The Code field must be 2 (unrecognized IPv6 Option

	Options header with an unknown Option Type of 135.	encountered). The Pointer field must be 0x2A (offset of the option field of Hop-by-Hop Options header). The NUT must discard the Echo Request and not send a Reply. The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU.

Part H: Most Significant Bits 11_b, multicast destination

Step	Action	Expected Behavior
8.	TN1 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.	The NUT must not generate any packets sent to TN1. The Echo Request is discarded, as the destination address is multicast. The NUT must not send an ICMPv6 Parameter Problem message.

Possible Problems:

- RFC 8200 allows for nodes to not process Hop-by-Hop Options. If that is the case this test may be omitted.

Test v6LC.1.2.7: Options Processing, Hop-by-Hop Options Header - Intermediate Node (Routers Only)

Purpose: Verify that a router properly processes both known and unknown options, and acts in accordance with the highest order two bits of the option.

Advanced Functionality:

- Multicast Routing

Reference:

- [IPv6-SPEC] – Section 4.2 and 4.3
- [ICMPv6] – Section 2.2, 2.4 and 3.4

Test Setup: No Common Test Setup is performed. 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: 17 (unknown, msb: 00_b) Opt Data Len: 4	Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 71 (unknown, msb: 01_b) Opt Data Len: 4
ICMPv6 Echo Request	ICMPv6 Echo Request

Packet E	Packet F
IPv6 Header	IPv6 Header

Next Header: 0	Next Header: 0
Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 135 (unknown, msb: 10_b) Opt Data Len: 4	Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 199 (unknown, msb: 11_b) Opt Data Len: 4
ICMPv6 Echo Request	ICMPv6 Echo Request

Packet G	Packet H
IPv6 Header Destination Address: FF1E::1:2 Next Header: 0	IPv6 Header Destination Address: FF1E::1:2 Next Header: 0
Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 135 (unknown, msb: 10_b) Opt Data Len: 4	Hop-by-Hop Options Header Next Header: 58 Header Ext. Length: 0 Option: 199 (unknown, msb: 11_b) Opt Data Len: 4
ICMPv6 Echo Request	ICMPv6 Echo Request

Procedure:

Part A: Pad1 Option

Step	Action	Expected Behavior
1.	TN1 transmits Packet A to TN2 with a first hop through the RUT, an Echo Request that has a Hop-by-Hop Options header with six Pad1 Options.	The RUT must forward the Echo Request to TN2.

Part B: PadN Option

Step	Action	Expected Behavior
2.	TN1 transmits Packet A to TN2 with a first hop through the RUT, an Echo Request that has a Hop-by-Hop Options header with a PadN Option with 4 bytes of Option Data.	The RUT must forward the Echo Request to TN2.

Part C: Most Significant Bits 00_b

Step	Action	Expected Behavior

3.	TN1 transmits Packet A to TN2 with a first hop through the RUT, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 17.	The unknown option is skipped and the header is processed. The RUT must forward the Echo Request to TN2.

Part D: Most Significant Bits 01_b

Step	Action	Expected Behavior
4.	TN1 transmits Packet A to TN2 with a first hop through the RUT, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 71.	The RUT must not forward the Echo Request to TN2. The Echo Request is discarded.

Part E: Most Significant Bits 10_b, unicast destination

Step	Action	Expected Behavior
5.	TN1 transmits Packet A to TN2 with a first hop through the RUT, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 135.	The RUT must send an ICMPv6 Parameter Problem message to TN1. The Code field must be 2 (unrecognized IPv6 Option encountered). The Pointer field must be 0x2A (offset of the option field of Hop-by-Hop Options header). The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU. The Destination Address should be the same as the Source Address in TN1's Echo Request Packet.

Part F: Most Significant Bits 11_b, unicast destination

Step	Action	Expected Behavior
6.	TN1 transmits Packet A to TN2 with a first hop through the RUT, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 199.	The RUT must send an ICMPv6 Parameter Problem message to TN1. The Code field must be 2 (unrecognized IPv6 Option encountered). The Pointer field must be 0x2A (offset of the option field of Hop-by-Hop Options header). The RUT must discard the Echo Request and not forward it to TN2. The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU. The Destination Address should be the same as the Source Address in TN1's Echo Request Packet.

Part G: Most Significant Bits 10_b, multicast destination

Step	Action	Expected Behavior

	Configure multicast routing on the RUT.	
	TN2 is an MLD Listener for the multicast group FF1E::1:2.	
7.	TN1 transmits Packet A to the global scope multicast destination on Link A with a first hop through the RUT, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 135.	The RUT must send an ICMPv6 Parameter Problem message to TN1. The Code field must be 2 (unrecognized IPv6 Option encountered). The Pointer field must be 0x2A (offset of the option field of Hop-by-Hop Options header). The RUT must discard the Echo Request and not forward it to Link B. The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU. The Destination Address of the Parameter Problem Message should be the same as the Source Address in TN1's Echo Request Packet.

Part H: Most Significant Bits 11_b, multicast destination

Step	Action	Expected Behavior
8.	Configure multicast routing on the RUT.	
9.	TN2 is an MLD Listener for the multicast group FF1E::1:2.	
10.	TN1 transmits Packet A to the global scope multicast destination on Link A with a first hop through the RUT, an Echo Request that has a Hop-by-Hop Options header with an unknown Option Type of 199.	The RUT must not forward the Echo Request to Link B. The Echo Request is discarded, as the destination address is multicast. The RUT must not send an ICMPv6 Parameter Problem message.

- **Possible Problems:**
    - The device under test may not support processing Hop-by-Hop Options per RFC 8200. If that is the case this test may be omitted.
    - For Parts G & H, PIM-SM may need to be enabled on routers that perform RPF lookups.

Test v6LC.1.2.8: Options Processing, Destination Options Header

Purpose: Verify that a node properly processes both known and unknown options, and acts in accordance with the highest order two bits of the option.

Reference:
- [IPv6-SPEC] – Sections 4.2 and 4.6
- [ICMPv6] – Sections 2.2, 2.4 and 3.4

Test Setup: No Common Test Setup is performed. 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: 17 (unknown, msb: 00_b) Opt Data Len: 4	Destination Options Header Next Header: 58 Header Ext. Length: 0 Option: 71 (unknown, msb: 01_b) 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	Destination Options Header Next Header: 58 Header Ext. Length: 0

Option: 135 (unknown, msb: 10_b) Opt Data Len: 4	Option: 199 (unknown, msb: 11_b) 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_b) Opt Data Len: 4	Destination Options Header Next Header: 58 Header Ext. Length: 0 Option: 199 (unknown, msb: 11_b) Opt Data Len: 4
ICMPv6 Echo Request	ICMPv6 Echo Request

Procedure:

Part A: Pad1 Option

Step	Action	Expected Behavior
1.	TN1 transmits Packet A to the NUT an Echo Request that has a Destination Options header with six Pad1 Options.	The NUT must send an Echo Reply to TN1.

Part B: PadN Option

Step	Action	Expected Behavior
2.	TN1 transmits Packet B to the NUT, an Echo Request that has a Destination Options header with a PadN Option with 4 bytes of Option Data.	The NUT must send an Echo Reply to TN1.

Part C: Most Significant Bits 00_b

Step	Action	Expected Behavior
3.	TN1 transmits Packet C to the NUT, an Echo Request that has a Destination Options header with an unknown Option Type of 17.	The unknown option is skipped and the header is processed. The NUT must send an Echo Reply to TN1.

Part D: Most Significant Bits 01_b

Step	Action	Expected Behavior
4.	TN1 transmits Packet D to the NUT, an Echo Request that has a Destination Options header with an unknown Option Type of 71.	The NUT must not generate any packets sent to TN1. The Echo Request is discarded.

Part E: Most Significant Bits 10_b, unicast destination

Step	Action	Expected Behavior
5.	TN1 transmits Packet E to the NUT, an Echo Request that has a Destination Options header with an unknown Option Type of 135.	The NUT must send an ICMPv6 Parameter Problem message to TN1. The Code field must be 2 (unrecognized IPv6 Option encountered). The Pointer field must be 0x2A (offset of the option field of Destination Options header). The NUT must discard the Echo Request and not send a Reply. The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU. • The Source Address of the Parameter Problem Message must be the same as the Destination Address in TN1's Echo Request Packet. • The Destination Address should be the same as the Source Address in TN1's Echo Request Packet.

Part F: Most Significant Bits 11_b, unicast destination

Step	Action	Expected Behavior
6.	TN1 transmits Packet F to the NUT, an Echo Request that has a Destination Options header with an unknown Option Type of 199.	The NUT must send an ICMPv6 Parameter Problem message to TN1. The Code field must be 2 (unrecognized IPv6 Option encountered). The Pointer field must be 0x2A (offset of the option field of Destination Options header). The NUT must discard the Echo Request and not send a Reply. The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU. • The Source Address of the Parameter Problem Message must be the same as the Destination Address in TN1's Echo Request Packet.

		• The Destination Address should be the same as the Source Address in TN1's Echo Request Packet.

Part G: Most Significant Bits 10_b, multicast destination

Step	Action	Expected Behavior
7.	TN1 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.	The NUT must send an ICMPv6 Parameter Problem message to TN1. The Code field must be 2 (unrecognized IPv6 Option encountered). The Pointer field must be 0x2A (offset of the option field of Destination Options header). The NUT must discard the Echo Request and not send a Reply. The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU. The Destination Address of the Parameter Problem Message should be the same as the Source Address in TN1's Echo Request Packet.

Part H: Most Significant Bits 11_b, multicast destination

Step	Action	Expected Behavior
8.	TN1 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.	The NUT must not generate any packets sent to TN1. The Echo Request is discarded, as the destination address is multicast. The NUT must not send an ICMPv6 Parameter Problem message. The NUT must discard the Echo Request and not send a Reply.

Possible Problems: None.

Test v6LC.1.2.9: Unrecognized Routing Type - End Node

Purpose: Verify that a node properly processes an IPv6 packet destined for it that contains a Routing header with an unrecognized Routing Type value.

Reference:

- [IPv6-SPEC] – Sections 4.4

Test Setup: Common Setup 1.1 is performed at the beginning of each test part. The Common Test Cleanup procedure is performed after each part.

Packet A

IPv6 Header Source Address: TN2's Global Address Destination Address: NUT'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

Step	Action	Expected Behavior
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 NUT.	The NUT must ignore the unrecognized Routing Type value and should respond to the Request by sending an Echo Reply to TN2 using TR1 as the first-hop.

Part B: Unrecognized Routing Type 0

Step	Action	Expected Behavior
2.	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 NUT.	The NUT must ignore the unrecognized Routing Type value and should respond to the Request by sending an Echo Reply to TN2 using TR1 as the first-hop.

Possible Problems: None.

Test v6LC.1.2.10: Unrecognized Routing Type - Intermediate Node

Purpose: Verify that a node properly processes an IPv6 packet as the intermediate node that contains a Routing header with an unrecognized Routing Type value.

Reference:

- [IPv6-SPEC] – Sections 4.4

Test Setup: Common Setup 1.1 is performed at the beginning of each test part. The Common Test Cleanup procedure is performed after each part.

Packet A

Packet A
IPv6 Header Source Address: TN2's Global Address Destination Address: NUT's 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

Step	Action	Expected Behavior
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 NUT.	The NUT must discard the Echo Request and send an ICMP Parameter Problem, Code 0, message to TN2's Global Address. The Pointer field must be 0x2A (offset of the Routing Type field of the Routing header).

Part B: Unrecognized Routing Type 0

Step	Action	Expected Behavior
2.	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 NUT.	The NUT must discard the Echo Request and send an ICMP Parameter Problem, Code 0, message to TN2's Global Address. The Pointer field must be 0x2A (offset of the Routing Type field of the Routing header).

Possible Problems: None.

Group 3: Fragmentation

Scope

The following tests cover fragmentation in IPv6.

Overview

The tests in this group verify that a node properly times out fragment reassembly, abandons reassembly on packets that exceed a maximum size, processes stub fragments, and reassembles overlapping fragments. These tests also verify that a node generates the proper ICMPv6 messages.

Test v6LC.1.3.1: Fragment Reassembly

Purpose: Verify that a node properly processes and reassembles fragmented IPv6 packets.

Reference:
- [IPv6-SPEC] – Sections 4.5 and 5
- [ICMPv6] – Section 3.3

Test Setup: Common Setup 1.1 is performed at the beginning of each 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

Step	Action	Expected Behavior
1.	TN1 transmits Fragments A.1, A.2, and A.3 in order. All fragments have the same Source Address, Destination Address, and Fragment ID..	The NUT must transmit an Echo Reply to TN1 in response to the reassembled Echo Request.

Part B: All Fragments are Valid, reverse order

Step	Action	Expected Behavior
2.	TN1 transmits Fragments A.3, A.2, and A.1, in that order. All fragments have the same Source Address, Destination Address, and Fragment ID.	The NUT must transmit an Echo Reply to TN1 in response to the reassembled Echo Request.

Part C: Fragment IDs Differ Between Fragments

Step	Action	Expected Behavior
3.	TN1 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.	The NUT must not transmit an Echo Reply to TN1, as the Echo Request could not be reassembled due to differences in the Fragment ID. The NUT should transmit an ICMPv6 Time Exceeded Message to TN1 sixty seconds after reception of Fragment A.1.

Part D: Source Addresses Differ Between Fragments

Step	Action	Expected Behavior
4.	TN1 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.	The NUT must not transmit an Echo Reply to TN1, as the Echo Request could not be reassembled due to differences in the Source Address. The NUT should transmit an ICMPv6 Time Exceeded Message to TN1 sixty seconds after reception of Fragment A.1.

Part E: Destination Address Differ Between Fragments

Step	Action	Expected Behavior
5.	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 NUT. Fragment A.2 has a Destination Address of the global address of the NUT. The Source Addresses and Fragment Ids for all fragments are the same.	The NUT must not transmit an Echo Reply to TN1, as the Echo Request could not be reassembled due to differences in the Destination Address. The NUT should transmit an ICMPv6 Time Exceeded Message to TN1 sixty seconds after reception of Fragment A.1.

Part F: Reassemble to 1500

Step	Action	Expected Behavior
6.	TN1 transmits an Echo Request to the NUT. TN1 answers any Neighbor Solicitation with a Neighbor Advertisement.	The NUT must respond to the Echo Request from TN1.
7.	TN1 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.	The NUT must respond to the Echo Request from TN1.

Possible Problems: None.

Test v6LC.1.3.2: Reassembly Time Exceeded

Purpose: Verify that a node takes the proper actions when the reassembly time has been exceeded for a packet.

Reference:

- [IPv6-SPEC] – Sections 4.5
- [ICMPv6] – Section 2.2, 3.3, 2.4

Test Setup: Common Setup 1.1 is performed at the beginning of each 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: TN1's Global Address Destination Address: NUT's Global Address	IPv6 Header Next Header: 44 Source Address: TN1's Global Address Destination Address: NUT's Global Address	IPv6 Header Next Header: 44 Source Address: TN1's Global Address Destination Address: NUT'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

Step	Action	Expected Behavior
1.	TN1 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.	Fragments A.2 and A.3 arrive just before the NUT's reassembly timer expires for Fragment A.1. The NUT must transmit an Echo Reply to TN1 in response to the reassembled Echo Request.

Part B: Time Exceeded Before Last Fragments Arrive

Step	Action	Expected Behavior
2.	TN1 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.	Fragments A.2 and A.3 arrive after the NUT's reassembly timer expires for Fragment A.1. The NUT must not transmit an Echo Reply to TN1, as the Echo Request could not be reassembled in time. The NUT should transmit an ICMPv6 Time Exceeded

		Message to TN1 sixty seconds after reception of Fragment A.1 with a code field value of 1 (Fragment Reassembly Time Exceeded). The Source Address of the Packet must be the same as the Global Destination Address of TN1's Echo Request packet. The Destination Address should be the same as the global source Address of TN1's Echo Request packet. The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU.

Part C: Time Exceeded (Global), Only First Fragment Received

Step	Action	Expected Behavior
3.	TN1 transmits Fragment A.1.	The NUT must not transmit an Echo Reply to TN1, as the Echo Request was not completed. The NUT should transmit an ICMPv6 Time Exceeded Message to TN1 sixty seconds after reception of Fragment A.1 with a code field value of 1 (Fragment Reassembly Time Exceeded). The Source Address of the Packet must be the same as the Destination Address of TN1's Echo Request packet. The Destination Address should be the same as the Source Address of TN1's Echo Request packet. The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU.

Part D: Time Exceeded (Link-local), Only First Fragment Received

Step	Action	Expected Behavior
4.	TN1 transmits Fragment A.1 with a source address of TN1's Link-local address and a destination address set to the NUT's Link-local address.	The NUT must not transmit an Echo Reply to TN1, as the Echo Request was not completed. The NUT should transmit an ICMPv6 Time Exceeded Message to TN1 sixty seconds after reception of Fragment A.1 with a code field value of 1 (fragment Reassembly Time Exceeded). The Source Address of the Packet must be the same as the Destination Address of TN1's Echo Request packet. The Destination Address should be the same as the Source Address of TN1's Echo Request packet. The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU.

Part E: Time Exceeded, Only Second Fragment Received

Step	Action	Expected Behavior
5.	TN1 transmits Fragment A.2.	The NUT must not transmit an Echo Reply or a Time Exceeded Message to TN1.

Possible Problems: None.

Test v6LC.1.3.3: Fragment Header M-Bit Set, Payload Length Invalid

Purpose: Verify that a node takes the proper actions when it receives a fragment with the M-bit set (more fragments), but which has a Payload Length that is not a multiple of 8 bytes.

Functionality Tag: Mandatory

Reference:
- [IPv6-SPEC] – Section 4.5
- [ICMPv6] – Section 3.4

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Packet A
IPv6 Header Payload Length: 21 bytes Next Header: 44
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 1
ICMPv6 Echo Request Data Length: 5 bytes

Procedure:

Step	Action	Expected Behavior
1.	TN1 transmits Packet A, an Echo Request that has a Fragment header with the M-bit set. The Payload Length is 21, which is not a multiple of 8 octets.	The NUT must not transmit an Echo Reply to TN1, as the fragment was discarded. The NUT should transmit an ICMPv6 Parameter Problem message to TN1. The Code field should be 0 (erroneous header field encountered). The Pointer field should be 0x04 (offset of Payload Length field of the IPv6 header).

Possible Problems: None.

Test v6LC.1.3.4: Atomic Fragments

Purpose: Verify that the node properly processes Atomic Fragments.

Functionality Tag: Mandatory

Reference:
- [IPv6-SPEC] – Section 4.5

Test Setup: Common Setup 1.1 is performed at the beginning of each test part. The Common Test Cleanup procedure is performed after each part.

Packet A
IPv6 Header Source Address: [See Below] Destination Address: [See Below] Next Header: 44
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 0
ICMPv6 Echo Request

Procedure:

Part A: Link-Local

Step	Action	Expected Behavior
1.	Transmit Packet A from a TN1's link-local address to the NUT's link-local address.	The NUT should process the fragment packets and transmit an Echo Reply.

Part B: Global

Step	Action	Expected Behavior
2.	Transmit Packet A from a TN1's global address to the NUT's global address.	The NUT should process the fragment packets and transmit an Echo Reply.

Possible Problems: None.

Test v6LC.1.3.5: Overlapping Fragments

Purpose: Verify that the node properly does not process overlapping fragments.

Advanced Functionality:

- Duplicate Overlapping Fragments

Reference:

- [IPv6-SPEC] – Section 4.5

Test Setup: Common Setup 1.1 is performed at the beginning of each 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: TN1's Link-Local Address Destination Address: NUT's Link-Local Address	IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Link-Local Address	IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Link-Local 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: (6) 48 bytes More Fragments flag: 0 Fragment Data: 40 Bytes
ICMPv6 Echo Request		

Fragment B.1	Fragment B.2	Fragment B.3
IPv6 Header Next Header: 44 Source Address: TN1's Global Address Destination Address: NUT's Global Address	IPv6 Header Next Header: 44 Source Address: TN1's Global Address Destination Address: NUT's Global Address	IPv6 Header Next Header: 44 Source Address: TN1's Global Address Destination Address: NUT'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: (6) 48 bytes More Fragments flag: 0 Fragment Data: 40 Bytes
ICMPv6 Echo Request		

Fragment C.1	Fragment C.2
IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Link-Local Address	IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Link-Local Address
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 1	Fragment Header Next Header: 58 Fragment Offset: (2) 16 bytes More Fragments flag: 0 Fragment Data: 32 Bytes
ICMPv6 Echo Request	

Fragment D.1	Fragment D.2
IPv6 Header Next Header: 44 Source Address: TN1's Global Address Destination Address: NUT's Global Address	IPv6 Header Next Header: 44 Source Address: TN1's Global Address Destination Address: NUT's Global Address
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 1	Fragment Header Next Header: 58 Fragment Offset: (2) 16 bytes More Fragments flag: 0 Fragment Data: 32 Bytes
ICMPv6 Echo Request	

Procedure:

Part A: Overlapping fragments (Link-Local)

Step	Action	Expected Behavior
1.	TN1 transmits Fragments A.1, A.2, and A.3 in that order. A2. and A.3 have overlapping payloads.	The NUT must discard the fragments and must not transmit an Echo Reply or Error message.

Part B: Reverse Order Fragments (Link-Local)

Step	Action	Expected Behavior

2.	TN1 transmits Fragments C.2 and C.1 in that order. The C1 and C2 fragments have overlapping payloads.	The NUT must discard the fragments and must not transmit an Echo Reply or Error message.

Part C: Duplicate Fragments (Link-Local)

Step	Action	Expected Behavior
3.	TN1 transmits Fragments A.1.	
4.	TN1 transmits Fragment A.1, A.2 and A.3 to the NUT. Fragment A.3 has an offset of (8) 64 bytes so that it doesn't overlap with A.2.	The NUT should process the fragment packets and transmit an Echo Reply.

Part D: Extra Fragments (Link-Local)

Step	Action	Expected Behavior
5.	TN1 transmits Fragments A.1 and A.2.	
6.	TN1 transmits Fragment A.3 that overlaps with fragment A2.	
7.	TN1 transmits Fragment A.3 with an offset of (8) 64 bytes so that it doesn't overlap with A.2.	The NUT must discard the fragments and must not transmit an Echo Reply or ICMPv6 Error message.

Part E: Overlapping fragments (Global)

Step	Action	Expected Behavior
8.	TN1 transmits Fragments B.1, B.2, and B.3 in that order. B.2. and B.3 have overlapping payloads.	The NUT must discard the fragments and must not transmit an Echo Reply or Error message.

Part F: Reverse Order Fragments (Global)

Step	Action	Expected Behavior
9.	TN1 transmits Fragments D.2 and D.1 in that order. The D.2 and D.1 fragments have overlapping payloads.	The NUT must discard the fragments and must not transmit an Echo Reply or Error message.

Part G: Duplicate Fragments (Global)

Step	Action	Expected Behavior
10.	TN1 transmits Fragments B.1.	
11.	TN1 transmits Fragment B.1, B.2 and B.3 to the NUT. Fragment B.3 has an offset of (8) 64 bytes so that it doesn't overlap with B.2.	The NUT should process the fragment packets and transmit an Echo Reply.

Part H: Extra Fragments (Global)

Step	Action	Expected Behavior
12.	TN1 transmits Fragments B.1 and B.2.	
13.	TN1 transmits Fragment B.3 that overlaps with fragment B.2.	
14.	TN1 transmits Fragment B.3 with an offset of (8) 64 bytes so that it doesn't overlap with B.2.	The NUT must discard the fragments and must not transmit an Echo Reply or ICMPv6 Error message.

Possible Problems: None.

Test v6LC.1.3.6: First Fragment Doesn't Contain All Headers

Purpose: Verify that the node properly does not process IPv6 packets that don't include all the headers through the Upper-Layer header.

Reference:

- [IPv6-SPEC] – Section 4.5

Test Setup: The devices are setup according to Common Test Setup.

Fragment A.1	Fragment A.2
IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Link-Local Address	IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Link-Local Address
Fragment Header Next Header: 60 Fragment Offset: 0 More Fragments flag: 1	Fragment Header Next Header: 58 Fragment Offset: 4 More Fragments flag: 0
Destination Options Header Next Header: 58 Option: PadN	ICMPv6 Echo Request

Fragment B.1	Fragment B.2
IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Link-Local Address	IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Link-Local Address
Fragment Header Next Header: 43 Fragment Offset: 0 More Fragments flag: 1	Fragment Header Next Header: 58 Fragment Offset: 4 More Fragments flag: 0
Routing Header Next Header: 58 Routing Type: 0 Segments Left: 0	ICMPv6 Echo Request

Fragment C.1	Fragment C.2
IPv6 Header Next Header: 44 Source Address: TN1's Global Address Destination Address: NUT's Global Address	IPv6 Header Next Header: 44 Source Address: TN1's Global Address Destination Address: NUT's Global Address
Fragment Header Next Header: 60 Fragment Offset: 0 More Fragments flag: 1	Fragment Header Next Header: 58 Fragment Offset: 4 More Fragments flag: 0
Destination Options Header Next Header: 58 Option: PadN	ICMPv6 Echo Request

Fragment D.1	Fragment D.2
IPv6 Header Next Header: 44 Source Address: TN1's Global Address Destination Address: NUT's Global Address	IPv6 Header Next Header: 44 Source Address: TN1's Global Address Destination Address: NUT's Global Address
Fragment Header Next Header: 43 Fragment Offset: 0 More Fragments flag: 1	Fragment Header Next Header: 58 Fragment Offset: 4 More Fragments flag: 0
Routing Header Next Header: 58 Routing Type: 0 Segments Left: 0	ICMPv6 Echo Request

Procedure:

Part A: Destination Options (Link-Local)

Step	Action	Expected Behavior
1.	TN1 transmits Packet A.1 and A.2 to the NUT.	The NUT must discard the Echo Request and transmit Parameter Problem with a code 3 with the pointer field set to 0.

Part B: Routing Options (Link-Local)

Step	Action	Expected Behavior

2.	TN1 transmits Packet B.1 and B.2 to the NUT.	The NUT must discard the Echo Request and transmit Parameter Problem with a code 3 with the pointer field set to 0.

Part C: Destination Options (Global)

Step	Action	Expected Behavior
3.	TN1 transmits Packet C.1 and C.2 to the NUT.	The NUT must discard the Echo Request and transmit Parameter Problem with a code 3 with the pointer field set to 0.

Part D: Routing Options (Global)

Step	Action	Expected Behavior
4.	TN1 transmits Packet D.1 and D.2 to the NUT.	The NUT must discard the Echo Request and transmit Parameter Problem with a code 3 with the pointer field set to 0.

Possible Problems: None.

Section 2: Neighbor Discovery

Overview: 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.

Default Packets

Echo Request
IPv6 Header Next Header: 58
ICMPv6 Header Type: 128 Code: 0

*Note: Due to the nature of the STALE state, one cannot verify state STALE without causing the state itself to change. For this reason, in tests where we require the NCE to transition from STALE to another state (except DELAY), we cannot verify state STALE with an observable action.

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

Redirect message

IPv6 Header Next Header: 58 Source Address: TR1's Link Local Address Destination Address: NUT's Link Local Address
ICMPv6 Header Type: 137 Code: 0
Redirected Header Option Type: 4 Length: Length of Invoking Packet in 8 octet units
Invoking Packet

Group 1: Address Resolution and Neighbor Unreachability Detection

Scope

The following tests cover Address Resolution and Neighbor Unreachability Detection in IPv6.

Overview

The tests in this group verify conformance of the Address Resolution and Neighbor Unreachability Detection function with the Neighbor Discovery Specification. Additionally support for Security Implications of IPv6 Fragmentation with IPv6 Neighbor Discovery.

Test v6LC.2.1.1: On-link Determination

Purpose: Verify that a node correctly determines that a destination is on-link.

Reference:
- [IPv6-ARCH] – Section 2.4
- [ND] – Sections 5.2

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

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

Procedure:

Part A: Link-local Address

Step	Action	Expected Behavior
1.	TN1 transmits Packet A an Echo Request with TN1's link-local source address.	The NUT should send a Neighbor Solicitation with Target Address equal to TN1's link-local address, indicating that the

		NUT has successfully determined that TN1 was on-link.

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

Step	Action	Expected Behavior
2.	If the NUT is a host, TR1 transmits the Router Advertisement. The Prefix Advertisement covers TN1's global address.	
3.	TN1 transmits Packet B, an Echo Request with TN1's global source address.	TN1's global address is covered by the on-link prefix. Hence, the NUT should consider TN1's global address as on-link. The NUT should send a Neighbor Solicitation with Target Address equal to TN1's global address, indicating that the NUT has successfully determined that TN1 was on-link.

Part C: Global Address, On-link Prefix does not cover TN2

Step	Action	Expected Behavior
4.	If the NUT is a host, TR1 transmits the Router Advertisement. The Prefix Advertisement does not cover TN2's global address.	
5.	TN2 transmits Packet C, an Echo Request with TN2's global source address.	TN2's global address is not covered by the on-link prefix. Hence, the NUT should consider TN2's global address as off-link. The NUT should send a Neighbor Solicitation with Target Address equal to TR1's link-local address indicating that the NUT has successfully determined that TN2 was off-link.

Possible Problems: A node may transmit more than 3 Neighbor Solicitations if it supports RFC 7048.

Test v6LC.2.1.2: Resolution Wait Queue

Purpose: Verify that a node properly queues packets while waiting for address resolution of the next hop.

Reference:
- [ND] – Section 3, Section 7.2.2

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Packet A	Packet B
IPv6 Header Next Header: 58 Source Address: TN1's Link-local Address	IPv6 Header Next Header: 58 Source Address: TN2's Link-local Address
ICMPv6 Echo Request Sequence Number: 3	ICMPv6 Echo Request Sequence Number: 4

Neighbor Advertisement C	Neighbor Advertisement D
IPv6 Header Next Header: 58 Source Address: TN1's Link-local Address Destination Address: NUT's Link-local Address	IPv6 Header Next Header: 58 Source Address: TN2's Link-local Address Destination Address: NUT's Link-local Address
Neighbor Advertisement Router flag: 0 Solicited flag: 1 Override flag: 1 Target Address: TN1's 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

Step	Action	Expected Behavior
1.	TN1 transmits Packet A, an Echo Request, 3 times. The Sequence number is incremented each time.	The NUT should transmit a Neighbor Solicitation with a Target Address equal to TN1's link-local address. The NUT should send Echo Replies to TN1 in response to Packet A.
2.	TN1 transmits the Neighbor Advertisement C in response to any	The Echo Replies should correspond to the last 3 Echo Requests sent by TN1 to the NUT, indicating successful queuing of

	Neighbor Solicitations from the NUT.	packets while waiting for address resolution to complete. The number of Echo Replies MUST be no less than 1.

Part B: Multiple Queues

Step	Action	Expected Behavior
3.	TN1 transmits Packet A, an Echo Request, 3 times. The Sequence number is incremented each time.	
4.	TN2 transmits Packet B, an Echo Request, 4 times. The Sequence number is incremented each time.	The NUT should transmit a Neighbor Solicitation with a Target Address equal to TN1's link-local address. The NUT should send Echo Replies to TN1 in response to Packet A. The NUT should transmit a Neighbor Solicitation with a Target Address equal to TN2's link-local address. The NUT should send Echo Replies to TN2 in response to Packet B.
5.	TN1 and TN2 transmit the Neighbor Advertisement C and D respectively in response to any Neighbor Solicitations from the NUT.	The Echo Replies should correspond to the last 3 Echo Requests sent by TN1 to the NUT, 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 TN2 to the NUT, 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 v6LC.2.1.3: Prefix Information Option Processing, On-link Flag (Hosts Only)

Purpose: Verify that a host properly processes the on-link flag of a Prefix Information Option.

Reference:

- [ND] – Section 6.3.4

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
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: TR1’s Global Address Destination Address: HUT’s Link-local Address
ICMPv6 Echo Request

Procedure:

Step	Action	Expected Behavior
1.	TR1 transmits Router Advertisement A.	
2.	TR1 transmits Packet A. TR1 should not respond to Neighbor Solicitations from the HUT.	In response to Packet A, the HUT should transmit 3 Neighbor Solicitations with a Target Address of TR1's global address.
3.	TR1 transmits Router Advertisement A with the on-link (L) flag clear.	
4.	TR1 transmits Packet A. TR1 should not respond to Neighbor Solicitations from the HUT.	In response to Packet A, the HUT should transmit 3 Neighbor Solicitations with a Target Address of TR1's global address.

Possible Problems: None.

Test v6LC.2.1.4: Host Prefix List (Hosts Only)

Purpose: Verify that a host properly updates its Prefix List upon receipt of Prefix Information Options, which have the on-link flag set.

Reference:
- [ND] – Sections 6.3.4

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: 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: HUT's Link-local Address
ICMPv6 Echo Request

Procedure:

Part A: Prefix Lifetime has not Expired

Step	Action	Expected Behavior

1.	TR1 transmits Router Advertisement A without the Prefix Option.	
2.	TR1 transmits a link-local Echo Request to the HUT.	The HUT should solicit and reply to the Echo Request transmitted by TR1.
3.	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.	
4.	TN1 transmits Packet B, whose Source Address is covered by the prefix advertised in Router Advertisement A.	In response to Packet B, the HUT should transmit Neighbor Solicitations with a Target Address of TN1's global address.

Part B: Prefix Lifetime updated by Router Advertisement

Step	Action	Expected Behavior
5.	TR1 transmits Router Advertisement A without the Prefix Option.	
6.	TR1 transmits a link-local Echo Request to the HUT.	The HUT should solicit and reply to the Echo Request transmitted by TR1.
7.	TR1 transmits Router Advertisement A. Wait 8 seconds.	
8.	TR1 transmits Router Advertisement A. Wait 8 seconds.	
9.	TN1 transmits Packet B, whose Source Address is covered by the prefix advertised in Router Advertisement A.	In response to Packet B, the HUT should transmit Neighbor Solicitations with a Target Address of TN1's global address.

Possible Problems: None.

Test v6LC.2.1.5: Neighbor Solicitation Origination, Address Resolution

Purpose: Verify that a node properly originates Neighbor Solicitations when trying to resolve the address of a neighbor.

Reference:

- [ND] – Sections 6.2.1, 7.2.2

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

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

Procedure:

Part A: Neighbor Solicitation Origination, Target Address Being Link-local

Step	Action	Expected Behavior
1.	If the NUT is a host, perform Common Test Setup 1.1 with a Retransmit Interval value of 1 second. If the NUT is a router, configure the Retransmit Interval value to 1 second.	
2.	TN1 transmits Packet A. The source address is TN1's link-local address and the destination address is the NUT's link-local address.	In response to Packet A, the NUT should transmit Neighbor Solicitations with a Target Address equal to the TN1's Link-local Address at intervals of 1 second. The NUT MUST transmit no more than 1 Neighbor Solicitation every 1 second. 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.
3.	Repeat Steps 1 and 2 with a Retransmit Interval value of 5 seconds and observe the packets transmitted by the NUT.	

Part B: Neighbor Solicitation Origination, Target Address Being Global

Step	Action	Expected Behavior
4.	If the NUT is a host, perform Common Test Setup 1.1 with a Retransmit Interval value of 1 second. If the NUT is a router, configure the Retransmit Interval value to 1 second.	
5.	TN1 transmits Packet B. The source address is TN1's global address and the destination is the NUT's global address.	In response to Packet B, the NUT should transmit Neighbor Solicitations with a Target Address equal to the TN1's Global Address at intervals of 1 second. The NUT MUST transmit no more than 1 Neighbor Solicitation every 1 second. 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.
6.	Repeat Steps 4 and 5 with a Retransmit Interval value of 5 seconds and observe the packets transmitted by the NUT.	

Possible Problems: None.

Test v6LC.2.1.6: Neighbor Solicitation Origination, Reachability Confirmation

Purpose: Verify that a node properly originates Neighbor Solicitations when trying to confirm the reachability of a neighbor.

Reference:

- [ND] – Sections 7.3

Test Setup: Perform Common Test Setup 1.1 with a Reachable time of 30 seconds and a Retransmit Interval value of 1 second before each part. The Common Test Cleanup procedure is performed after each part.

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

Packet C	Packet D
IPv6 Header Next Header: 58 Source Address: TN1's Link-local Address Destination Address: NUT's Global Address	IPv6 Header Next Header: 58 Source Address: TN1's Global Address Destination Address: NUT's Link-local Address
ICMPv6 Echo Request	ICMPv6 Echo Request

Procedure:

Part A: Neighbor Solicitation Origination, Link-local => Link-local

Step	Action	Expected Behavior
1.	TN1 transmit Packet A. The source address is TN1's link-local address and the destination address is the NUT's link-local address.	In response to Packet A, the NUT should transmit Neighbor Solicitations with a Target Address equal to the TN1's link-local Address at intervals of 1 second. The NUT MUST transmit no more than 1 Neighbor Solicitation every 1 second. Once a Neighbor Advertisement is received from TN1, the NUT should send an Echo Reply in

		response to Packet A. The NCE of TN1 is in state REACHABLE.
2.	TN1 sends a Neighbor Advertisement upon receiving Neighbor Solicitations from the NUT.	
3.	Wait REACHABLE_TIME * MAX_RANDOM_FACTOR seconds so that the NCE of TN1 transit to state STALE.	
4.	TN1 transmits Packet A. The source address is TN1's Link-local address and the destination address is the NUT's Link-local address.	In response to Packet A, the NUT should transmit an Echo Reply.
5.	Wait DELAY_FIRST_PROBE_TIME seconds so that NCE of TN1 transit to state PROBE.	The NUT should transmit Neighbor Solicitations with the NUT's link-local address being the source address and TN1's link-local address as the destination address. The maximum number of Neighbor Solicitations that the NUT can transmit is 3.

Part B: Neighbor Solicitation Origination, Global => Global

Step	Action	Expected Behavior
6.	TN1 transmit Packet B. The source address is TN1's global address and the destination address is the NUT's global address.	In response to Packet B, the NUT should transmit Neighbor Solicitations with a Target Address equal to the TN1's global Address at intervals of 1 second. The NUT MUST transmit no more than 1 Neighbor Solicitation every 1 second. Once a Neighbor Advertisement is received from TN1, the NUT should send an Echo Reply in response to Packet B. The NCE of TN1 is in state REACHABLE.
7.	TN1 sends a Neighbor Advertisement upon receiving Neighbor Solicitations from the NUT.	
8.	Wait REACHABLE_TIME * MAX_RANDOM_FACTOR seconds so that the NCE of TN1 transit to state STALE.	
9.	TN1 transmits Packet B. The source address is TN1's global address and the destination address is the NUT's global address.	In response to Packet B, the NUT should transmit an Echo Reply.
10.	Wait DELAY_FIRST_PROBE_TIME seconds so that NCE of TN1 transit to state PROBE.	The NUT should transmit Neighbor Solicitations with the NUT's global or link-local address being the source address and TN1's global address as the destination address. The maximum number of Neighbor Solicitations that the NUT can transmit is 3.

Part C: Neighbor Solicitation Origination, Link-local => Global

Step	Action	Expected Behavior
11.	TN1 transmit Packet C. The source address is TN1's link-local address and the destination address is the NUT's global address.	In response to Packet C, the NUT should transmit Neighbor Solicitations with a Target Address equal to the TN1's link-local Address at intervals of 1 second. The NUT MUST transmit no more than 1 Neighbor Solicitation every 1 second. Once a Neighbor Advertisement is received from TN1, the NUT should send an Echo Reply in response to Packet C. The NCE of TN1 is in state REACHABLE.
12.	TN1 sends a Neighbor Advertisement upon receiving Neighbor Solicitations from the NUT.	
13.	Wait REACHABLE_TIME * MAX_RANDOM_FACTOR seconds so that the NCE of TN1 transit to state STALE.	
14.	TN1 transmits Packet C. The source address is TN1's link-local address and the destination address is the NUT's global address.	In response to Packet C, the NUT should transmit an Echo Reply.
15.	Wait DELAY_FIRST_PROBE_TIME seconds so that NCE of TN1 transit to state PROBE.	The NUT should transmit Neighbor Solicitations with the NUT's global or link-local address being the source address and TN1's link-local address as the destination address. The maximum number of Neighbor Solicitations that the NUT can transmit is 3.

Part D: Neighbor Solicitation Origination, Global => Link-local

Step	Action	Expected Behavior
16.	TN1 transmit Packet D. The source address is TN1's global address and the destination address is the NUT's link-local address.	In response to Packet D, the NUT should transmit Neighbor Solicitations with a Target Address equal to the TN1's global Address at intervals of 1 second. The NUT MUST transmit no more than 1 Neighbor Solicitation every 1 second. Once a Neighbor Advertisement is received from TN1, the NUT should send an Echo Reply in response to Packet D. The NCE of TN1 is in state REACHABLE.
17.	TN1 sends a Neighbor Advertisement upon receiving Neighbor Solicitations from the NUT.	
18.	Wait REACHABLE_TIME * MAX_RANDOM_FACTOR	

	seconds so that the NCE of TN1 transit to state STALE.	
19.	TN1 transmits Packet D. The source address is TN1's global address and the destination address is the NUT's link-local address.	In response to Packet D, the NUT should transmit an Echo Reply.
20.	Wait DELAY_FIRST_PROBE_TIME seconds so that NCE of TN1 transit to state PROBE.	The NUT should transmit Neighbor Solicitations with the NUT's global or link-local address being the source address and TN1's global address as the destination address. The maximum number of Neighbor Solicitations that the NUT can transmit is 3.

Possible Problems: None.

Test v6LC.2.1.7: Invalid Neighbor Solicitation Handling

Purpose: Verify that a node takes the proper actions upon receipt of an invalid Neighbor Solicitation.

Reference:
- [ND] – Sections 7.1.1 and 7.2.3

Test Setup: No Common Test Setup is performed. 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: TN1's Link-local Address Destination Address: NUT's Link-local Address Hop Limit: 255	IPv6 Header Next Header: 58 Source Address: Unspecified Address Destination Address: NUT's Link-local Address Hop Limit: 255	IPv6 Header Next Header: 58 Source Address: Unspecified Address Destination Address: NUT's Solicited-node Multicast Address Hop Limit: 255
Neighbor Sol. Target Address: NUT's Link-local Address Source Link-layer Address: TN1's Link-layer address	Neighbor Sol. Target Address: NUT's Link-local Address	Neighbor Sol. Target Address: NUT's Link-local Address Source Link-layer Address: TN1's Link-layer address

Procedure:

Part A: Invalid Target Address

Step	Action	Expected Behavior
1.	TN1 transmits Neighbor Solicitation A with the Target Address set to the All Nodes Multicast.	The NUT must not transmit any packets corresponding to Neighbor Solicitation A.

Part B: Invalid Destination Address

Step	Action	Expected Behavior
2.	TN1 transmits Neighbor Solicitation B.	The NUT must not transmit any packets corresponding to Neighbor Solicitation B.

Part C: Invalid Source Link-layer Address Option

Step	Action	Expected Behavior
3.	TN1 transmits Neighbor Solicitation C.	The NUT must not transmit any packets corresponding to Neighbor Solicitation C.

Part D: Invalid Source Link-layer Address Option

Step	Action	Expected Behavior
4.	TN1 transmits Neighbor Solicitation A with the Hop Limit set to 254.	The NUT must not transmit any packets corresponding to Neighbor Solicitation A.

Part E: Invalid Checksum

Step	Action	Expected Behavior
5.	TN1 transmits Neighbor Solicitation A with the ICMP checksum set to be invalid.	The NUT must not transmit any packets corresponding to Neighbor Solicitation A.

Part F: Invalid ICMP Code

Step	Action	Expected Behavior
6.	TN1 transmits Neighbor Solicitation A with the ICMP Code set to 1.	The NUT must not transmit any packets corresponding to Neighbor Solicitation A.

Part G: Invalid ICMP Length

Step	Action	Expected Behavior
7.	TN1 transmits Neighbor Solicitation A with the ICMP Length set to 16.	The NUT must not transmit any packets corresponding to Neighbor Solicitation A.

Part H: Option of Length 0

Step	Action	Expected Behavior
8.	TN1 transmits Neighbor Solicitation A with an Option Length set to 0.	The NUT must not transmit any packets corresponding to Neighbor Solicitation A.

Possible Problems: None.

Test v6LC.2.1.8: Neighbor Solicitation Processing, No NCE

Purpose: Verify that a node properly updates its neighbor cache upon receipt of neighbor solicitations when there is no NCE exists for that neighbor.

Reference:

- [IPv6-ARCH] – Section 2, 2.8
- [ND] – Sections 7.2.3 and 7.2.4

Test Setup: No Common Test Setup is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. The Common Test Cleanup procedure is performed after each part.

Neighbor Solicitation A	Neighbor Solicitation B
IPv6 Header Next Header: 58 Destination Address: NUT's Link-local Address Source Address: TN1's Link-local Address	IPv6 Header Next Header: 58 Destination Address: NUT's Solicited-node Multicast Link-local Address Source Address: TN1's Link-local Address
Neighbor Solicitation Target Address: NUT's Link-local Address Source Link-Layer Address: TN1's MAC address	Neighbor Solicitation Target Address: NUT's Link-local Address Source Link-Layer Address: TN1's MAC address

Procedure:

Part A: Unicast Neighbor Solicitation

Step	Action	Expected Behavior
1.	TN1 transmits Neighbor Solicitation A.	
2.	TN1 transmits an Echo Request to the NUT.	The NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **STALE**. The NUT should reply to Neighbor Solicitation A by sending a Neighbor Advertisement. After responding to the Neighbor Solicitation, the NUT 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 NUT should send a unicast Neighbor Solicitation to TN1.

Part B: Multicast Neighbor Solicitation

Step	Action	Expected Behavior
3.	TN1 transmits Neighbor Solicitation B.	
4.	TN1 transmits an Echo Request to the NUT.	The NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **STALE**. The NUT should reply to Neighbor Solicitation B by sending a Neighbor Advertisement. After responding to the Neighbor Solicitation, the NUT 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 NUT should send a unicast Neighbor Solicitation to TN1.

Part C: Unicast Neighbor Solicitation without SLL

Step	Action	Expected Behavior
5.	TN1 transmits Neighbor Solicitation A without a SLL option.	
6.	TN1 transmits an Echo Request to the NUT.	The NUT should reply to Neighbor Solicitation A by sending multicast Neighbor Solicitations in state INCOMPLETE. The NUT should respond to the Echo Request by sending multicast Neighbor Solicitations in state INCOMPLETE.

Possible Problems: None.

Test v6LC.2.1.9: Neighbor Solicitation Processing, NCE State INCOMPLETE

Purpose: Verify that a node properly updates its neighbor cache upon receipt of neighbor solicitations when the NCE of the neighbor is in state INCOMPLETE.

Reference:

- [IPv6-ARCH] – Section 2, 2.8
- [ND] – Sections 7.2.3 and 7.2.4

Test Setup: No Common Test Setup is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. The Common Test Cleanup procedure is performed after each part.

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

Neighbor Solicitation B	Neighbor Solicitation C
IPv6 Header Next Header: 58 Destination Address: NUT's Link-local Address Source Address: TN1's Link-local Address	IPv6 Header Next Header: 58 Destination Address: NUT's Solicited-node Multicast Link-local Address Source Address: TN1's Link-local Address
Neighbor Solicitation Target Address: NUT's Link-local Address Source Link-Layer Address: TN1's MAC address	Neighbor Solicitation Target Address: NUT's Link-local Address Source Link-Layer Address: TN1's MAC address

Procedure:

Part A: Unicast Neighbor Solicitation

Step	Action	Expected Behavior
1.	TN1 transmits Packet A.	The NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
2.	TN1 transmits Neighbor Solicitation B.	After receiving TN1's Neighbor Solicitation, the NUT should send its queued Echo Reply to TN1. The NUT should than update the NCE of TN1 to state **STALE** and update its link-layer address for TN1 accordingly. The NUT should reply to Neighbor Solicitation B by sending a Neighbor Advertisement.
3.	TN1 transmits an Echo Request to the NUT.	The NUT 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 NUT should send a Unicast Neighbor Solicitation to TN1.

Part B: Multicast Neighbor Solicitation

Step	Action	Expected Behavior
4.	TN1 transmits Packet A.	The NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
5.	TN1 transmits Neighbor Solicitation C.	After receiving TN1's Neighbor Solicitation, the NUT should send its queued Echo Reply to TN1. The NUT should then update the NCE of TN1 to state **STALE** and update its link-layer address for TN1 accordingly. The NUT should reply to Neighbor Solicitation C by sending a Neighbor Advertisement.
6.	TN1 transmits an Echo Request to the NUT.	The NUT 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 NUT should send a Unicast Neighbor Solicitation to TN1.

Part C: Unicast Neighbor Solicitation without SLL

Step	Action	Expected Behavior
7.	TN1 transmits Packet A.	The NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.

8.	TN1 transmits Neighbor Solicitation B without the Source Link-layer Address option.	After receiving TN1's Neighbor Solicitation, the NUT should not update the NCE of TN1 and remain in state **INCOMPLETE**.

Possible Problems: None.

Test v6LC.2.1.10: Neighbor Solicitation Processing, NCE State REACHABLE

Purpose: Verify that a node properly updates its neighbor cache upon receipt of neighbor solicitations when the NCE of the neighbor is in state REACHABLE.

Reference:

- [IPv6-ARCH] – Section 2, 2.8
- [ND] – Sections 7.2.3 and 7.2.4

Test Setup: No Common Test Setup is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. The Common Test Cleanup procedure is performed after each part.

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

Neighbor Advertisement B
IPv6 Header Next Header: 58 Source Address: TN1's Link-local Address Destination Address: NUT'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	Neighbor Solicitation D
IPv6 Header Next Header: 58 Destination Address: NUT's Link-local	IPv6 Header Next Header: 58 Destination Address: NUT's Solicited-node

Address Source Address: TN1's Link-local Address	Multicast Link-local Address Source Address: TN1's Link-local Address
Neighbor Solicitation Target Address: NUT's Link-local Address Source Link-Layer Address: TN1's MAC address	Neighbor Solicitation Target Address: NUT's Link-local Address Source Link-Layer Address: TN1's MAC address

Procedure:

Part A: Unicast Neighbor Solicitation with the same SLLA

Step	Action	Expected Behavior
1.	TN1 transmits Echo Request A.	The NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
2.	TN1 transmits a solicited Neighbor Advertisement B.	After receiving TN1's Neighbor Advertisement, the NUT should send its queued Echo Reply to TN1. The NUT should then update the NCE of TN1 to state **REACHABLE** and update its link-layer address for TN1 accordingly.
3.	TN1 transmits Echo Request A.	Because the NUT is in state **REACHABLE**, after receiving the Echo Request from TN1, the NUT should send an Echo Reply. After DELAY_FIRST_PROBE_TIME, the NUT should not send a unicast Neighbor Solicitation to TN1.
4.	TN1 transmits Neighbor Solicitation C.	
5.	TN1 transmits an Echo Request A.	The NUT should not update the NCE of TN1, the NUT should reply to Neighbor Solicitation C by sending a Neighbor Advertisement. After responding to the Neighbor Solicitation, the NUT should respond to the Echo Request by sending an Echo Reply and should stay in state **REACHABLE**. After DELAY_FIRST_PROBE_TIME, the NUT should not send a unicast Neighbor Solicitation to TN1.

Part B: Unicast Neighbor Solicitation with a different SLLA

Step	Action	Expected Behavior

6.	TN1 transmits Echo Request A.	The NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
7.	TN1 transmits a solicited Neighbor Advertisement B.	After receiving TN1's Neighbor Advertisement, the NUT should send its queued Echo Reply to TN1. The NUT should then update the NCE of TN1 to state **REACHABLE** and update its link-layer address for TN1 accordingly.
8.	TN1 transmits Echo Request A.	Because the NUT is in state **REACHABLE**, after receiving the Echo Request from TN1, the NUT should send an Echo Reply. After DELAY_FIRST_PROBE_TIME, the NUT should not send a unicast Neighbor Solicitation to TN1.
9.	TN1 transmits Neighbor Solicitation C with a different address as the Source Link-layer Address.	
10.	TN1 transmits an Echo Request A.	The NUT should update the NCE of TN1 to state **STALE** and update TN1's Link-layer address to its new Link-layer address from the received Neighbor Solicitation C. The NUT should reply to Neighbor Solicitation C by sending a Neighbor Advertisement. After responding to the Neighbor Solicitation, the NUT 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 NUT should send a unicast Neighbor Solicitation to TN1 with the Target set the new Link-Layer address of TN1.

Part C: Multicast Neighbor Solicitation with the same SLLA

Step	Action	Expected Behavior
11.	TN1 transmits Echo Request A.	The NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
12.	TN1 transmits a solicited Neighbor Advertisement B.	After receiving TN1's Neighbor Advertisement, the NUT should send its queued Echo Reply to TN1. The NUT should then update the NCE of TN1 to state **REACHABLE** and update its link-layer address for TN1 accordingly.
13.	TN1 transmits Echo Request A.	Because the NUT is in state **REACHABLE**, after receiving the Echo Request from TN1, the NUT should send an Echo Reply. After DELAY_FIRST_PROBE_TIME, the NUT

		should not send a unicast Neighbor Solicitation to TN1.
14.	TN1 transmits Neighbor Solicitation D.	
15.	TN1 transmits an Echo Request A.	The NUT should not update the NCE of TN1, the NUT should reply to Neighbor Solicitation D by sending a Neighbor Advertisement. After responding to the Neighbor Solicitation, the NUT should respond to the Echo Request by sending an Echo Reply and should stay in state **REACHABLE**. After DELAY_FIRST_PROBE_TIME, the NUT should not send a unicast Neighbor Solicitation to TN1.

Part D: Multicast Neighbor Solicitation with a different SLLA

Step	Action	Expected Behavior
16.	TN1 transmits Echo Request A.	The NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
17.	TN1 transmits a solicited Neighbor Advertisement B.	After receiving TN1's Neighbor Advertisement, the NUT should send its queued Echo Reply to TN1. The NUT should then update the NCE of TN1 to state **REACHABLE** and update its link-layer address for TN1 accordingly.
18.	TN1 transmits Echo Request A.	Because the NUT is in state **REACHABLE**, after receiving the Echo Request from TN1, the NUT should send an Echo Reply. After DELAY_FIRST_PROBE_TIME, the NUT should not send a unicast Neighbor Solicitation to TN1.
19.	TN1 transmits Neighbor Solicitation D with a different address as the Source Link-layer Address.	
20.	TN1 transmits an Echo Request A.	The NUT should update the NCE of TN1 to state **STALE** and update TN1's Link-layer address to its new Link-layer address from the received Neighbor Solicitation D. The NUT should reply to Neighbor Solicitation D by sending a Neighbor Advertisement. After responding to the Neighbor Solicitation, the NUT 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 NUT should send a unicast Neighbor Solicitation to TN1 with the Target set to the new Link-Layer address of TN1.

Possible Problems: None.

Test v6LC.2.1.11: Neighbor Solicitation Processing, NCE State STALE

Purpose: Verify that a node properly updates its neighbor cache upon receipt of neighbor solicitations when the NCE of the neighbor is in state STALE.

Reference:

- [IPv6-ARCH] – Section 2, 2.8
- [ND] – Sections 7.2.3 and 7.2.4

Test Setup: No Common Test Setup is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. The Common Test Cleanup procedure is performed after each part.

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

Neighbor Advertisement B
IPv6 Header Next Header: 58 Source Address: TN1's Link-local Address Destination Address: NUT'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	Neighbor Solicitation D
IPv6 Header Next Header: 58 Destination Address: NUT's Link-local	IPv6 Header Next Header: 58 Destination Address: NUT's Solicited-node

Address Source Address: TN1's Link-local Address	Multicast Link-local Address Source Address: TN1's Link-local Address
Neighbor Solicitation Target Address: NUT's Link-local Address Source Link-Layer Address: TN1's MAC address	Neighbor Solicitation Target Address: NUT's Link-local Address Source Link-Layer Address: TN1's MAC address

Procedure:

Part A: Unicast Neighbor Solicitation with the same SLLA

Step	Action	Expected Behavior
1.	TN1 transmits Echo Request A.	The NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
2.	TN1 transmits a solicited Neighbor Advertisement B.	After receiving TN1's Neighbor Advertisement, the NUT should send its queued Echo Reply to TN1. The NUT should then update the NCE of TN1 to state **REACHABLE** and update its link-layer address for TN1 accordingly.
3.	TN1 transmits Echo Request A.	Because the NUT is in state **REACHABLE**, after receiving the Echo Request from TN1, the NUT should send an Echo Reply. After DELAY_FIRST_PROBE_TIME, the NUT should not send a unicast Neighbor Solicitation to TN1.
4.	Wait (REACHABLE_TIME * MAX_RANDOM_FACTOR) seconds.	The NUT should update the NCE of TN1 to state **STALE**. (See Note in Section 2 title page.)
5.	TN1 transmits Neighbor Solicitation C.	
6.	TN1 transmits an Echo Request to the NUT.	The NUT should not update the NCE of TN1 and should stay in state **STALE**. The NUT should reply to the Neighbor Solicitation by sending a Neighbor Advertisement. After responding to the Neighbor Solicitation, the NUT should respond to the Echo Request by sending an Echo Reply and set the state of the TN1's Entry to **DELAY**. After DELAY_FIRST_PROBE_TIME, the NUT should send a unicast Neighbor Solicitation to TN1.

Part B: Unicast Neighbor Solicitation with a different SLLA

Step	Action	Expected Behavior
7.	TN1 transmits Echo Request A.	The NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
8.	TN1 transmits a solicited Neighbor Advertisement B.	After receiving TN1's Neighbor Advertisement, the NUT should send its queued Echo Reply to TN1. The NUT should then update the NCE of TN1 to state **REACHABLE** and update its link-layer address for TN1 accordingly.
9.	TN1 transmits Echo Request A.	Because the NUT is in state **REACHABLE**, after receiving the Echo Request from TN1, the NUT should send an Echo Reply. After DELAY_FIRST_PROBE_TIME, the NUT should not send a unicast Neighbor Solicitation to TN1.
10.	Wait (REACHABLE_TIME * MAX_RANDOM_FACTOR) seconds.	The NUT should update the NCE of TN1 to state **STALE**. (See Note in Section 2 title page.)
11.	TN1 transmits Neighbor Solicitation C with a different address as the Source Link-layer Address.	
12.	TN1 transmits an Echo Request to the NUT.	The NUT should update TN1's Link-layer address to its new link-layer address from the received Neighbor Solicitation C. The NUT should not update the NCE of TN1 and should stay in state **STALE**. The NUT should reply to the Neighbor Solicitation by sending a Neighbor Advertisement to TN1's new Link-Layer address. After responding to the Neighbor Solicitation, the NUT should respond to the Echo Request by sending an Echo Reply and set the state of the TN1's Entry to **DELAY**. After DELAY_FIRST_PROBE_TIME, the NUT should send a unicast Neighbor Solicitation to TN1 using the new link-layer address as the Target.

Part C: Multicast Neighbor Solicitation with the same SLLA

Step	Action	Expected Behavior
13.	TN1 transmits Echo Request A.	The NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
14.	TN1 transmits a solicited Neighbor Advertisement B.	After receiving TN1's Neighbor Advertisement, the NUT should send its

		queued Echo Reply to TN1. The NUT should then update the NCE of TN1 to state **REACHABLE** and update its link-layer address for TN1 accordingly.
15.	TN1 transmits Echo Request A.	Because the NUT is in state **REACHABLE**, after receiving the Echo Request from TN1, the NUT should send an Echo Reply. After DELAY_FIRST_PROBE_TIME, the NUT should not send a unicast Neighbor Solicitation to TN1.
16.	Wait (REACHABLE_TIME * MAX_RANDOM_FACTOR) seconds.	The NUT should update the NCE of TN1 to state **STALE**. (See Note in Section 2 title page.)
17.	TN1 transmits Neighbor Solicitation D.	
18.	TN1 transmits an Echo Request to the NUT.	The NUT should not update the NCE of TN1 and should stay in state **STALE**. The NUT should not update the NCE of TN1. The NUT should reply to the Neighbor Solicitation by sending a Neighbor Advertisement. After responding to the Neighbor Solicitation, the NUT should respond to the Echo Request by sending an Echo Reply and set the state of the TN1's Entry to **DELAY**. After DELAY_FIRST_PROBE_TIME, the NUT should send a unicast Neighbor Solicitation to TN1.

Part D: Multicast Neighbor Solicitation with a different SLLA

Step	Action	Expected Behavior
19.	TN1 transmits Echo Request A.	The NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
20.	TN1 transmits a solicited Neighbor Advertisement B.	After receiving TN1's Neighbor Advertisement, the NUT should send its queued Echo Reply to TN1. The NUT should then update the NCE of TN1 to state **REACHABLE** and update its link-layer address for TN1 accordingly.
21.	TN1 transmits Echo Request A.	Because the NUT is in state **REACHABLE**, after receiving the Echo Request from TN1, the NUT should send an Echo Reply. After DELAY_FIRST_PROBE_TIME, the NUT should not send a unicast Neighbor Solicitation to TN1.
22.	Wait (REACHABLE_TIME * MAX_RANDOM_FACTOR) seconds.	The NUT should update the NCE of TN1 to state **STALE**. (See Note in Section 2 title page.)

23.	TN1 transmits Neighbor Solicitation D with a different address as the Source Link-layer Address.	
24.	TN1 transmits an Echo Request to the NUT.	The NUT should update TN1's Link-layer address to its new link-layer address from the received Neighbor Solicitation D. The NUT should not update the NCE of TN1 and should stay in state **STALE**. The NUT should reply to the Neighbor Solicitation by sending a Neighbor Advertisement to TN1's new Link-Layer address. After responding to the Neighbor Solicitation, the NUT should respond to the Echo Request by sending an Echo Reply and set the state of the TN1's Entry to **DELAY**. After DELAY_FIRST_PROBE_TIME, the NUT should send a unicast Neighbor Solicitation to TN1 using the new link-layer address as the Target.

Possible Problems: None.

Test v6LC.2.1.12: Neighbor Solicitation Processing, NCE State PROBE

Purpose: Verify that a node properly updates its neighbor cache upon receipt of neighbor solicitations when the NCE of the neighbor is in state Probe.

Reference:

- [IPv6-ARCH] – Section 2, 2.8
- [ND] – Sections 7.2.3 and 7.2.4

Test Setup: No Common Test Setup is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. The Common Test Cleanup procedure is performed after each part.

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

Neighbor Advertisement B
IPv6 Header Next Header: 58 Source Address: TN1's Link-local Address Destination Address: NUT's Link-local Address
Neighbor Advertisement Router flag: 0 Solicited flag: 0 Override flag: 1 Target Address: TN1's Link-local Address

Neighbor Solicitation C	Neighbor Solicitation D
IPv6 Header Next Header: 58 Destination Address: NUT's Link-local	IPv6 Header Next Header: 58 Destination Address: NUT's Solicited-node

Address Source Address: TN1's Link-local Address	Multicast Link-local Address Source Address: TN1's Link-local Address
Neighbor Solicitation Target Address: NUT's Link-local Address Source Link-Layer Address: TN1's MAC address	Neighbor Solicitation Target Address: NUT's Link-local Address Source Link-Layer Address: TN1's MAC address

Procedure:

Part A: Unicast Neighbor Solicitation with the same SLLA

Step	Action	Expected Behavior
1.	TN1 transmits Packet A to the NUT.	
2.	TN1 transmits Neighbor Advertisement B to the NUT after receiving any Neighbor Solicitations from the NUT.	The NUT should update the NCE of TN1 to state **STALE**. After receiving the Echo Request from TN1, the NUT should send a Reply and enter state **DELAY**.
3.	Wait (DELAY_FIRST_PROBE_TIME) seconds.	After DELAY_FIRST_PROBE_TIME, the NUT should transition to state **PROBE** by sending a unicast Neighbor Solicitation to TN1.
4.	TN1 transmits Neighbor Solicitation C.	
5.	TN1 transmits an Echo Request to the NUT.	The NUT should not update the state of TN1's NCE after sending its queued Neighbor Advertisement and Echo Reply and should stay in state **PROBE**. The NUT should retransmit its unicast Neighbor Solicitation to TN1.

Part B: Unicast Neighbor Solicitation with a different SLLA

Step	Action	Expected Behavior
6.	TN1 transmits Packet A to the NUT.	
7.	TN1 transmits Neighbor Advertisement B to the NUT after receiving any Neighbor Solicitations from the NUT.	The NUT should update the NCE of TN1 to state **STALE**. After receiving the Echo Request from TN1, the NUT should send a Reply and enter state **DELAY**.
8.	Wait (DELAY_FIRST_PROBE_TIME) seconds.	After DELAY_FIRST_PROBE_TIME, the NUT should transition to state **PROBE** by sending a unicast Neighbor Solicitation to TN1.

9.	TN1 transmits Neighbor Solicitation C with a different address as the Source Link-layer Address.	
10.	TN1 transmits an Echo Request to the NUT.	The NUT should update TN1's Link-layer address to its new link-layer address from the received Neighbor Solicitation C and MUST update the state of TN1's NCE to **STALE**. The NUT should reply to the Neighbor Solicitation by sending a Neighbor Advertisement using TN1's new Link-Layer address. After responding to the Neighbor Solicitation, the NUT should respond to the Echo Request by sending an Echo Reply and set the state of the TN1's Entry to **DELAY**. After DELAY_FIRST_PROBE_TIME, the NUT should send a unicast Neighbor Solicitation to TN1 using the new Link-layer address as the Target.

Part C: Multicast Neighbor Solicitation with the same SLLA

Step	Action	Expected Behavior
11.	TN1 transmits Packet A to the NUT.	
12.	TN1 transmits Neighbor Advertisement B to the NUT after receiving any Neighbor Solicitations from the NUT.	The NUT should update the NCE of TN1 to state **STALE**. After receiving the Echo Request from TN1, the NUT should send a Reply and enter state **DELAY**.
13.	Wait (DELAY_FIRST_PROBE_TIME) seconds.	After DELAY_FIRST_PROBE_TIME, the NUT should transition to state **PROBE** by sending a unicast Neighbor Solicitation to TN1.
14.	TN1 transmits Neighbor Solicitation D.	
15.	TN1 transmits an Echo Request to the NUT.	The NUT should not update the state of TN1's NCE after sending it's queued Neighbor Advertisement and Echo Reply and should stay in state **PROBE**. The NUT should retransmit its unicast Neighbor Solicitation to TN1.

Part D: Multicast Neighbor Solicitation with a different SLLA

Step	Action	Expected Behavior
16.	TN1 transmits Packet A to the NUT.	
17.	TN1 transmits Neighbor Advertisement B to the NUT after receiving any Neighbor Solicitations from the NUT.	The NUT should update the NCE of TN1 to state **STALE**. After receiving the Echo Request from TN1, the NUT should send a Reply and enter state **DELAY**.
18.	Wait (DELAY_FIRST_PROBE_TIME) seconds.	After DELAY_FIRST_PROBE_TIME, the NUT should transition to state **PROBE** by

		sending a unicast Neighbor Solicitation to TN1.
19.	TN1 transmits Neighbor Solicitation D with a different address as the Source Link-layer Address.	
20.	TN1 transmits an Echo Request to the NUT.	The NUT should update TN1's Link-layer address to its new link-layer address from the received Neighbor Solicitation D and MUST update the state of TN1's NCE to **STALE**. The NUT should reply to the Neighbor Solicitation by sending a Neighbor Advertisement using TN1's new Link-Layer address. After responding to the Neighbor Solicitation, the NUT should respond to the Echo Request by sending an Echo Reply and set the state of the TN1's Entry to **DELAY**. After DELAY_FIRST_PROBE_TIME, the NUT should send a unicast Neighbor Solicitation to TN1 using the new Link-layer address as the Target.

Possible Problems: None.

Test v6LC.2.1.13: Neighbor Solicitation Processing, IsRouter Flag (Host Only)

Purpose: Verify that a host does not modify the IsRouter flag after receiving a Neighbor Solicitation.

Reference:

- [IPv6-ARCH] – Section 2.6.1, 2.8
- [ND] – Sections 7.2.3

Test Setup: Common Test Setup 1.1 is performed. The Common Test Cleanup procedure is performed after each part.

Packet A
IPv6 Header Next Header: 58 Source Address: TN2's off-link Address Destination Address: HUT's Global Address
ICMPv6 Echo Request

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

Neighbor Solicitation C	Neighbor Solicitation D
IPv6 Header Next Header: 58 Destination Address: HUT's Link-local Address Source Address: TR1's Link-local Address	IPv6 Header Next Header: 58 Destination Address: NUT's Solicited-node Multicast Link-local Address Source Address: TR1's Link-local Address
Neighbor Solicitation	Neighbor Solicitation

Target Address: HUT's Link-local Address Source Link-Layer Address: TR1's MAC address	Target Address: NUT's Link-local Address Source Link-Layer Address: MAC Address Y (Different from TR1 MAC)

Procedure:

Part A: Unicast Neighbor Solicitation without SLLA

Step	Action	Expected Behavior
1.	TR1 transmits Neighbor Solicitation B.	
2.	TN2 transmits Packet A to the HUT.	The HUT should transmit an Echo Reply using TR1 as its default router. The HUT should not update the IsRouter flag after receiving the NS.

Part B: Unicast Neighbor Solicitation with a SLLA

Step	Action	Expected Behavior
3.	TR1 transmits Neighbor Solicitation C.	
4.	TN2 transmits Packet A to the HUT.	The HUT should transmit an Echo Reply using TR1 as its default router. The HUT should not update the IsRouter flag after receiving the NS.

Part C: Multicast Neighbor Solicitation with a different SLLA

Step	Action	Expected Behavior
5.	TR1 transmits Neighbor Solicitation D.	
6.	TN2 transmits Packet A to the HUT.	The HUT should transmit an Echo Reply using MAC address Y, the updated link-layer address, as the destination MAC address. The HUT should not update the IsRouter flag after receiving the NS.

Possible Problems: None.

Test v6LC.2.1.14: Neighbor Solicitation Processing, Anycast (Routers Only)

Purpose: Verify that a router properly processes a Neighbor Solicitation for an anycast address.

Reference:
- [IPv6-ARCH] – Section 2, 2.6, 2.6.1, 2.8
- [ND] – Sections 7.2.3 and 7.2.4

Test Setup: No Common Test Setup is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. The Common Test Cleanup procedure is performed after each part.

Procedure:

Step	Action	Expected Behavior
1.	Ensure the RUT has a Subnet-Router anycast address on Net0.	
2.	TN1 transmits a Neighbor Solicitation to the RUT's Subnet-Router anycast address.	The RUT should respond to TN1 by sending a Neighbor Advertisement between 0 and MAX_ANYCAST_DELAY_TIME after it receives the Neighbor Solicitation. The RUT's Neighbor Advertisement should contain a value of 0 in the override flag field.

Possible Problems: None.

Test v6LC.2.1.15: Invalid Neighbor Advertisement Handling

Purpose: Verify that a node takes the proper actions upon receipt of an invalid Neighbor Advertisement.

Reference:

- [ND] – Sections 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: TN1'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: TN1's link-local address TLLOPT: TN1's MAC address

Procedure:

Part A: NUT receives invalid NA (Solicited Flag ==1)

Step	Action	Expected Behavior
1.	TN1 transmits an Echo Request to the NUT.	The NUT should transmit a Neighbor Solicitation to TN1's solicited-node multicast address.
2.	TN1 transmits Neighbor Advertisement A with the Solicited flag set to 1.	The NUT should ignore the Neighbor Advertisement sent by TN1 and should continue to transmit Neighbor Solicitations to TN1's solicited-node multicast address.

Part B: NUT receives invalid NA (Hop Limit == 254)

Step	Action	Expected Behavior

3.	TN1 transmits an Echo Request to the NUT.	The NUT should transmit a Neighbor Solicitation to TN1's solicited-node multicast address.
4.	TN1 to transmit Neighbor Advertisement A with the Hop Limit set to 254.	The NUT should ignore the Neighbor Advertisement sent by TN1 and should continue to transmit Neighbor Solicitations to TN1's solicited-node multicast address.

Part C: NUT receives invalid NA (Invalid Checksum)

Step	Action	Expected Behavior
5.	TN1 transmits an Echo Request to the NUT.	The NUT should transmit a Neighbor Solicitation to TN1's solicited-node multicast address.
6.	TN1 to transmit Neighbor Advertisement A with an invalid checksum.	The NUT should ignore the Neighbor Advertisement sent by TN1 and should continue to transmit Neighbor Solicitations to TN1's solicited-node multicast address.

Part D: NUT receives invalid NA (Invalid ICMP Code)

Step	Action	Expected Behavior
7.	TN1 transmits an Echo Request to the NUT.	The NUT should transmit a Neighbor Solicitation to TN1's solicited-node multicast address.
8.	TN1 to transmit Neighbor Advertisement A with the ICMP code set to 1.	The NUT should ignore the Neighbor Advertisement sent by TN1 and should continue to transmit Neighbor Solicitations to TN1's solicited-node multicast address.

Part E: NUT receives invalid NA (ICMP length < 24 octets)

Step	Action	Expected Behavior
9.	TN1 transmits an Echo Request to the NUT.	The NUT should transmit a Neighbor Solicitation to TN1's solicited-node multicast address.
10.	TN1 to transmit Neighbor Advertisement A with the ICMP length set to 16.	The NUT should ignore the Neighbor Advertisement sent by TN1 and should continue to transmit Neighbor Solicitations to TN1's solicited-node multicast address.

Part F: NUT receives invalid NA (target == multicast address)

Step	Action	Expected Behavior
11.	TN1 transmits an Echo Request to the NUT.	The NUT should transmit a Neighbor Solicitation to TN1's solicited-node multicast address.
12.	TN1 to transmit Neighbor Advertisement A with the Target Address set to the solicited multicast of TN1's link-local address.	The NUT should ignore the Neighbor Advertisement sent by TN1 and should continue to transmit Neighbor Solicitations to TN1's solicited-node multicast address.

Part G: NUT receives invalid NA (option length == zero)

Step	Action	Expected Behavior
13.	TN1 transmits an Echo Request to the NUT.	The NUT should transmit a Neighbor Solicitation to TN1's solicited-node multicast address.
14.	TN1 to transmit Neighbor Advertisement A with the Option length set to 0.	The NUT should ignore the Neighbor Advertisement sent by TN1 and should continue to transmit Neighbor Solicitations to TN1's solicited-node multicast address.

Possible Problems: None.

Test v6LC.2.1.16: Neighbor Advertisement Processing, No NCE

Purpose: Verify that a node silently discards a Neighbor Advertisement if the target does not have a Neighbor Cache entry.

Reference:

- [ND] – Sections 7.2.5

Test Setup: No Common Test Setup is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. The Common Test Cleanup procedure is performed after each part.

Neighbor Advertisement A	Neighbor Advertisement B
IPv6 Header Next Header: 58	IPv6 Header Next Header: 58
Neighbor Advertisement Solicited flag: 0 Override flag: 0 Target Link-layer Option	Neighbor Advertisement Solicited flag: 0 Override flag: 1 Target Link-layer Option

Neighbor Advertisement C	Neighbor Advertisement D
IPv6 Header Next Header: 58	IPv6 Header Next Header: 58
Neighbor Advertisement Solicited flag: 1 Override flag: 0 Target Link-layer Option	Neighbor Advertisement Solicited flag: 1 Override flag: 1 Target Link-layer Option

Procedure:

Part A: Receiving NA with S = 0, O = 0, and TLLA

Step	Action	Expected Behavior
1.	TN1 transmits Neighbor Advertisement A.	After receiving the Neighbor Advertisement from TN1, the NUT should not transmit any packets and no NCE's should be created for TN1.
2.	TN1 transmits an Echo Request to the NUT.	After receiving the Echo Request from TN1, the NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.

Part B: Receiving NA with S = 0, O = 1, and TLLA

Step	Action	Expected Behavior
3.	TN1 transmits Neighbor Advertisement B.	After receiving the Neighbor Advertisement from TN1, the NUT should not transmit any packets and no NCE's should be created for TN1.
4.	TN1 transmits an Echo Request to the NUT.	After receiving the Echo Request from TN1, the NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.

Part C: Receiving NA with S = 1, O = 0, and TLLA

Step	Action	Expected Behavior
5.	TN1 transmits Neighbor Advertisement C.	After receiving the Neighbor Advertisement from TN1, the NUT should not transmit any packets and no NCE's should be created for TN1.
6.	TN1 transmits an Echo Request to the NUT.	After receiving the Echo Request from TN1, the NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.

Part D: Receiving NA with S = 1, O = 1, and TLLA

Step	Action	Expected Behavior
7.	TN1 transmits Neighbor Advertisement D.	After receiving the Neighbor Advertisement from TN1, the NUT should not transmit any packets and no NCE's should be created for TN1.
8.	TN1 transmits an Echo Request to the NUT.	After receiving the Echo Request from TN1, the NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.

Part E: Receiving NA with S = 0, O = 0, and NO TLLA

Step	Action	Expected Behavior
9.	TN1 transmits Neighbor Advertisement A without the Target Link-layer Address Option.	After receiving the Neighbor Advertisement from TN1, the NUT should not transmit any packets and no NCE's should be created for TN1.
10.	TN1 transmits an Echo Request to the NUT.	After receiving the Echo Request from TN1, the NUT should create a Neighbor Cache

		Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.

Part F: Receiving NA with S = 0, O = 1, and NO TLLA

Step	Action	Expected Behavior
11.	TN1 transmits Neighbor Advertisement B without the Target Link-layer Address Option.	After receiving the Neighbor Advertisement from TN1, the NUT should not transmit any packets and no NCE's should be created for TN1.
12.	TN1 transmits an Echo Request to the NUT.	After receiving the Echo Request from TN1, the NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.

Part G: Receiving NA with S = 1, O = 0, and NO TLLA

Step	Action	Expected Behavior
13.	TN1 transmits Neighbor Advertisement C without the Target Link-layer Address Option.	After receiving the Neighbor Advertisement from TN1, the NUT should not transmit any packets and no NCE's should be created for TN1.
14.	TN1 transmits an Echo Request to the NUT.	After receiving the Echo Request from TN1, the NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.

Part H: Receiving NA with S = 1, O = 1, and NO TLLA

Step	Action	Expected Behavior
15.	TN1 transmits Neighbor Advertisement D without the Target Link-layer Address Option.	After receiving the Neighbor Advertisement from TN1, the NUT should not transmit any packets and no NCE's should be created for TN1.
16.	TN1 transmits an Echo Request to the NUT.	After receiving the Echo Request from TN1, the NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.

Possible Problems: None.

Test v6LC.2.1.17: Neighbor Advertisement Processing, NCE State INCOMPLETE

Purpose: Verify that a node properly updates its Neighbor Cache from the INCOMPLETE state upon receipt of a Neighbor Advertisement.

Reference:

- [ND] – Sections 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: No Common Test Setup is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. The Common Test Cleanup procedure is performed after each part.

Packet 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. 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

Step	Action	Expected Behavior
1.	TN1 transmits Packet A.	After receiving the Echo Request from TN1, the NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry

		to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
2.	TN1 transmits Neighbor Advertisement B.	After receiving the Neighbor Advertisement from TN1, the NUT should send the queued Echo Reply to TN1 and update its NCE of TN1 with the received Target Link-layer Address and change the state of the NCE to **REACHABLE**.
3.	TN1 transmits an Echo Request.	Because the NUT is in state **REACHABLE**, after receiving the Echo Request from TN1, the NUT should send an Echo Reply. After DELAY_FIRST_PROBE_TIME, the NUT should not send a unicast Neighbor Solicitation to TN1.

Part B: Receiving NA with S = 1 and O = 0

Step	Action	Expected Behavior
4.	TN1 transmits Packet A.	After receiving the Echo Request from TN1, the NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
5.	TN1 transmits Neighbor Advertisement C.	After receiving the Neighbor Advertisement from TN1, the NUT should send the queued Echo Reply to TN1 and update its NCE of TN1 with the received Target Link-layer Address and change the state of the NCE to **REACHABLE**.
6.	TN1 transmits an Echo Request.	Because the NUT is in state **REACHABLE**, after receiving the Echo Request from TN1, the NUT should send an Echo Reply. After DELAY_FIRST_PROBE_TIME, the NUT should not send a unicast Neighbor Solicitation to TN1.

Part C: Receiving NA with S = 0 and O = 1

Step	Action	Expected Behavior
7.	TN1 transmits Packet A.	After receiving the Echo Request from TN1, the NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
8.	TN1 transmits Neighbor Advertisement D.	After receiving the Neighbor Advertisement from TN1, the NUT should update its NCE of TN1 with the received Target Link-layer Address and change the state of the NCE to **STALE** and send the queued Echo Reply to TN1. After DELAY_FIRST_PROBE_TIME, the NUT

		should send a unicast Neighbor Solicitation to TN1.

Part D: Receiving NA with S = 0 and O = 0

Step	Action	Expected Behavior
9.	TN1 transmits Packet A.	After receiving the Echo Request from TN1, the NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
10.	TN1 transmits Neighbor Advertisement E.	After receiving the Neighbor Advertisement from TN1, the NUT should update its NCE of TN1 with the received Target Link-layer Address and change the state of the NCE to **STALE** and send the queued Echo Reply to TN1. After DELAY_FIRST_PROBE_TIME, the NUT should send a unicast Neighbor Solicitation to TN1.

Part E: Receiving NA without Target Link-Layer Address Option

Step	Action	Expected Behavior
11.	TN1 transmits Packet A.	After receiving the Echo Request from TN1, the NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
12.	TN1 transmits a Neighbor Advertisement without any Target Link-Layer Address Option.	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 v6LC.2.1.18: Neighbor Advertisement Processing, NCE State REACHABLE

Purpose: Verify that a node properly updates its Neighbor Cache from the REACHABLE state upon receipt of a Neighbor Advertisement.

Reference:

- [ND] – Section 7.3.3 and 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: No Common Test Setup is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. 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-R)

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:

Step	Action	Expected Behavior
1.	TN1 transmits Echo Request A.	The NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
2.	TN1 transmits a solicited Neighbor Advertisement to the NUT.	Because the NUT is now in state **REACHABLE**, after receiving the Echo Request from TN1, the NUT should send an Echo Reply. After DELAY_FIRST_PROBE_TIME, the NUT should must not send a unicast Neighbor Solicitation to TN1.
3.	TN1 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.	
4.	TN1 transmits an Echo Request.	The NUT MUST update the state of TN1's NCE and the LLA according to the table in the discussion above. After receiving the Echo Request from TN1 in step 4, the NUT should must send an Echo Reply and react according to the following: **Parts A-H,L-N and Q-R to REACHABLE:**

		After DELAY_FIRST_PROBE_TIME, the NUT must not send a unicast Neighbor Solicitation to TN1. **Part L** The NUT's Echo Reply should be sent to the new updated link-layer destination address of TN1. **Parts I-K and O-P to STALE:** After DELAY_FIRST_PROBE_TIME, the NUT should send a unicast Neighbor Solicitation to TN1. **Parts J and P** The NUT's Echo Reply sent in response to the Echo Request sent in step 4 must be sent to the new updated link-layer destination address of TN1. The Neighbor Solicitation should use the new updated link-layer destination address.
5.	Perform the common cleanup procedure.	
6.	Repeat Steps 1 through 5 for Parts B through R.	

Possible Problems: None.

Test v6LC.2.1.19: Neighbor Advertisement Processing, NCE State STALE

Purpose: Verify that a node properly updates its Neighbor Cache from the STALE state upon receipt of a Neighbor Advertisement.

Reference:

- [ND] – Section 7.3.3 and 7.2.5

Destination	Solicited 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: No Common Test Setup is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. 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-R)
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:

Step	Action	Expected Behavior
1.	TN1 transmits Echo Request A.	The NUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The NUT should send a multicast Neighbor Solicitation to TN1.
2.	TN1 transmits a solicited Neighbor Advertisement to the NUT.	Because the NUT is now in state **REACHABLE**, after receiving the Echo Request from TN1, the NUT should send an Echo Reply. After DELAY_FIRST_PROBE_TIME, the NUT should not send a unicast Neighbor Solicitation to TN1.
3.	Wait (REACHABLE_TIME * MAX_RANDOM_FACTOR) seconds.	The NUT should change the state of TN1's NCE to **STALE**. (See Note in Section 2 title page.)
4.	TN1 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.	

5.	TN1 transmits an Echo Request.	The NUT MUST update the state of TN1's NCE and the LLA according to the table in the discussion above. After receiving the Echo Request from TN1 in step 5, the NUT should send an Echo Reply and react according to the following: **Parts C,D,G,H and L to REACHABLE:** After DELAY_FIRST_PROBE_TIME, the NUT should not send a unicast Neighbor Solicitation to TN1. **Part L:** The NUT's Echo Reply should be sent to the new updated link-layer destination address of TN1. **Parts A,B,E,F,I-K, and M-R to STALE:** After DELAY_FIRST_PROBE_TIME, the NUT should send a unicast Neighbor Solicitation to TN1. **Parts J and P** The NUT's Echo Reply sent in response to the Echo Request sent in step 4 must be sent to the new updated link-layer destination address of TN1. The Neighbor Solicitation should use the new updated link-layer destination address.
6.	Perform the common cleanup procedure.	
7.	Repeat Steps 1 through 6 for Parts B through R.	

Possible Problems: None.

Test v6LC.2.1.20: Neighbor Advertisement Processing, NCE State PROBE

Purpose: Verify that a node properly updates its Neighbor Cache from the PROBE state upon receipt of a Neighbor Advertisement.

Functionality Tag: Mandatory

Reference:

- [ND] – Section 7.3.3 and 7.2.5

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: No Common Test Setup is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. 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

Neighbor Adv. (Q-R)

IPv6 Header Next Header: 58 Source Address: TN1's Link-local Address Destination Address: NUT's Link-local Address
Neighbor Advertisement Router flag: 0 Solicited flag: 0 Override flag: 1 Target Address: TN1's Link-local Address

Procedure:

Step	Action	Expected Behavior
1.	TN1 transmits Echo Request A.	
2.	TN1 transmits Neighbor Advertisement Q to the NUT.	The NUT should change the state of TN1's NCE to **STALE**. After receiving the Echo Request from TN1, the NUT should send a Reply and enter state **DELAY.**

3.	Wait (DELAY_FIRST_PROBE_TIME) seconds.	The NUT should change the state of TN1's NCE to **PROBE** by transmitting a unicast Neighbor Solicitation to TN1.
4.	TN1 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.	
5.	Skip sending an Echo Request for Parts A, B, E, F, I, K, M, N, O, Q and R. Otherwise, TN1 transmits an Echo Request.	The NUT MUST update the state of TN1's NCE and the LLA according to the table in the discussion above. The NUT should then react according to the following: **Parts C, D, G, H and L to REACHABLE:** The NUT should send an Echo Reply. After DELAY_FIRST_PROBE_TIME, the NUT should not send a unicast Neighbor Solicitation to TN1. **Part L** The NUT's Echo Reply should be sent to the new updated link-layer destination address of TN1. **Parts J and P to STALE:** The NUT should send an Echo Reply. After DELAY_FIRST_PROBE_TIME, the NUT should send a unicast Neighbor Solicitation to TN1. The NUT's Echo Reply should be sent to the new updated link-layer destination address of TN1. 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 NUT should send a unicast Neighbor Solicitation to TN1.
6.	Perform the common cleanup procedure.	
7.	Repeat Steps 1 through 6 for Parts B through R.	

Possible Problems: None.

Test v6LC.2.1.21: Neighbor Advertisement Processing, R-bit Change (Hosts Only)

Purpose: Verify that a host takes appropriate actions when a neighbor who is a router starts transmitting Neighbor Advertisements with the Router flag clear.

Reference:

- [ND] – Section 7.2.5

Test Setup: No Common Test Setup is performed. 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: TN1's off-link Global Address Destination Address: HUT's 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	Neighbor Advertisement F
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 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	Neighbor Advertisement H
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 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:

Step	Action	Expected Behavior
1.	TR1 transmits the Router Advertisement without a Source Link-layer Address Option.	
2.	TN1 transmits Packet A.	The HUT should solicit TR1 by transmitting Neighbor Solicitations with a Target Address of TR1's Link-local Address.
3.	TR1 responds to Neighbor Solicitations from the HUT with a Neighbor Advertisement with the Router, Solicited, and Override flags set.	The HUT should transmit an Echo Reply to Packet A using the TR1 as the first hop.
4.	TR1 transmits Neighbor Advertisement A.	
5.	TN1 transmits Packet A.	The HUT MUST not transmit an Echo Reply using TR1 as the first hop in response to Packet A and the HUT MUST not transmit multicast NS's with a target set to TR1's link-local address.
6.	Perform the common cleanup procedure.	
7.	Repeat Steps 1 through 8 seven times with Neighbor Advertisement B, C, D, E, F, G and H respectively in Step 4.	

Possible Problems: None.

Test v6LC.2.1.22: Atomic Fragments in Neighbor Solicitation and Neighbor Advertisement

Purpose: Verify that the NUT doesn't process Neighbor Solicitations or Neighbor Advertisements messages with atomic fragments.

Reference:

- [RFC-6980] – Section 5

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Neighbor Solicitation

IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Link-Local Address
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 0
ICMPv6 Neighbor Solicitation
Source Link-Layer Option

Neighbor Advertisement

IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Link-Local Address
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 0
ICMPv6 Neighbor Solicitation
Target Link-Layer Option

Procedure:

Part A: Neighbor Solicitation with Atomic Fragment

Step	Action	Expected Behavior
1.	TN1 transmits Neighbor Solicitation.	
2.	TN1 transmits an Echo Request to the NUT.	Observe the NUT transmitting a Neighbor Solicitation indicating that it didn't process the Neighbor Solicitation. The NUT must not transmit an Echo Reply.

Part B: Neighbor Advertisement with Atomic Fragment

Step	Action	Expected Behavior
3.	TN1 transmits an Echo Request to the DUT.	Observe the NUT transmitting a Neighbor Solicitation for TN1.
4.	TN1 transmits Neighbor Advertisement.	The NUT should not transmit an Echo Reply indicating that it did not process the fragmented Neighbor Advertisement.

Possible Problems: None.

Test v6LC.2.1.23: Fragment Header in Neighbor Solicitation and Neighbor Advertisement

Purpose: Verify that the NUT doesn't process Neighbor Solicitation and Neighbor Advertisement messages with fragments.

Reference:

- [RFC-6980] – Section 5

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Neighbor Solicitation	NS Fragment
IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Link-Local Address	IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Global Address
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 1	Fragment Header Next Header: 58 Fragment Offset: 2 More Fragments flag: 0 Fragment Data: 16 Bytes
ICMPv6 Neighbor Solicitation	
Source Link-Layer Option	

Neighbor Advertisement	NA Fragment
IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Link-Local Address	IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Link-Local Address
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 1	Fragment Header Next Header: 58 Fragment Offset: 2 More Fragments flag: 0 Fragment Data: 16 Bytes

ICMPv6 Neighbor Solicitation	
Target Link-Layer Option	

Procedure:

Part A: Neighbor Solicitation with Fragment Header

Step	Action	Expected Behavior
1.	TN1 transmits Neighbor Solicitation and NS fragment.	
2.	TN1 transmits an Echo Request to the NUT.	Observe the NUT transmitting a Neighbor Solicitation indicating that it didn't process the Neighbor Solicitation. The NUT must not transmit an Echo Reply.

Part B: Neighbor Advertisement with Fragment Header

Step	Action	Expected Behavior
3.	TN1 transmits an Echo Request to the DUT.	Observe the NUT transmitting a Neighbor Solicitation for TN1.
4.	TN1 transmits Neighbor Advertisement and NA fragment	The NUT should not transmit an Echo Reply indicating that it did not process the fragmented Neighbor Advertisement.

Possible Problems: None.

Group 2: Router and Prefix Discovery

Scope

The following tests cover Router and Prefix Discovery in IPv6.

Overview

The tests in this group verify that a host properly performs Router and Prefix Discovery.

Test v6LC.2.2.1: Router Solicitations (Hosts Only)

Purpose: Verify that a host sends valid Router Solicitations at the appropriate time.

Reference:

- [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:

Step	Action	Expected Behavior
1.	Reboot the HUT.	The HUT must transmit a Router Solicitation, but no more than MAX_RTR_SOLICITATIONS (3). The Router Solicitations should be sent from the link-local address of the HUT. The destination address should be the All-Routers multicast address. A retransmitted Router Solicitation must not be sent before RTR_SOLICITATION_INTERVAL (4) seconds.

Possible Problems: A device that supports RFC 7559 may transmit more than 3 Router Solicitations. If that is the case this test may be omitted.

Test v6LC.2.2.2: Router Solicitations, Solicited Router Advertisement (Hosts Only)

Purpose: Verify that a host sends valid Router Solicitations appropriately in response to Router Advertisements.

Reference:

- [ND] – Sections 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

Step	Action	Expected Behavior
1.	Reboot the HUT.	
2.	Wait until the HUT 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	The HUT should transmit only one Router Solicitation. The Router Solicitation should be sent from either the link-local address of the HUT or the unspecified address. The destination address should be the All-Routers multicast address. The Router

		Solicitation may or may not include a Source Link-layer Address option.

Part B: Valid Router Advertisement, Source Link-layer Address Option

Step	Action	Expected Behavior
5.	Reboot the HUT.	
6.	Wait until the HUT transmits a Router Solicitation.	
7.	TR1 transmits Router Advertisement A with 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.	
8.	Wait RTR_SOLICITATION_INTERVAL + MAX_RTR_SOLICITATION_DELAY	The HUT should transmit only one Router Solicitation. The Router Solicitation should be sent from either the link-local address of the HUT or the unspecified address. The destination address should be the All-Routers multicast address. The Router Solicitation may or may not include a Source Link-layer Address option.

Part C: Invalid Router Advertisement, Global Source Address

Step	Action	Expected Behavior
9.	Reboot the HUT.	
10.	Wait until the HUT transmits a Router Solicitation.	
11.	TR1 transmits Router Advertisement A with a Source Link-layer Address Option. The Source Address is the global address of TR1. The Hop Limit is 255. The ICMP Code is 0. The ICMP Checksum is valid.	
12.	Wait RTR_SOLICITATION_INTERVAL + MAX_RTR_SOLICITATION_DELAY	The HUT should ignore the Invalid Router Advertisement and continue to transmit Router Solicitations. The Router Solicitations should be sent from either the link-local address of the HUT or the unspecified address. The destination address should be the All-Routers multicast address. The Router Solicitations may or may not include a Source Link-layer Address option.

Part D: Invalid Router Advertisement, Bad Hop Limit

Step	Action	Expected Behavior
13.	Reboot the HUT.	

14.	Wait until the HUT transmits a Router Solicitation.	
15.	TR1 transmits Router Advertisement A with a Source Link-layer Address Option. The Source Address is the link-local address of TR1. The Hop Limit is 2. The ICMP Code is 0. The ICMP Checksum is valid.	
16.	Wait RTR_SOLICITATION_INTERVAL + MAX_RTR_SOLICITATION_DELAY	The HUT should ignore the invalid Router Advertisement and continue to transmit Router Solicitations. The Router Solicitations should be sent from either the link-local address of the HUT or the unspecified address. The destination address should be the All-Routers multicast address. The Router Solicitations may or may not include a Source Link-layer Address option.

Part E: Invalid Router Advertisement, Bad ICMP Checksum

Step	Action	Expected Behavior
17.	Reboot the HUT.	
18.	Wait until the HUT transmits a Router Solicitation.	
19.	TR1 transmits Router Advertisement A with 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 invalid.	
20.	Wait RTR_SOLICITATION_INTERVAL + MAX_RTR_SOLICITATION_DELAY	The HUT should ignore the invalid Router Advertisement and continue to transmit Router Solicitations. The Router Solicitations should be sent from either the link-local address of the HUT or the unspecified address. The destination address should be the All-Routers multicast address. The Router Solicitations may or may not include a Source Link-layer Address option.

Part F: Invalid Router Advertisement, Bad ICMP Code

Step	Action	Expected Behavior
21.	Reboot the HUT.	
22.	Wait until the HUT transmits a Router Solicitation.	
23.	TR1 transmits Router Advertisement A with 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 1. The ICMP Checksum is valid.	
24.	Wait RTR_SOLICITATION_INTERVAL + MAX_RTR_SOLICITATION_DELAY	The HUT should ignore the invalid Router Advertisement and continue to transmit Router Solicitations. The Router Solicitations should be sent from either the link-local address of the HUT or the unspecified address. The destination address should be the All-Routers multicast address. The Router Solicitations may or may not include a Source Link-layer Address option.

Part G: Valid Router Advertisement, Unicast Destination

Step	Action	Expected Behavior
25.	Reboot the HUT.	
26.	Wait until the HUT transmits a Router Solicitation.	
27.	TR1 transmits Router Advertisement A with 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. The destination address is the HUT's link-local address.	
28.	Wait RTR_SOLICITATION_INTERVAL + MAX_RTR_SOLICITATION_DELAY	The HUT should transmit only one Router Solicitation. The Router Solicitation should be sent from either the link-local address of the HUT or the unspecified address. The destination address should be the All-Routers multicast address. The Router Solicitation may or may not include a Source Link-layer Address option.

Possible Problems: If a host only transmit one Router Solicitation upon a reboot this test case may be omitted.

Test v6LC.2.2.3: Host Ignores Router Solicitations (Hosts Only)

Purpose: Verify that a host sends valid Router Solicitations appropriately in response to Router Advertisements.

Reference:

- [ND] – Sections 6.2.6

Test Setup: No Common Test Setup is performed. 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

Step	Action	Expected Behavior
1.	TN1 transmits Router Solicitation A. The Destination Address is the All-Router multicast Address.	
2.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT.	
3.	TN1 transmits a link-local Echo Request to the HUT.	
4.	Wait 2 seconds.	The HUT should send a multicast Neighbor Solicitation for TN1, indicating the HUT did not process the Router Solicitation from TN1.

Part B: All-Nodes Multicast Destination

Step	Action	Expected Behavior
5.	TN1 transmits Router Solicitation A. The Destination Address is the All-Nodes multicast Address.	
6.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT.	
7.	TN1 transmits a link-local Echo Request to the HUT.	
8.	Wait 2 seconds.	The HUT should send a multicast Neighbor Solicitation for TN1, indicating the HUT did

		not process the Router Solicitation from TN1.

Part C: Link-local Unicast Destination

Step	Action	Expected Behavior
9.	TN1 transmits Router Solicitation A. The Destination Address is the link-local address of the HUT.	
10.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT.	
11.	TN1 transmits a link-local Echo Request to the HUT.	
12.	Wait 2 seconds.	The HUT should send a multicast Neighbor Solicitation for TN1, indicating the HUT did not process the Router Solicitation from TN1.

Possible Problems: None.

Test v6LC.2.2.4: Router Ignores Invalid Router Solicitations (Routers Only)

Purpose: Verify that a router ignores invalid Router Solicitations.

Reference:
- [ND] – Sections 6.1.1, 6.2.6

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Hop Limit is not 255

Step	Action	Expected Behavior
1.	TN1 transmits a Router Solicitation with an IPv6 Hop Limit of 254. The Router Solicitation is valid otherwise.	The RUT must discard the Router Solicitation from TN1 and must not transmit a corresponding Router Advertisement within MAX_RA_DELAY_TIME (0.5) seconds.

Part B: ICMPv6 checksum is not valid

Step	Action	Expected Behavior
2.	TN1 transmits a Router Solicitation with an invalid ICMPv6 checksum. The Router Solicitation is valid otherwise.	The RUT must discard the Router Solicitation from TN1 and must not transmit a corresponding Router Advertisement within MAX_RA_DELAY_TIME (0.5) seconds.

Part C: ICMPv6 code is not 0

Step	Action	Expected Behavior
3.	TN1 transmits a Router Solicitation with an invalid ICMPv6 code of 1. The Router Solicitation is valid otherwise.	The RUT must discard the Router Solicitation from TN1 and must not transmit a corresponding Router Advertisement within MAX_RA_DELAY_TIME (0.5) seconds.

Part D: ICMPv6 length is less than 8 octets

Step	Action	Expected Behavior
4.	TN1 transmits a Router Solicitation with an ICMPv6 length of 6. The Router Solicitation is valid otherwise.	The RUT must discard the Router Solicitation from TN1 and must not transmit a corresponding Router Advertisement within MAX_RA_DELAY_TIME (0.5) seconds.

Part E: Option has length 0

Step	Action	Expected Behavior
5.	TN1 transmits a Router Solicitation that contains an Option with a length of 0. The Router Solicitation is valid otherwise.	The RUT must discard the Router Solicitation from TN1 and must not transmit a corresponding Router Advertisement within MAX_RA_DELAY_TIME (0.5) seconds.

Part F: Unspecified IP source address and a source link-layer address option

Step	Action	Expected Behavior
6.	TN1 transmits a Router Solicitation with an unspecified IP source address and a source link-layer address option. The Router Solicitation is valid otherwise.	The RUT must discard the Router Solicitation from TN1 and must not transmit a corresponding Router Advertisement within MAX_RA_DELAY_TIME (0.5) seconds.

Possible Problems: None.

Test v6LC.2.2.5: Router Sends Valid Router Advertisement (Routers Only)

Purpose: Verify that a router sends valid Router Advertisements.

Reference:

- [IPv6-ARCH] – Section 2.6.1, 2.8
- [ND] – Section 6.1.2 and 6.2.6

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Procedure:

Step	Action	Expected Behavior
1.	TN1 transmits a valid Router Solicitation.	The RUT 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.

Possible Problems: None.

Test v6LC.2.2.6: Router Does Not Send Router Advertisements on Non-advertising Interface (Routers Only)

Purpose: Verify that a router does not send Router Advertisements on non-advertising interfaces.

Reference:

- [ND] – Sections 6.2.2

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Router Solicitation A	Router Solicitation B	Router Solicitation C
IPv6 Header Next Header: 58 Source Address: Unspecified Address	IPv6 Header Next Header: 58 Source Address: TN1's Link-local Address	IPv6 Header Next Header: 58 Source Address: TN2's Link-local Address
Router Solicitation	Router Solicitation	Router Solicitation

Procedure:

Part A: No advertising interfaces

Step	Action	Expected Behavior
1.	Configure Interface A on the RUT to be a non-advertising interface.	
2.	TN1 to transmit Router Solicitation A to the RUT on Interface A.	The RUT must not send Router Advertisements out on Interface A.
3.	TN1 to transmit Router Solicitation B to the RUT on Interface A.	The RUT must not send Router Advertisements out on Interface A.

Part B: Advertising interfaces

Step	Action	Expected Behavior
4.	Configure Interface B on the RUT to be a non-advertising interface.	
5.	TN1 to transmit Router Solicitation A to the RUT on Interface A.	The RUT must send Router Advertisements out on Interface A.
6.	TN1 to transmit Router Solicitation B to the RUT on Interface A.	The RUT must send Router Advertisements out on Interface A.
7.	TN2 to transmit Router Solicitation A to the RUT on Interface B.	The RUT must not send Router Advertisements out on Interface B.
8.	TN2 to transmit Router Solicitation C to the RUT on Interface B	The RUT must not send Router Advertisements out on Interface B.

Possible Problems: None.

Test v6LC.2.2.7: Sending Unsolicited Router Advertisements (Routers Only)

Purpose: Verify that a router sends the first few advertisements (up to MAX_INITIAL_RTR_ADVERTISEMENTS) from an interface when it becomes an advertising interface at a maximum interval value of MAX_INITIAL_RTR_ADVERT_INTERVAL (16) seconds. Verify that a router transmits valid router advertisements.

Reference:

- [ND] – Sections 6.2.4, 6.2.6
- [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: Sending Unsolicited RA (MinRtrAdvInterval <= interval <= MaxRtrAdvInterval)

Step	Action	Expected Behavior
1.	Configure Interface A on the RUT to be an advertising interface with a MinRtrAdvInterval of 5 seconds and a MaxRtrInterval of 10 seconds.	The RUT transmits the consecutive Router Advertisements at randomly chosen intervals between the interface's configured MinRtrAdvInterval (5) and MaxRtrAdvInterval (10) seconds, and it MUST NOT transmit Router Advertisements more frequently than indicated by MinRtrAdvInterval (5) seconds.

Part B: Advertising interfaces

Step	Action	Expected Behavior
2.	Configure Interface A on the RUT to be an advertising interface with a MinRtrAdvInterval of 198 seconds and a MaxRtrInterval of 600 seconds.	The RUT should transmit the first MAX_INITIAL_RTR_ADVERTISEMENTS (3) at MAX_INITIAL_RTR_ADVERT_INTERVAL (16) seconds.

Part C: Sending Unsolicited RA (Min Values)

Step	Action	Expected Behavior
3.	Configure Interface A on the RUT to be an advertising interface with the following values: AdvSendAdvertisements - TRUE MaxRtrAdvInterval - 4 MinRtrAdvInterval – 3 AdvCurHopLimit – 0 AdvManagedFlag – False	The RUT should transmit the Router Advertisements with the same values as configured.

	AdvOtherConfigFlag – False AdvDefaultLifetime – 0 (min value) AdvReachableTime – 0 (min value) AdvRetransTimer – 0 (min value) AdvOnlinkFlag – False AdvAutonomousFlag – False AdvValidLifetime – 0 AdvPreferredLifetime – 0 AdvLinkMTU – 0 (No MTU Option)	

Part D: Sending Unsolicited RA (Max Values)

Step	Action	Expected Behavior
4.	Configure Interface A on the RUT to be an advertising interface with the following values: AdvSendAdvertisements - TRUE MaxRtrAdvInterval - 1800 MinRtrAdvInterval – 1350 AdvCurHopLimit – 0xff AdvManagedFlag – True AdvOtherConfigFlag – True AdvDefaultLifetime – 9000 AdvReachableTime – 3,600,000 AdvRetransTimer – 0xffffffff AdvOnlinkFlag – True AdvAutonomousFlag – True AdvValidLifetime – 0xffffffff AdvPreferredLifetime – 0xffffffff AdvLinkMTU – 1500	The RUT should transmit the Router Advertisements with the same values as configured.

Part E: Sending Unsolicited RA (Global Unicast Address – prefix end with zero-value fields)

Step	Action	Expected Behavior
5.	Configure Interface A on the RUT to be an advertising interface with prefix 8000:0000::/64.	The RUT should transmit the Router Advertisements with the same values as configured.

Part F: Sending Unsolicited RA (Site-Local prefix)

Step	Action	Expected Behavior
6.	Configure Interface A on the RUT to be an advertising interface with prefix FEC0::/64.	The RUT should transmit the Router Advertisements with the same values as configured.

Possible Problems: The NUT may define other max and min values for Router Advertisement variables. These values can be used for Part C and D.

Test v6LC.2.2.8: Ceasing to Be an Advertising Interface (Routers Only)

Purpose: Verify that a router sends correct Router Advertisements when its interface ceases to be an advertising interface.

Reference:

- [ND] – Sections 6.2.5

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Procedure:

Step	Action	Expected Behavior
1.	Configure Interface A on the RUT to be an advertising interface.	
2.	Configure Interface A on the RUT to discontinue being an advertising interface.	The RUT should transmit no more than MAX_FINAL_RTR_ADVERTISEMENTS (3) final multicast Router Advertisement on the interface with a Router Lifetime field of zero.

Possible Problems: None.

Test v6LC.2.2.9: Processing Router Solicitations (Routers Only)

Purpose: Verify that a router correctly processes Router Solicitations and transmits Router Advertisements.

Reference:

- [ND] – Sections 6.2.6

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Router Solicitation A	Router Solicitation B
IPv6 Header Next Header: 58 Source Address: TN1's Link Local Address	IPv6 Header Next Header: 58 Source Address: Unspecified Address
Router Solicitation	Router Solicitation

Procedure:

Part A: MAX_RA_DELAY_TIME

Step	Action	Expected Behavior
1.	TN1 transmits Router Solicitation A twice, 3 seconds apart. The Destination Address is the all-routers multicast address.	The RUT MUST transmit a Router Advertisement between 0 and MAX_RA_DELAY_TIME (0.5) seconds after the receipt of each Router Solicitation A.

Part B: MIN_DELAY_BETWEEN_RAS

Step	Action	Expected Behavior
2.	Configure the RUT with a MinRtrAdvInterval of 30 seconds and a MaxRtrAdvInterval of 40 seconds.	
3.	TN1 transmits Router Solicitation B twice, 2 seconds apart. The destination Address is the all-routers multicast address.	The RUT MUST NOT transmit more than one advertisement every MIN_DELAY_BETWEEN_RAS (3) seconds.

Possible Problems: None.

Test v6LC.2.2.10: Router Solicitation Processing, Neighbor Cache (Routers Only)

Purpose: Verify that a router properly updates its Neighbor Cache upon receipt of a Router Solicitation.

Reference:

- [ND] – Sections 6.2.6 and 7.3.3

Test Setup: No Common Test Setup is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. 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 Destination Address: All Router multicast address
Router Solicitation Source Link-layer Option

Echo Request B
IPv6 Header Next Header: 58 Source Address: TN1's Link-local Address Destination Address: RUT's Link-local Address
ICMPv6 Echo Request

Neighbor Advertisement C
IPv6 Header Next Header: 58 Source Address: TN1's Link-local Address Destination Address: RUT's Link-local Address
Neighbor Advertisement Router flag: 0 Solicited flag: 1

Override flag: 1 Target Address: TN1's Link-local Address

Procedure:

Part A: RS processing with SLL, no NCE

Step	Action	Expected Behavior
1.	TN1 transmits Router Solicitation A.	
2.	TN1 transmits an Echo Request to the RUT.	The RUT must create an NCE for TN1, set the NCE's state to **STALE**, and record TN1's Link-layer Address. Because the RUT's NCE for TN1 is in state **STALE**, the RUT should send an Echo Reply to TN1 and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the RUT should send a unicast Neighbor Solicitation to TN1.

Part B: RS processing without SLL, no NCE

Step	Action	Expected Behavior
3.	TN1 transmits Router Solicitation A.	
4.	TN1 transmits an Echo Request to the RUT.	The RUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The RUT should send a multicast Neighbor Solicitation to TN1.

Part C: RS processing, NCE INCOMPLETE

Step	Action	Expected Behavior
5.	TN1 transmits Echo Request B. TN1 does not respond to any Neighbor Solicitations from the RUT.	The RUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The RUT should send a multicast Neighbor Solicitation to TN1.
6.	TN1 transmits Router Solicitation A.	The RUT must update the state of TN1's NCE to **STALE** and update its Link-layer Address. Because the RUT's NCE for TN1 is in state **STALE**, the RUT should send an Echo Reply to TN1's earlier request using the received Link-Layer address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the RUT should send a unicast Neighbor Solicitation to TN1.

Part D: RS with SLLA changed, NCE REACHABLE

Step	Action	Expected Behavior
7.	TN1 transmits Echo Request B. TN1 does not respond to any Neighbor Solicitations from the RUT.	The RUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The RUT should send a multicast Neighbor Solicitation to TN1.
8.	TN1 transmits Neighbor Advertisement C.	The RUT should update the state of TN1's NCE to **REACHABLE** and record TN1's Link-layer Address. Because the RUT is in state **REACHABLE**, after receiving the earlier Echo Request from TN1, the RUT should send an Echo Reply using the received Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the RUT should not send a unicast Neighbor Solicitation to TN1.
9.	TN1 transmits Router Solicitation A with a different Source Link-layer Address.	
10.	TN1 transmits an Echo Request to the RUT.	The RUT must change the state of the TN1's NCE to STALE and update its Link-layer Address according to the Router Solicitation received in Step 15. Because the RUT's NCE for TN1 is in state **STALE**, the RUT should send an Echo Reply to TN1 using the new Link-Layer address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the RUT should send a unicast Neighbor Solicitation to TN1.

Part E: RS with SLLA unchanged, NCE REACHABLE

Step	Action	Expected Behavior
11.	TN1 transmits Echo Request B. TN1 does not respond to any Neighbor Solicitations from the RUT.	The RUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The RUT should send a multicast Neighbor Solicitation to TN1.
12.	TN1 transmits Neighbor Advertisement C.	The RUT should update the state of TN1's NCE to **REACHABLE** and record TN1's Link-layer Address. Because the RUT is in state **REACHABLE**, after receiving the earlier Echo Request from TN1, the RUT should send an Echo Reply using the received Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the RUT should not send a unicast Neighbor Solicitation to TN1.

13.	TN1 transmits Router Solicitation A with the same Source Link-layer Address.	
14.	TN1 transmits an Echo Request to the RUT.	The RUT must not change the state of the TN1's NCE. After receiving the Echo Request from TN1, the RUT should send an Echo Reply using the same Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the RUT should not send a unicast Neighbor Solicitation to TN1.

Part F: RS with SLLA changed, NCE STALE

Step	Action	Expected Behavior
15.	TN1 transmits Echo Request B. TN1 does not respond to any Neighbor Solicitations from the RUT.	The RUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The RUT should send a multicast Neighbor Solicitation to TN1.
16.	TN1 transmits Neighbor Advertisement C.	The RUT should update the state of TN1's NCE to **REACHABLE** and record TN1's Link-layer Address. Because the RUT is in state **REACHABLE**, after receiving the earlier Echo Request from TN1, the RUT should send an Echo Reply using the received Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the RUT should not send a unicast Neighbor Solicitation to TN1.
17.	Wait (REACHABLE_TIME * MAX_RANDOM_FACTOR) seconds.	
18.	TN1 transmits Router Solicitation A with a different Source Link-layer Address.	
19.	TN1 transmits an Echo Request to the RUT.	The RUT should remain in state STALE, send an Echo Reply to TN1 using the updated Link-Layer address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the RUT should send a unicast Neighbor Solicitation to TN1.

Part G: RS with SLLA unchanged, NCE STALE

Step	Action	Expected Behavior
20.	TN1 transmits Echo Request B. TN1 does not respond to any Neighbor Solicitations from the RUT.	The RUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The RUT should send a multicast Neighbor Solicitation to TN1.
21.	TN1 transmits Neighbor Advertisement C.	The RUT should update the state of TN1's NCE to **REACHABLE** and record TN1's

		Link-layer Address. Because the RUT is in state **REACHABLE**, after receiving the earlier Echo Request from TN1, the RUT should send an Echo Reply using the received Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the RUT should not send a unicast Neighbor Solicitation to TN1.
22.	Wait (REACHABLE_TIME * MAX_RANDOM_FACTOR) seconds.	
23.	TN1 transmits Router Solicitation A with the same Source Link-layer Address.	
24.	TN1 transmits an Echo Request to the RUT.	The RUT should remain in state STALE, send an Echo Reply to TN1 using the unchanged Link-Layer address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the RUT should send a unicast Neighbor Solicitation to TN1.

Part H: RS with SLLA changed, NCE PROBE

Step	Action	Expected Behavior
25.	TN1 transmits Echo Request B. TN1 does not respond to any Neighbor Solicitations from the RUT.	The RUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The RUT should send a multicast Neighbor Solicitation to TN1.
26.	TN1 transmits Neighbor Advertisement C.	The RUT should update the state of TN1's NCE to **REACHABLE** and record TN1's Link-layer Address. Because the RUT is in state **REACHABLE**, after receiving the earlier Echo Request from TN1, the RUT should send an Echo Reply using the received Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the RUT should not send a unicast Neighbor Solicitation to TN1.
27.	Wait (REACHABLE_TIME * MAX_RANDOM_FACTOR) seconds.	
28.	TN1 transmits Echo Request B.	The RUT should update the state of TN1's NCE to STALE, send an Echo Reply to TN1 using the same Link-Layer address and enter state **DELAY**.
29.	Wait (DELAY_FIRST_PROBE_TIME) seconds.	The RUT should update the state of TN1's NCE to **PROBE** by sending a unicast Neighbor Solicitation to TN1.
30.	TN1 transmits Router Solicitation A with a different Source Link-layer Address.	

31.	TN1 transmits an Echo Request to the RUT.	The RUT must change the state of the TN1's NCE to **STALE** and update TN1's Link-Layer Address according to the received Router Solicitation. Because the RUT's NCE for TN1 is in state **STALE**, the RUT should send an Echo Reply to TN1 using the new Link-Layer Address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the RUT should send a unicast Neighbor Solicitation to TN1.

Part I: RS with SLLA unchanged, NCE PROBE

Step	Action	Expected Behavior
32.	TN1 transmits Echo Request B. TN1 does not respond to any Neighbor Solicitations from the RUT.	The RUT should create a Neighbor Cache Entry for TN1 and set the state of the Entry to **INCOMPLETE**. The RUT should send a multicast Neighbor Solicitation to TN1.
33.	TN1 transmits Neighbor Advertisement C.	The RUT should update the state of TN1's NCE to **REACHABLE** and record TN1's Link-layer Address. Because the RUT is in state **REACHABLE**, after receiving the earlier Echo Request from TN1, the RUT should send an Echo Reply using the received Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the RUT should not send a unicast Neighbor Solicitation to TN1.
34.	Wait (REACHABLE_TIME * MAX_RANDOM_FACTOR) seconds.	
35.	TN1 transmits Echo Request B.	The RUT should update the state of TN1's NCE to STALE, send an Echo Reply to TN1 using the same Link-Layer address and enter state **DELAY**.
36.	Wait (DELAY_FIRST_PROBE_TIME) seconds.	The RUT should update the state of TN1's NCE to **PROBE** by sending a unicast Neighbor Solicitation to TN1.
37.	TN1 transmits Router Solicitation A with the same Source Link-layer Address.	
38.	TN1 transmits an Echo Request to the RUT.	The RUT must not change the state of the TN1's NCE. The RUT must continue to be in state **PROBE** and send unicast Neighbor Solicitations to TN1 up to MAX_UNICAST_SOLICIT times.

Possible Problems: None.

Test v6LC.2.2.11: Default Router Switch (Hosts Only)

Purpose: Verify that a host maintains at least two routers in its Default Router List and will switch routers when the router in use fails.

Reference:

- [ND] – Sections 5.2, 5.3

Test Setup: No Common Test Setup is performed. 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

Procedure:

Step	Action	Expected Behavior
1.	TR1 transmits Router Advertisement A.	
2.	TN2 transmits Packet A, an Echo Request.	The HUT should transmit a Neighbor Solicitation with a Target Address equal to TR1's link-local address.
3.	TR1 transmits a Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	The HUT should send an Echo Reply to TN2 via TR1 in response to Packet A.
4.	TR2 transmits Router Advertisement B.	
5.	TN2 transmits Packet A every 3 seconds for 30 seconds. Packet A is	The HUT should send Echo Replies to TR1's link local address until Reachable

	an ICMPv6 Echo Request that has an off-link global source address.	Time expires. When Reachable Time expires, the HUT should send 3 Neighbor Solicitations to TR1's link local address.
6.	When Reachable Time expires, and the HUT solicits TR1, no Neighbor Advertisements are transmitted by TR1.	The HUT selects TR2 from its Default Router list. The HUT sends Neighbor Solicitations to TR2's link local address.

Possible Problems: None.

Test v6LC.2.2.12: Router Advertisement Processing, Validity (Hosts Only)

Purpose: Verify that a host properly discards an invalid Router Advertisement.

Reference:

- [ND] – Sections 6.1.2

Test Setup: No Common Test Setup is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. The 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

Step	Action	Expected Behavior
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 HUT.	The HUT should transmit a multicast Neighbor Solicitation for TR1, indicating the HUT did not have an NCE for TR1.

Part B: Hop Limit less than 255

Step	Action	Expected Behavior
4.	TR1 transmits the Router Advertisement. The Hop Limit is 2. The Router Advertisement is valid otherwise.	
5.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT). (3 seconds)	
6.	TR1 transmits a link-local Echo Request to the HUT.	The HUT should transmit a multicast Neighbor Solicitation for TR1, indicating the HUT did not have an NCE for TR1.

Part C: Invalid Checksum

Step	Action	Expected Behavior
7.	TR1 transmits the Router Advertisement. The ICMP Checksum is invalid. The Router Advertisement is valid otherwise.	
8.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT). (3 seconds)	
9.	TR1 transmits a link-local Echo Request to the HUT.	The HUT should transmit a multicast Neighbor Solicitation for TR1, indicating the HUT did not have an NCE for TR1.

Part D: Invalid ICMP Code

Step	Action	Expected Behavior
10.	TR1 transmits the Router Advertisement. The ICMP Code is 1. The Router Advertisement is valid otherwise.	
11.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT). (3 seconds)	
12.	TR1 transmits a link-local Echo Request to the HUT.	The HUT should transmit a multicast Neighbor Solicitation for TR1, indicating the HUT did not have an NCE for TR1.

Part E: Invalid ICMP Length

Step	Action	Expected Behavior
13.	TR1 transmits the Router Advertisement with an ICMP length of 14. 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 HUT.	The HUT should transmit a multicast Neighbor Solicitation for TR1, indicating the HUT did not have an NCE for TR1.

Part F: Option of Length 0

Step	Action	Expected Behavior
16.	TR1 transmits the Router Advertisement with an option of length 0. The Router Advertisement is valid otherwise.	
17.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT). (3 seconds)	
18.	TR1 transmits a link-local Echo Request to the HUT.	The HUT should transmit a multicast Neighbor Solicitation for TR1, indicating the HUT did not have an NCE for TR1.

Possible Problems: None.

Test v6LC.2.2.13: Router Advertisement Processing, Cur Hop Limit

Purpose: Verify that a node properly processes the Cur Hop Limit field of a Router Advertisement.

Reference:

- [ND] – Sections 4.2, 6.2.1 and 6.3.4

Test Setup: Common Test Setup 1.1 is performed. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Unspecified

Step	Action	Expected Behavior
1.	TN1 transmits an Echo Request to the NUT.	The NUT should respond to the Request from TN1. Observe the Hop Limit value in the Echo Reply packet the NUT transmits.
2.	If the NUT is a host, TR1 transmits a Router Advertisement with a Cur Hop Limit value of 0 (Zero). If the NUT is a router, configure the Cur Hop Limit to a value of 0 (zero) and observe the Router Advertisement from the NUT.	If the NUT is a router, the NUT should transmit a Router Advertisement with a CurHopLimit value set to zero.
3.	TN1 transmits an Echo Request to the NUT.	The NUT should respond to the Request from TN1. The Hop Limit value in the Echo Reply should be the same as was used in step 1.

Part B: Non-Zero

Step	Action	Expected Behavior
4.	TN1 transmits an Echo Request to the NUT.	The NUT should respond to the Request from TN1. Observe the Hop Limit value in the Echo Reply packet the NUT transmits.
5.	If the NUT is a host, TR1 transmits a Router Advertisement with a Cur Hop Limit value of 100. If the NUT is a router, configure the Cur Hop Limit to a value of 100 and observe the Router Advertisement from the NUT.	If the NUT is a router, the NUT should transmit a Router Advertisement with a CurHopLimit value set to 100.
6.	TN1 transmits an Echo Request to the NUT.	The NUT should respond to the Request from TN1. The Hop Limit value in the Echo Reply should be 100.

Possible Problems: None.

Test v6LC.2.2.14: Router Advertisement Processing, Router Lifetime (Hosts Only)

Purpose: Verify that a host properly processes a Router Advertisement and the Router Lifetime field within it.

Reference:
- [ND] – Sections 6.3.4

Test Setup: For Parts B and C, Common Test Setup 1.2 is performed. 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

Step	Action	Expected Behavior
1.	TR1 transmits the Router Advertisement.	
2.	TN2 transmits a global Echo Request to the HUT every second for 19 seconds.	The HUT should respond to the Echo Requests from TN2 using TR1 as a first hop.
3.	TR1 transmits the Router Advertisement.	
4.	TN2 transmits a global Echo Request to the HUT every second for 21 seconds.	The HUT 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 HUT

		MUST not transmit an Echo Reply or transmit multicast NS's with a target address set to TR1's link-local address.

Part B: Router Lifetime set to Zero

Step	Action	Expected Behavior
5.	TN2 transmits a global Echo Request to the HUT.	The HUT should use TR1 or TR2 as a first hop.
6.	TR1 transmits a Router Advertisement with Router Lifetime set to zero.	
7.	TN2 transmits a global Echo Request to the HUT.	The HUT should use TR2 as a first hop.
8.	TR2 transmits a Router Advertisement with Router Lifetime set to zero.	
9.	TN2 transmits a global Echo Request to the HUT.	The HUT 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: Router Lifetime Set to Five; Allowed to Expire

Step	Action	Expected Behavior
10.	TN2 transmits a global Echo Request to the HUT.	The HUT should use TR1 or TR2 as a first hop.
11.	TR1 transmits a Router Advertisement with Router Lifetime set to five.	
12.	Wait seven seconds.	
13.	TN2 transmits a global Echo Request to the HUT.	The HUT should use TR2 as a first hop.
14.	TR2 transmits a Router Advertisement with Router Lifetime set to five.	
15.	Wait seven seconds.	
16.	TN2 transmits a global Echo Request to the HUT.	The HUT 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 v6LC.2.2.15: Router Advertisement Processing, Reachable Time

Purpose: Verify that a node updates its BaseReachableTime variable and re-computes its ReachableTime variable upon receipt of a Router Advertisement or a configuration with a specified Reachable Time.

Reference:
- [ND] – Sections 6.2.1 and 6.3.4

Test Setup: No Common Test Setup is performed. 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: [see below] Reachable Time: [see below] Retransmit Interval: 1 second

Procedure:

Part A: RA Processing – Reachable Time (Host Only)

Step	Action	Expected Behavior
1.	TR1 transmits the Router Advertisement with a Router Lifetime of 0 seconds and a Reachable Time of 10 seconds.	
2.	TN1 transmits a link-local Echo Request to the HUT. TN1 must reply to any Neighbor Solicitations from the HUT.	The HUT should solicit for TN1's link-local address and transmit an Echo Reply.
3.	Repeat Step 2 every second for 40 seconds.	The HUT 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)].

4.	TR1 transmits the Router Advertisement with a Reachable Time of 40 seconds.	
5.	Repeat Step 2 every second for 140 seconds.	The HUT 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)].

Part B: Reachable Time Configuration (Routers Only)

Step	Action	Expected Behavior
6.	Configure the RUT to transmit Router Advertisements with a Router Lifetime value of 0 seconds and a Reachable Time of 10 seconds.	
7.	TN1 transmits a link-local Echo Request to the RUT. TN1 must reply to any Neighbor Solicitations from the RUT.	The RUT should solicit for TN1's link-local address and transmit an Echo Reply.
8.	Repeat Step 7 every second for 40 seconds.	The RUT 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)].

Possible Problems: None.

Test v6LC.2.2.16: Router Advertisement Processing, Neighbor Cache (Hosts Only)

Purpose: Verify that a host properly updates its Neighbor Cache upon receipt of a Router Advertisement.

Reference:
- [ND] – Sections 6.3.4 and 7.3.3

Test Setup: No Common Test Setup is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. 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: 0 seconds Reachable Time: 10 seconds Retransmit Interval: 1 second Source Link-layer Option

Echo Request B
IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address Destination Address: HUT's Link-local Address
ICMPv6 Echo Request

Neighbor Advertisement C
IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address Destination Address: HUT's Link-local Address

Neighbor Advertisement
Router flag: 1 Solicited flag: 1 Override flag: 1 Target Address: TR1's Link-local Address

Procedure:

Part A: RA processing, no NCE

Step	Action	Expected Behavior
1.	TR1 transmits Router Advertisement A.	
2.	TR1 transmits an Echo Request to the HUT.	The HUT must create a NCE for TR1, set the NCE's state to **STALE**, and record TR1's Link-layer Address. Because the HUT's NCE for TR1 is in state **STALE**, the HUT should send an Echo Reply to TR1 and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the HUT should send a unicast Neighbor Solicitation to TR1.

Part B: RA processing, NCE INCOMPLETE

Step	Action	Expected Behavior
3.	TR1 transmits Echo Request B. TR1 does not respond to any Neighbor Solicitations from the HUT.	The HUT should create a Neighbor Cache Entry for TR1 and set the state of the Entry to **INCOMPLETE**. The HUT should send a multicast Neighbor Solicitation to TR1.
4.	TR1 transmits Router Advertisement A.	The HUT must update the state of TR1's NCE to **STALE** and update its Link-layer Address. Because the HUT's NCE for TR1 is in state **STALE**, the HUT should send an Echo Reply to TR1's earlier request using the received Link-Layer address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the HUT should send a unicast Neighbor Solicitation to TR1.

Part C: RA with SLLA changed, NCE REACHABLE

Step	Action	Expected Behavior
5.	TR1 transmits Echo Request B. TR1 does not respond to any Neighbor Solicitations from the HUT.	The HUT should create a Neighbor Cache Entry for TR1 and set the state of the Entry to **INCOMPLETE**. The HUT should send a multicast Neighbor Solicitation to TR1.

6.	TR1 transmits Neighbor Advertisement C.	The HUT should update the state of TR1's NCE to **REACHABLE** and record TR1's Link-layer Address. Because the HUT is in state **REACHABLE**, after receiving the earlier Echo Request from TR1, the HUT should send an Echo Reply using the received Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the HUT should not send a unicast Neighbor Solicitation to TR1.
7.	TR1 transmits Router Advertisement A with a different Source Link-layer Address.	
8.	TR1 transmits an Echo Request to the HUT.	The HUT must change the state of the TR1's NCE to STALE and update its Link-layer Address according to the Router Advertisement received in Step 12. Because the HUT's NCE for TR1 is in state **STALE**, the HUT should send an Echo Reply to TR1 using the new Link-Layer address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the HUT should send a unicast Neighbor Solicitation to TR1.

Part D: RA with SLLA unchanged, NCE REACHABLE

Step	Action	Expected Behavior
9.	TR1 transmits Echo Request B. TR1 does not respond to any Neighbor Solicitations from the HUT.	The HUT should create a Neighbor Cache Entry for TR1 and set the state of the Entry to **INCOMPLETE**. The HUT should send a multicast Neighbor Solicitation to TR1.
10.	TR1 transmits Neighbor Advertisement C.	The HUT should update the state of TR1's NCE to **REACHABLE** and record TR1's Link-layer Address. Because the HUT is in state **REACHABLE**, after receiving the earlier Echo Request from TR1, the HUT should send an Echo Reply using the received Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the HUT should not send a unicast Neighbor Solicitation to TR1.
11.	TR1 transmits Router Advertisement A with the same Source Link-layer Address.	
12.	TR1 transmits an Echo Request to the HUT.	The HUT must not change the state of the TR1's NCE. After receiving the Echo Request from TR1, the HUT should send an Echo Reply using the same Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the HUT

		should not send a unicast Neighbor Solicitation to TR1.

Part E: RA without SLLA, NCE REACHABLE

Step	Action	Expected Behavior
13.	TR1 transmits Echo Request B. TR1 does not respond to any Neighbor Solicitations from the HUT.	The HUT should create a Neighbor Cache Entry for TR1 and set the state of the Entry to **INCOMPLETE**. The HUT should send a multicast Neighbor Solicitation to TR1.
14.	TR1 transmits Neighbor Advertisement C.	The HUT should update the state of TR1's NCE to **REACHABLE** and record TR1's Link-layer Address. Because the HUT is in state **REACHABLE**, after receiving the earlier Echo Request from TR1, the HUT should send an Echo Reply using the received Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the HUT should not send a unicast Neighbor Solicitation to TR1.
15.	TR1 transmits Router Advertisement A without a Source Link-layer Address.	
16.	TR1 transmits an Echo Request to the HUT.	The HUT must not change the state of the TR1's NCE. After receiving the Echo Request from TR1, the HUT should send an Echo Reply using the same Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the HUT should not send a unicast Neighbor Solicitation to TR1.

Part F: RA with SLLA changed, NCE Probe

Step	Action	Expected Behavior
17.	TR1 transmits Echo Request B. TR1 does not respond to any Neighbor Solicitations from the HUT.	The HUT should create a Neighbor Cache Entry for TR1 and set the state of the Entry to **INCOMPLETE**. The HUT should send a multicast Neighbor Solicitation to TR1.
18.	TR1 transmits Neighbor Advertisement C.	The HUT should update the state of TR1's NCE to **REACHABLE** and record TR1's Link-layer Address. Because the HUT is in state **REACHABLE**, after receiving the earlier Echo Request from TR1, the HUT should send an Echo Reply using the received Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the HUT should not send a unicast Neighbor Solicitation to TR1.
19.	Wait (REACHABLE_TIME * MAX_RANDOM_FACTOR) seconds.	

20.	TR1 transmits Echo Request B.	The HUT should update the state of TR1's NCE to STALE, send an Echo Reply to TR1 using the same Link-Layer address and enter state **DELAY**.
21.	Wait (DELAY_FIRST_PROBE_TIME) seconds.	The HUT should update the state of TR1's NCE to **PROBE** by sending a unicast Neighbor Solicitation to TR1.
22.	TR1 transmits Router Advertisement A with a different Source Link-layer Address.	
23.	TR1 transmits an Echo Request to the HUT.	The HUT must change the state of the TR1's NCE to **STALE** and update TR1's Link-Layer Address according to the received Router Advertisement. Because the HUT's NCE for TR1 is in state **STALE**, the HUT should send an Echo Reply to TR1 using the new Link-Layer Address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the NUT should send a unicast Neighbor Solicitation to TR1.

Part G: RA with SLLA unchanged, NCE Probe

Step	Action	Expected Behavior
24.	TR1 transmits Echo Request B. TR1 does not respond to any Neighbor Solicitations from the HUT.	The HUT should create a Neighbor Cache Entry for TR1 and set the state of the Entry to **INCOMPLETE**. The HUT should send a multicast Neighbor Solicitation to TR1.
25.	TR1 transmits Neighbor Advertisement C.	The HUT should update the state of TR1's NCE to **REACHABLE** and record TR1's Link-layer Address. Because the HUT is in state **REACHABLE**, after receiving the earlier Echo Request from TR1, the HUT should send an Echo Reply using the received Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the HUT should not send a unicast Neighbor Solicitation to TR1.
26.	Wait (REACHABLE_TIME * MAX_RANDOM_FACTOR) seconds.	
27.	TR1 transmits Echo Request B.	The HUT should update the state of TR1's NCE to STALE, send an Echo Reply to TR1 using the same Link-Layer address and enter state **DELAY**.
28.	Wait (DELAY_FIRST_PROBE_TIME) seconds.	The HUT should update the state of TR1's NCE to **PROBE** by sending a unicast Neighbor Solicitation to TR1.
29.	TR1 transmits Router Advertisement A with the same Source Link-layer Address.	

30.	TR1 transmits an Echo Request to the HUT.	The HUT must not change the state of the TR1's NCE. The HUT must continue to be in state **PROBE** and send unicast Neighbor Solicitations to TR1 up to MAX_UNICAST_SOLICIT times.

Part H: RA without SLLA, NCE Probe

Step	Action	Expected Behavior
31.	TR1 transmits Echo Request B. TR1 does not respond to any Neighbor Solicitations from the HUT.	The HUT should create a Neighbor Cache Entry for TR1 and set the state of the Entry to **INCOMPLETE**. The HUT should send a multicast Neighbor Solicitation to TR1.
32.	TR1 transmits Neighbor Advertisement C.	The HUT should update the state of TR1's NCE to **REACHABLE** and record TR1's Link-layer Address. Because the HUT is in state **REACHABLE**, after receiving the earlier Echo Request from TR1, the HUT should send an Echo Reply using the received Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the HUT should not send a unicast Neighbor Solicitation to TR1.
33.	Wait (REACHABLE_TIME * MAX_RANDOM_FACTOR) seconds.	
34.	TR1 transmits Echo Request B.	The HUT should update the state of TR1's NCE to STALE, send an Echo Reply to TR1 using the same Link-Layer address and enter state **DELAY**.
35.	Wait (DELAY_FIRST_PROBE_TIME) seconds.	The HUT should update the state of TR1's NCE to **PROBE** by sending a unicast Neighbor Solicitation to TR1.
36.	TR1 transmits Router Advertisement A without a Source Link-layer Address.	
37.	TR1 transmits an Echo Request to the HUT.	The HUT must not change the state of the TR1's NCE. The HUT must continue to be in state **PROBE** and send unicast Neighbor Solicitations to TR1 up to MAX_UNICAST_SOLICIT times.

Part I: RA with SLLA changed, NCE Stale

Step	Action	Expected Behavior
38.	TR1 transmits Echo Request B. TR1 does not respond to any Neighbor Solicitations from the HUT.	The HUT should create a Neighbor Cache Entry for TR1 and set the state of the Entry to **INCOMPLETE**. The HUT should send a multicast Neighbor Solicitation to TR1.
39.	TR1 transmits Neighbor Advertisement C.	The HUT should update the state of TR1's NCE to **REACHABLE** and record TR1's Link-layer Address. Because the HUT is in

		state **REACHABLE**, after receiving the earlier Echo Request from TR1, the HUT should send an Echo Reply using the received Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the HUT should not send a unicast Neighbor Solicitation to TR1.
40.	Wait (REACHABLE_TIME * MAX_RANDOM_FACTOR) seconds.	
41.	TR1 transmits Router Advertisement A with a different Source Link-layer Address.	
42.	TR1 transmits an Echo Request to the HUT.	The HUT must change the state of the TN1's NCE to **STALE** and update TR1's Link-Layer Address according to the received Router Advertisement. Because the HUT's NCE for TR1 is in state **STALE**, the HUT should send an Echo Reply to TR1 using the new Link-Layer Address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the NUT should send a unicast Neighbor Solicitation to TR1.

Part J: RA with SLLA unchanged, NCE Stale

Step	Action	Expected Behavior
43.	TR1 transmits Echo Request B. TR1 does not respond to any Neighbor Solicitations from the HUT.	The HUT should create a Neighbor Cache Entry for TR1 and set the state of the Entry to **INCOMPLETE**. The HUT should send a multicast Neighbor Solicitation to TR1.
44.	TR1 transmits Neighbor Advertisement C.	The HUT should update the state of TR1's NCE to **REACHABLE** and record TR1's Link-layer Address. Because the HUT is in state **REACHABLE**, after receiving the earlier Echo Request from TR1, the HUT should send an Echo Reply using the received Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the HUT should not send a unicast Neighbor Solicitation to TR1.
45.	Wait (REACHABLE_TIME * MAX_RANDOM_FACTOR) seconds.	
46.	TR1 transmits Router Advertisement A with the same Source Link-layer Address.	
47.	TR1 transmits an Echo Request to the HUT.	The HUT must change the state of the TR1's NCE to **STALE** and update TR1's Link-Layer Address according to the received Router Advertisement. Because the HUT's

		NCE for TR1 is in state **STALE**, the HUT should send an Echo Reply to TR1 using the unchanged Link-Layer Address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the NUT should send a unicast Neighbor Solicitation to TR1.

Part K: RA without SLLA , NCE Stale

Step	Action	Expected Behavior
48.	TR1 transmits Echo Request B. TR1 does not respond to any Neighbor Solicitations from the HUT.	The HUT should create a Neighbor Cache Entry for TR1 and set the state of the Entry to **INCOMPLETE**. The HUT should send a multicast Neighbor Solicitation to TR1.
49.	TR1 transmits Neighbor Advertisement C.	The HUT should update the state of TR1's NCE to **REACHABLE** and record TR1's Link-layer Address. Because the HUT is in state **REACHABLE**, after receiving the earlier Echo Request from TR1, the HUT should send an Echo Reply using the received Link-Layer Address. After DELAY_FIRST_PROBE_TIME, the HUT should not send a unicast Neighbor Solicitation to TR1.
50.	Wait (REACHABLE_TIME * MAX_RANDOM_FACTOR) seconds.	
51.	TR1 transmits Router Advertisement A without Source Link-layer Address.	
52.	TR1 transmits an Echo Request to the HUT.	The HUT must change the state of the TR1's NCE to **STALE** and update TR1's Link-Layer Address according to the received Router Advertisement. Because the HUT's NCE for TR1 is in state **STALE**, the HUT should send an Echo Reply to TR1 using the unchanged Link-Layer Address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the NUT should send a unicast Neighbor Solicitation to TR1.

Possible Problems: None.

Test v6LC.2.2.17: Router Advertisement Processing, IsRouter Flag (Hosts Only)

Purpose: Verify that a host properly updates the IsRouter flag in its Neighbor Cache upon receipt of a Router Advertisement.

Reference:
- [ND] – Sections 6.3.4

Test Setup: No Common Test Setup is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. 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: TN2's off-link Global Address Destination Address: HUT's Global Address
ICMPv6 Echo Request

Procedure:

Part A: RA without Source Link-layer option

Step	Action	Expected Behavior
1.	TR1 transmits a Link-local Echo Request to the HUT.	

2.	TR1 answers any Neighbor Solicitations with a Neighbor Advertisement (R=0, S=1, O=1) to the HUT.	The HUT should transmit an Echo Reply to TR1's link local address and update its NCE to state REACHABLE. The HUT sets the IsRouter flag to false.
3.	TR1 transmits Router Advertisement A without a Source Link-layer option to the HUT.	
4.	Wait for the HUT to perform Duplicate Address Detection on its global address.	
5.	TN2 transmits Echo Request A to the HUT with a next hop of TR1.	The HUT sets the IsRouter flag to true and transmits an Echo Reply to TN2's off-link address with a next hop of TR1.

Part B: RA with same Source Link-layer option as cached

Step	Action	Expected Behavior
6.	TR1 transmits a Link-local Echo Request to the HUT.	
7.	TR1 answers any Neighbor Solicitations with a Neighbor Advertisement (R=0, S=1, O=1) to the HUT.	The HUT should transmit an Echo Reply to TR1's link local address and update its NCE to state REACHABLE. The HUT sets the IsRouter flag to false.
8.	TR1 transmits Router Advertisement A with the same Source Link-layer option to the HUT.	
9.	Wait for the HUT to perform Duplicate Address Detection on its global address.	
10.	TN2 transmits Echo Request A to the HUT with a next hop of TR1.	The HUT sets the IsRouter flag to true and transmits an Echo Reply to TN2's off-link address with a next hop of TR1.

Part C: RA with different Source Link-layer option as cached

Step	Action	Expected Behavior
11.	TR1 transmits a Link-local Echo Request to the HUT.	
12.	TR1 answers any Neighbor Solicitations with a Neighbor Advertisement (R=0, S=1, O=1) to the HUT.	The HUT should transmit an Echo Reply to TR1's link local address and update its NCE to state REACHABLE. The HUT sets the IsRouter flag to false.
13.	TR1 transmits Router Advertisement A with a different Source Link-layer option to the HUT.	
14.	Wait for the HUT to perform Duplicate Address Detection on its global address.	
15.	TN2 transmits Echo Request A to the HUT with a next hop of TR1.	The HUT sets the IsRouter flag to true and transmits an Echo Reply to TN2's off-link address with a next hop of TR1.

Possible Problems: None.

Test v6LC.2.2.18: Next-hop Determination (Hosts Only)

Purpose: Verify that a host properly determines the next hop.

Reference:

- [ND] – Sections 3.1, 5.2 and 6.3.6

Test Setup: No Common Test Setup is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. 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: TN2's off-link Global Address Destination Address: HUT's Global Address
ICMPv6 Echo Request

Procedure:

Step	Action	Expected Behavior
1.	TR1 transmits Router Advertisement A to the HUT.	
2.	TN2 transmits Echo Request B to the HUT with a next hop of TR1.	The HUT should transmit an Echo Reply to TN2's off-link global address using TR1 as its next hop.

Possible Problems: None.

Test v6LC.2.2.19: Router Advertisement Processing, On-link determination (Host Only)

Purpose: Verify that a host properly rejects an invalid prefix length, however the prefix length is still valid for on-link determination when the on-link flag is true.

Reference:

- [ND] – Sections 6.3.4
- [SLAAC] – Section 5.5.3

Test Setup: Common Test Setup 1.1 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
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: HUT's Global Address
ICMPv6 Echo Request

Procedure:

Step	Action	Expected Behavior
1.	TR1 transmits Router Advertisement A to the HUT.	
2.	TN1 transmits Echo Request B to the HUT.	The HUT should transmit an Echo Reply to TN1's global address on-link.

Possible Problems: None.

Test v6LC.2.2.20: Sending Router Advertisement with Route Preference (Router Only)

Purpose: Verify that the RUT transmits a Router Preference in Router Advertisements.

Reference:
- [RFC-4191] – Section 2.2

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: High Router Preference

Step	Action	Expected Behavior
1.	Configure the RUT to advertise a Router Preference of High.	Observe the RUT transmitting a Router Advertisement with the Preference Value set to 01.

Part B: Medium Router Preference

Step	Action	Expected Behavior
2.	Configure the RUT to advertise a Router Preference of Medium.	Observe the RUT transmitting a Router Advertisement with the Preference Value set to 00.

Part C: Low Router Preference

Step	Action	Expected Behavior
3.	Configure the RUT to advertise a Router Preference of Low.	Observe the RUT transmitting a Router Advertisement with the Preference Value set to 11.

Possible Problems: None

Test v6LC.2.2.21: Transmitting Route Information Option (Router Only)

Purpose: Verify that the RUT transmits a Router Information Option in Router Advertisements.

Reference:
- [RFC-4191] – Section 2.3

Test Setup: The devices are setup according to Common Test Setup.

Procedure:

Part A: Route Information Option with Prefix Length of 64

Step	Action	Expected Behavior
1.	Configure the RUT to advertise Route Information Option on interface A with following Prefix 2001:2:0:2000::/64 with a lifetime of 600 seconds and PRF set to high.	Observe the RUT transmitting a Router Advertisement with a properly formatted Route Information Option that includes: • Type = 24 • Length = 2 or 3 • Resvd = zero. • Route Lifetime = 600 seconds • Prefix Length = 64 • PRF= High

Part B: Route Information Option with a Prefix Length less than 64

Step	Action	Expected Behavior
2.	Configure the RUT to advertise Route Information Option on interface A with Prefix 2001:2::/32 with a lifetime of 600 seconds and PRF set to medium.	Observe the RUT transmitting a Router Advertisement with a properly formatted Route Information Option that includes: • Type = 24 • Length = 2 or 3 • Resvd = zero. • Route Lifetime = 600 seconds • Prefix Length = 32 • PRF = Medium

Part C: Route Information Option with Prefix Length greater than 64

Step	Action	Expected Behavior
3.	Configure the RUT to advertise Route Information Option on interface A with Prefix 2001:2:0:2000::/96 with a lifetime of 600 seconds and PRF set to low.	Observe the RUT transmitting a Router Advertisement with a properly formatted Route Information Option that includes: • Type field = 24 • Length = 3 • Resvd field = zero. • Route Lifetime = 600 seconds

		• Prefix Length = 96 • PRF = Low

Part D: Route Information Option with Prefix Length of 0

Step	Action	Expected Behavior
4.	Configure the RUT to advertise Route Information Option on interface A with Prefix ::/0 with a lifetime of 600 seconds.	Observe the RUT transmitting a Router Advertisement with a properly formatted Route Information Option that includes: • Type = 24 • Length = 1, 2, or 3 • Resvd = zero. • Route Lifetime = 600 seconds • Prefix Length = 0

Part E: Non-advertising Interface

Step	Action	Expected Behavior
5.	Configure the RUT to advertise Route Information Option on interface A.	Observe the RUT transmitting a Router Advertisement with a properly formatted Route Information Option.
6.	Configure Interface A on the RUT to discontinue being an advertising interface.	Observe the RUT transmitting a Router Advertisement with a properly formatted Route Information Option with the Prefix from Step 1 with a lifetime of zero.

Possible Problems: None.

Test v6LC.2.2.22: Processing Router Advertisements with Router Preference (Host Only)

Purpose: Verify that the HUT uses a Default Router List with preference values for Type B Host.

Reference:

- [RFC-4191] – Section 3.1

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: Multicast Address
Router Advertisement Router Preference: [See Below]
Source Link-layer Address Option

Router Advertisement B
IPv6 Header Next Header: 58 Source Address: TR2's Link-Local Address Destination Address: Multicast Address
Router Advertisement Router Preference: [See Below]
Source Link-layer Address Option

Procedure:

Part A: High Route Preference

Step	Action	Expected Behavior
1.	TR1 transmits a Router Advertisement A with Default Router Preference set to High (01).	
2.	TR2 transmits a Router Advertisement B with Default	

	Router Preference set to Medium (00).	
3.	TR1 forwards an Echo Request from TN2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR1.

Part B: Low Route Preference

Step	Action	Expected Behavior
4.	TR1 transmits a Router Advertisement A with Default Router Preference set to Low (11).	
5.	TR2 transmits a Router Advertisement B with Default Router Preference set to Medium (00).	
6.	TR1 forwards an Echo Request from TN2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR2.

Part C: Reserved Route Preference

Step	Action	Expected Behavior
7.	TR1 transmits a Router Advertisement A with Default Router Preference set to Reserved (10).	
8.	TR2 transmits a Router Advertisement B with Default Router Preference set to Low (11).	
9.	TR1 forwards an Echo Request from TN2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR1.
10.	TR2 transmits a Router Advertisement B with Default Router Preference set to High (01).	
11.	TR1 forwards an Echo Request from TN2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR2.

Part D: Change lower Route Preference

Step	Action	Expected Behavior
12.	TR1 transmits a Router Advertisement A with Default Router Preference set to High (01).	
13.	TR2 transmits a Router Advertisement B with Default Router Preference set to Medium (00).	

14.	TR1 forwards an Echo Request from TN2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR1.
15.	TR1 transmits a Router Advertisement A with Default Router Preference set to Low (11).	
16.	TR1 forwards an Echo Request from TN2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR2.

Part E: Change higher Route Preference

Step	Action	Expected Behavior
17.	TR1 transmits a Router Advertisement A with Default Router Preference set to Low (11).	
18.	TR2 transmits a Router Advertisement B with Default Router Preference set to Medium (00).	
19.	TR1 forwards an Echo Request from TN2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR2.
20.	TR1 transmits a Router Advertisement A with Default Router Preference set to High (10).	
21.	TR1 forwards an Echo Request from TN2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR1.

Possible Problems: None.

Test v6LC.2.2.23: Processing Router Advertisement with Route Information Option (Host Only)

Purpose: Verify that the HUT uses a Route Information Option to choose the next-hop.

Advanced Functionality:

- RFC 4191 Type C Host

Reference:

- [RFC-4191] – Section 3.1

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: Multicast Address
Router Advertisement Router Preference: Medium (00)
Source Link-layer Address Option

Router Advertisement B

IPv6 Header Next Header: 58 Source Address: TR2's Link-Local Address Destination Address: Multicast Address
Router Advertisement Router Preference: Medium (00)
Source Link-layer Address Option
Route Information Option Prefix Length: [See Below] PRF: [See Below] Route Lifetime: [See Below] Prefix: 2001:2:0:2000::

Router Advertisement C

IPv6 Header

Next Header: 58 Source Address: TR1's Link-Local Address Destination Address: Multicast Address
Router Advertisement Router Preference: [See Below]
Source Link-layer Address Option
Route Information Option Prefix Length: [See Below] PRF: [See Below] Route Lifetime: [See Below] Prefix: 2001:2:0:2000::

Procedure:

Part A: Route Information Option High

Step	Action	Expected Behavior
1.	TR1 transmits a Router Advertisement A.	
2.	TR2 advertises Router Advertisement B with Route Information Option with the following information: Length: 2 Prefix Length: 64 PRF: High Lifetime: 30 seconds	
3.	TR1 forwards an Echo Request from TN2 with a source address of 2001:2:0:2000::2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR2.

Part B: Route Information Option Low

Step	Action	Expected Behavior
4.	TR1 transmits a Router Advertisement A.	
5.	TR2 advertises Router Advertisement B with Route Information Option with the following information: Length: 2 Prefix Length: 64 PRF: Low Lifetime: 30 seconds	

6.	TR1 forwards an Echo Request from TN2 with a source address of 2001:2:0:2000::2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR2.

Part C: Route Information Option with PRF set to Reserved

Step	Action	Expected Behavior
7.	TR1 advertises Router Advertisement C with Route Information Option with the following information: Length: 2 Prefix Length: 64 PRF: Low Lifetime: 30 seconds	
8.	TR2 advertises Router Advertisement B with Route Information Option with the following information: Length: 2 Prefix Length: 64 PRF: Reserved Lifetime: 30 seconds	
9.	TR2 forwards an Echo Request from TN2 with a source address of 2001:2:0:2000::2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR1.

Part D: Route Information Option with a Prefix Length of 96

Step	Action	Expected Behavior
10.	TR1 transmits a Router Advertisement.	
11.	TR2 advertises Router Advertisement B with Route Information Option with the following information: Length: 3 Prefix Length: 96 PRF: High Lifetime: 30 seconds Prefix:2001:2:0:2000:0:1::	
12.	TR1 forwards an Echo Request from TN2 with a source address of 2001:2:0:2000:0:1::2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR2.

Part E: Route Information Option with a Prefix Length of 32

Step	Action	Expected Behavior
13.	TR1 transmits a Router Advertisement A.	

14.	TR2 advertises Router Advertisement B with Route Information Option with the following information: Length: 2 Prefix Length: 32 PRF: High Lifetime: 30 seconds Prefix:2001:2:0:2000::	
15.	TR1 forwards an Echo Request from TN2 with a source address of 2001:2:0:2000::2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR2.

Part F: PRF change in Route Information Option

Step	Action	Expected Behavior
16.	TR1 advertises Router Advertisement C with Route Information Option with the following information: Length: 2 Prefix Length: 64 PRF: Low Lifetime: 30 seconds Prefix:2001:2:0:2000::	
17.	TR2 advertises Router Advertisement B with Route Information Option with the following information: Length: 2 Prefix Length: 64 PRF: Medium Lifetime: 30 seconds Prefix:2001:2:0:2000::	
18.	TR1 forwards an Echo Request from TN2 with a source address of 2001:2:0:2000::2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR2.
19.	TR1 advertises Router Advertisement C with Route Information Option with the following information: Length: 2 Prefix Length: 64 PRF: High Lifetime: 30 seconds Prefix:2001:2:0:2000::	
20.	TR1 forwards an Echo Request from TN2 with a source address of 2001:2:0:2000::2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR1.

Part G: Route Information Option with a Prefix Length of 0 and PRF of High

Step	Action	Expected Behavior
21.	TR1 transmits a Router Advertisement A.	
22.	TR2 advertises Router Advertisement B with Route Information Option with the following information: Length: 1 Prefix Length: 0 PRF: High Lifetime: 30 seconds Prefix: ::	
23.	TR1 forwards an Echo Request from TN2 with a source address of 2001:2:0:2000::2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR2.

Part H: Route Information Option with a Prefix Length of 0 and PRF of Low

Step	Action	Expected Behavior
24.	TR1 transmits a Router Advertisement A.	
25.	TR2 advertises Router Advertisement B with Route Information Option with the following information: Length: 1 Prefix Length: 0 PRF: Low Lifetime: 30 seconds Prefix: ::	
26.	TR1 forwards an Echo Request from TN2 with a source address of 2001:2:0:2000::2 to the NUT.	The NUT should respond to the Echo Request with an Echo Reply with a next-hop of TR1.

Part I: Expired Lifetime

Step	Action	Expected Behavior
27.	TR1 transmits a Router Advertisement C with Route Information Option with the following information: Length: 2 Prefix Length: 64 PRF: Medium Lifetime: 200 seconds Prefix: 2001:2:0:2000::	
28.	TR2 advertises Router Advertisement B with Route	

	Information Option with the following information: Length: 2 Prefix Length: 64 PRF: High Lifetime: 60 seconds Prefix: 2001:2:0:2000:: on interface A.	
29.	TR1 forwards an Echo Request from TN2 with a source address of 2001:2:0:2000::2 to the NUT.	The NUT responds to the Echo Request with an Echo Reply with a next-hop of TR2.
30.	Wait 90 seconds.	
31.	TR1 forwards an Echo Request from TN2 with a source address of 2001:2:0:2000::2 to the NUT.	The NUT responds to the Echo Request with an Echo Reply with a next-hop of TR1.

Part J: Route Information Option with a Prefix Length of 0 and Lifetime set to 0

Step	Action	Expected Behavior
32.	TR1 transmits a Router Advertisement C with no Route Information Option	
33.	TR2 advertises Router Advertisement B with Route Information Option with the following information: Length: 1 Prefix Length: 0 PRF: High Lifetime: 600 seconds Prefix: :: on interface A.	
34.	TR1 forwards an Echo Request from TN2 to the NUT.	The NUT responds to the Echo Request with an Echo Reply with a next-hop of TR2.
35.	TR2 advertises Router Advertisement B with Route Information Option with the following information: Length: 1 Prefix Length: 0 PRF: High Lifetime: 0 seconds Prefix: :: on interface A.	
36.	TR1 forwards an Echo Request from TN2 to the NUT.	The NUT responds to the Echo Request with an Echo Reply with a next-hop of TR1.

Possible Problems: None.

Test v6LC.2.2.24: Router Advertisement DNS (Router Only)

Purpose: Verify that the RUT transmits DNS options in Router Advertisements.

Reference:
- [RA-DNS] – 5.1 and 5.2

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Recursive DNS Option

Step	Action	Expected Behavior
1.	Configure the RUT to transmit Router Advertisement a Recursive DNS Server Option. If the RUT does not require an option lifetime value to be specified, then none is provided.	Observe the RUT transmitting a Router Advertisement with a properly formatted Recursive DNS Server Option that includes: • Type = 25 • Length = 3 • Reserved Field • Lifetime Field >= 3 * MaxRtrAdvInterval • Address of IPv6 Recursive Server

Part B: Search List Option

Step	Action	Expected Behavior
2.	Configure the RUT to transmit Router Advertisement a DNS Search List Option. If the RUT does not require an option lifetime value to be specified, then none is provided.	Observe the RUT transmitting a Router Advertisement with a properly formatted DNS Search List Option that includes: • Type = 31 • Length = 4 • Reserved Field • Lifetime Field >= 3 * MaxRtrAdvInterval • Domain Names of DNS Search List = test.example.com

Possible Problems: If a RUT is unable to configure Recursive DNS Options or Search List Options without manually configuring an option lifetime (no default value can be specified), then any non-zero value can be configured for the option lifetime.

Test v6LC.2.2.25: Processing Router Advertisement DNS (Host Only)

Purpose: Verify that the HUT processes DNS options in Router Advertisements.

Advanced Functionality:

- Router Advertisement DNS
- Transmitting Echo Requests (Passive Node)

Reference:

- [RA-DNS] – 5.1 and 5.2

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part. Configure DNS-Server to have a DNS record for node1.test.example.com of TN1.

Router Advertisement A

IPv6 Header Next Header: 58 Source Address: TR1's Link-Local Address Destination Address: Multicast Address
Router Advertisement
Recursive DNS Option Lifetime: [See Below] Address: DNS-Server Global address

Router Advertisement B

IPv6 Header Next Header: 58 Source Address: TR1's Link-Local Address Destination Address: Multicast Address
Router Advertisement
Recursive DNS Option Lifetime: [See Below] Address: DNS-Server Global address
DNS Search List Lifetime: [See Below] Search List: test.example.com

Procedure:

Part A: Recursive DNS Option

Step	Action	Expected Behavior
1.	TR1 to transmit Router Advertisement A with a lifetime of 60 in the RDNSS Option.	
2.	Configure the HUT to transmit an Echo Request with a destination of node1.test.example.com.	Observe the HUT transmitting a DNS Query to DNS-Server.

Part B: Recursive DNS Option lifetime 0

Step	Action	Expected Behavior
3.	TR1 to transmit Router Advertisement A with a lifetime 0 in the RDNSS Option.	
4.	Configure the HUT to transmit an Echo Request with a destination of node1.test.example.com.	Observe the HUT does not transmit a DNS Query to DNS-Server.

Part C: Recursive DNS Option Expired

Step	Action	Expected Behavior
5.	TR1 to transmit Router Advertisement A with a lifetime 60 in the RDNSS Option.	
6.	Configure the HUT to transmit an Echo Request with a destination of node1.test.example.com.	Observe the HUT transmitting a DNS Query to DNS-Server.
7.	Wait 65 seconds.	
8.	Configure the HUT to transmit an Echo Request with a destination of node1.test.example.com.	Observe the HUT doesn't transmit a DNS Query to DNS-Server.

Part D: Search List Option

Step	Action	Expected Behavior
9.	TR1 to transmit Router Advertisement B with a lifetime of 60 in the DNSSL Option.	
10.	Configure the HUT to transmit an Echo Request with a destination of node1.	Observe the HUT transmitting a DNS Query to DNS-Server with the Search List.

Part E: Search List Option with a Lifetime of 0

Step	Action	Expected Behavior
11.	TR1 to transmit Router Advertisement A with a lifetime 0 in the DNSSL Option.	
12.	Configure the HUT to transmit an Echo Request with a destination of node1.	Observe the HUT doesn’t transmit a DNS Query to DNS-Server with the Search List.

Part F: Search List Option Expired

Step	Action	Expected Behavior
13.	TR1 to transmit Router Advertisement A. The RDNSS Option has a lifetime that lasts the entire test. The DNSSL Option has a lifetime of 60.	
14.	Configure the HUT to transmit an Echo Request with a destination of node1.	Observe the HUT transmitting a DNS Query to DNS-Server.
15.	Wait 65 seconds.	
16.	Configure the HUT to transmit an Echo Request with a destination of node1.	Observe the HUT doesn't transmit a DNS Query to DNS-Server.

Possible Problems: None.

Test v6LC.2.2.26: Atomic Fragments in Router Solicitations and Router Advertisement

Purpose: Verify that the NUT doesn't process Router Solicitation and Router Advertisement messages with atomic fragments.

Reference:

- [RFC-6980] – Section 5

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: 44 Source Address: TR1's Link-Local Address Destination Address: NUT's Link-Local Address
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 0
ICMPv6 Router Advertisement
Source Link-Layer Option

Router Solicitation B
IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Link-Local Address
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 0
ICMPv6 Router Solicitation
Source Link-Layer Option

Procedure:

Part A: Router Advertisement with Atomic Fragment (Host Only)

Step	Action	Expected Behavior
1.	TR1 transmits Router Advertisement A.	
2.	TR1 transmits an Echo Request to the NUT.	Observe the NUT transmitting a Neighbor Solicitation indicating that it didn't process the Router Advertisement. The NUT must not transmit an Echo Reply.

Part B: Router Solicitation with Atomic Fragment (Router Only)

Step	Action	Expected Behavior
3.	TN1 transmits Router Solicitation B.	The NUT must not transmit a unicast Router Advertisement to TN1
4.	TN1 transmits an Echo Request to the NUT.	Observe the NUT transmitting a Neighbor Solicitation indicating that it didn't process the Router Solicitation. The NUT must not transmit an Echo Reply.

Possible Problems: None.

Test v6LC.2.2.27: Fragments in Router Solicitation and Router Advertisements

Purpose: Verify that the NUT doesn't process Router Solicitation and Router Advertisement messages with fragments.

Reference:

- [RFC-6980] – Section 5

Test Setup: No Common Test Setup is performed. The Common Test Cleanup procedure is performed after each part.

Router Advertisement	RA Fragment
IPv6 Header Next Header: 44 Source Address: TR1's Link-Local Address Destination Address: NUT's Link-Local Address	IPv6 Header Next Header: 44 Source Address: TR1's Link-Local Address Destination Address: NUT's Global Address
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 1	Fragment Header Next Header: 58 Fragment Offset: 6 More Fragments flag: 0 Fragment Data: 8 Bytes
ICMPv6 Router Advertisement	
Source Link-Layer Option	

Router Solicitation	RS Fragment
IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Link-Local Address	IPv6 Header Next Header: 44 Source Address: TN1's Link-Local Address Destination Address: NUT's Link-Local Address
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 1	Fragment Header Next Header: 58 Fragment Offset: 1 More Fragments flag: 0 Fragment Data: 8 Bytes
ICMPv6 Router Solicitation	
Source Link-Layer Option	

Procedure:

Part A: Router Advertisement with Fragment Header (Host Only)

Step	Action	Expected Behavior
1.	TR1 transmits Router Advertisement and RA fragment.	
2.	TR1 transmits an Echo Request to the NUT.	Observe the NUT transmitting a Neighbor Solicitation indicating that it didn't process the Router Advertisement. The NUT must not transmit an Echo Reply.

Part B: Router Solicitation with Fragment Header (Router Only)

Step	Action	Expected Behavior
3.	TN1 transmits Router Solicitation and RS fragment.	The NUT must not transmit a unicast Router Advertisement to TN1
4.	TN1 transmits an Echo Request to the NUT.	Observe the NUT transmitting a Neighbor Solicitation indicating that it didn't process the Router Solicitation. The NUT must not transmit an Echo Reply.

Possible Problems: None.

Group 3: Redirect Function

Scope

The following tests cover the Redirect function in IPv6.

Overview

Tests in this group verify that a node properly processes valid, suspicious, and invalid Redirect messages. These tests also verify a node uses the appropriate first hop when redirected twice, receiving invalid options, having no entry in its Destination Cache, or when the new first hop is not reachable. These tests also verify interactions between Target Link-layer Address options with the Neighbor Cache.

Test v6LC.2.3.1: Redirected On-link: Valid (Hosts Only)

Purpose: Verify that a host properly processes valid Redirect messages when redirected on-link.

Reference:
- [ND] – Sections 4.6.1, 4.6.3, and 8.3

Test Setup: Common Test Setup 1.1 is performed. The Common Test Cleanup procedure is performed after each part. The following table details the Redirect message transmitted in each Part:

IPv6 Destination Address	TLLA Option	Redirected Packet Option	Part
Global (HUT)	No	No	A
Global (HUT)	No	Yes	B
Global (HUT)	Yes	No	C
Global (HUT)	Yes	Yes	D

Procedure:

Part A: No TLLA Option or Redirect Packet Option

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
2.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the off-link global address of TN1. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
3.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should transmit a Neighbor Solicitation for TN1's global address and an Echo Reply directly on-link to TN1, indicating the HUT processed the Redirect message.

Part B: No TLLA Option

Step	Action	Expected Behavior
4.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The	The HUT should respond to the Echo Request using TR1 as a first hop.

	Destination Address is the global address of the HUT.	
5.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the off-link global address of TN1. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
6.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should transmit a Neighbor Solicitation for TN1's global address and an Echo Reply directly on-link to TN1, indicating the HUT processed the Redirect message.

Part C: No Redirect Packet Option

Step	Action	Expected Behavior
7.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
8.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the off-link global address of TN1. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
9.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should transmit an Echo Reply directly on-link to TN1, indicating the HUT processed the Redirect message.

Part D: TLLA Option and Redirect Packet Option

Step	Action	Expected Behavior
10.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
11.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the off-	

	link global address of TN1. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
12.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should transmit an Echo Reply directly on-link to TN1, indicating the HUT processed the Redirect message.

Possible Problems: None.

Test v6LC.2.3.2: Redirected On-link: Suspicious (Hosts Only)

Purpose: Verify that a host properly processes suspicious Redirect messages when redirected on-link.

Reference:

- [ND] – Sections 4.6.1, 4.6.3, and 8.3

Test Setup: Common Test Setup 1.1 is performed. The Common Test Cleanup procedure is performed after each part. The following table details the Redirect message transmitted in each Part:

Procedure:

Part A: Option Unrecognized

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
2.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the global address of TN1. The Redirect message contains a Target Link-layer Address option. The Redirect message also contains an unrecognized option.	
3.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the second Echo Request directly on-link to TN1, indicating the HUT processed the Redirect message.

Part B: Reserved Field is Non-zero

Step	Action	Expected Behavior
4.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
5.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the	

	global address of TN1. The Redirect message has a non-zero Reserved field.	
6.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the second Echo Request directly on-link to TN1, indicating the HUT processed the Redirect message.

Part C: Target Address not Covered by On-link Prefix

Step	Action	Expected Behavior
7.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
8.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the global address of TN1. The Redirect message contains a Target Address of a global address of TN1 that is not covered by an on-link prefix.	
9.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the second Echo Request directly on-link to TN1, indicating the HUT processed the Redirect message.

Possible Problems: None.

Test v6LC.2.3.3: Redirected On-link: Invalid (Hosts Only)

Purpose: Verify that a host properly processes invalid Redirect messages when redirected on-link.

Reference:
- [ND] – Sections 4.5 and 8.1

Test Setup: Common Test Setup 1.1 is performed. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Redirect Source Address is Global

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
2.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the off-link global address of TN1. The Redirect message contains an incorrect IPv6 Source Address (the off-link global address of TN2.	
3.	TR1 forwards an Echo Request from TN1 to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Part B: Redirect Source Address is not the current first-hop router

Step	Action	Expected Behavior
4.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
5.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the off-link global address of TN1. The Redirect message contains an	

	incorrect IPv6 Source Address (the link-local address of TR2).	
6.	TR1 forwards an Echo Request from TN1 to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Part C: Hop Limit is not 255

Step	Action	Expected Behavior
7.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
8.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the off-link global address of TN1. The Redirect message contains an incorrect IPv6 Hop Limit of 254.	
9.	TR1 forwards an Echo Request from TN1 to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Part D: ICMPv6 Code is not 0

Step	Action	Expected Behavior
10.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
11.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the off-link global address of TN1. The Redirect message contains an incorrect ICMPv6 code of 1.	
12.	TR1 forwards an Echo Request from TN1 to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Part E: ICMPv6 Checksum is invalid

Step	Action	Expected Behavior
13.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
14.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the off-link global address of TN1. The Redirect message contains an incorrect ICMPv6 Checksum.	
15.	TR1 forwards an Echo Request from TN1 to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Part F: ICMPv6 Destination Address is Multicast

Step	Action	Expected Behavior
16.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
17.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the off-link global address of TN1. The Redirect message contains an ICMPv6 Destination Address of the All-nodes multicast address.	
18.	TR1 forwards an Echo Request from TN1 to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Part G: Target Address is Multicast

Step	Action	Expected Behavior
19.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The	The HUT should respond to the Echo Request using TR1 as a first hop.

	Destination Address is the global address of the HUT.	
20.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the off-link global address of TN1. The Redirect message contains a Target Address of the All-nodes multicast address.	
21.	TR1 forwards an Echo Request from TN1 to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Part H: ICMPv6 length is less than 40 Octets

Step	Action	Expected Behavior
22.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
23.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the off-link global address of TN1. The Redirect message contains an invalid ICMPv6 Length of 39 bytes.	
24.	TR1 forwards an Echo Request from TN1 to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Part I: Option has Length Zero

Step	Action	Expected Behavior
25.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
26.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the off-link global address of TN1. The Redirect message contains an Option with length 0.	

27.	TR1 forwards an Echo Request from TN1 to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Possible Problems: None.

Test v6LC.2.3.4: Redirected to Alternate Router: Valid (Hosts Only)

Purpose: Verify that a host properly processes valid Redirect messages when redirected to alternate router.

Reference:

- [ND] – Sections 4.6.1, 4.6.3, and 8.3

Test Setup: Common Test Setup 1.1 is performed. TR2 transmits an Echo Request to the HUT's link-local address. TR2 responds to any Neighbor Solicitations from the HUT with a Neighbor Advertisement with the solicited bit set to 1 causing the HUT to update its NCE for TR2 to state REACHABLE. The Common Test Cleanup procedure is performed after each part. The following table details the Redirect message transmitted in each Part:

IPv6 Destination Address	TLLA Option	Redirected Packet Option	Part
Global (HUT)	No	No	A
Global (HUT)	No	Yes	B
Global (HUT)	Yes	No	C
Global (HUT)	Yes	Yes	D

Procedure:

Part A: No TLLA or Redirect Packet Option

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
2.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
3.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should transmit an Echo Reply to TN1 using TR2 as a first hop, indicating the HUT processed the Redirect message.

Part B: No TLLA Option

Step	Action	Expected Behavior
4.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
5.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
6.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should transmit an Echo Reply to TN1 using TR2 as a first hop, indicating the HUT processed the Redirect message.

Part C: No Redirect Option

Step	Action	Expected Behavior
7.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
8.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
9.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should transmit an Echo Reply to TN1 using TR2 as a first hop, indicating the HUT processed the Redirect message.

Part D: TLLA and Redirected Packet Option

Step	Action	Expected Behavior

10.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
11.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
12.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should transmit an Echo Reply to TN1 using TR2 as a first hop, indicating the HUT processed the Redirect message.

Possible Problems: None.

Test v6LC.2.3.5: Redirected to Alternate Router: Suspicious (Hosts Only)

Purpose: Verify that a host properly processes suspicious Redirect messages when redirected to an alternate router.

Reference:

- [ND] – Sections 4.6.1, 4.6.3, and 8.3

Test Setup: Common Test Setup 1.1 is performed. TR2 transmits an Echo Request to the HUT's link-local address. TR2 responds to any Neighbor Solicitations from the HUT with a Neighbor Advertisement with the solicited bit set to 1 causing the HUT to update its NCE for TR2 to state REACHABLE. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Option Unrecognized

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
2.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option. The Redirect message also contains an unrecognized option.	
3.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the second Echo Request using TR2 as a first hop, indicating the HUT processed the Redirect message.

Part B: Reserved Field is Non-zero

Step	Action	Expected Behavior
4.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
5.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of	

	TN1. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option. The Redirect message also contains a non-zero Reserved field.	
6.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the second Echo Request using TR2 as a first hop, indicating the HUT processed the Redirect message.

Possible Problems: None.

Test v6LC.2.3.6: Redirected to Alternate Router: Invalid (Hosts Only)

Purpose: Verify that a host properly processes invalid Redirect messages when redirected on-link.

Reference:

- [ND] – Sections 4.5 and 8.1
- [ICMPv6] – Section 2.4

Test Setup: Common Test Setup 1.1 is performed. TR2 transmits an Echo Request to the HUT's link-local address. TR2 responds to any Neighbor Solicitations from the HUT with a Neighbor Advertisement with the solicited bit set to 1 causing the HUT to update its NCE for TR2 to state REACHABLE. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Redirect Source Address is Global

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
2.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains an incorrect IPv6 Source Address (the off-link global address of TN2).	
3.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Part B: Redirect Source Address is not the current first-hop router

Step	Action	Expected Behavior
4.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
5.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination	

	Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains an incorrect IPv6 Source Address (the link-local address of TR2).	
6.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Part C: Hop Limit is not 255

Step	Action	Expected Behavior
7.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
8.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains an incorrect IPv6 Hop Limit of 254.	
9.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Part D: ICMPv6 Code is not 0

Step	Action	Expected Behavior
10.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
11.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains an incorrect ICMPv6 Code of 1.	
12.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

	Destination Address is the global address of the HUT.	

Part E: ICMPv6 Checksum is invalid

Step	Action	Expected Behavior
13.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
14.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains an incorrect ICMPv6 Checksum.	
15.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Part F: ICMPv6 Destination Address is Multicast

Step	Action	Expected Behavior
16.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
17.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains an ICMPv6 Destination Address of the All-nodes multicast address.	
18.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Part G: Target Address is Multicast

Step	Action	Expected Behavior
19.	TR1 forwards an Echo Request to the HUT. The Source Address is the	The HUT should respond to the Echo Request using TR1 as a first hop.

	off-link global address of TN1. The Destination Address is the global address of the HUT.	
20.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains a Target Address of the All-nodes multicast address.	
21.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Part H: ICMPv6 length is less than 40 Octets

Step	Action	Expected Behavior
22.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
23.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains an invalid IPv6 Length of 39 bytes.	
24.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Part I: Option of Length 0

Step	Action	Expected Behavior
25.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
26.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The	

	Redirect message contains an Option with length 0.	
27.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should also respond to the second Echo Request using TR1 as a first hop, indicating the HUT did not process the invalid Redirect message.

Possible Problems: None.

Test v6LC.2.3.7: Redirected Twice (Hosts Only)

Purpose: Verify that a host properly processes valid Redirect messages twice for the same destination.

Reference:

- [ND] – Sections 8.3

Test Setup: Common Test Setup 1.1 is performed. TR2 transmits an Echo Request to the HUT's link-local address. TR2 and TR3 both transmits an Echo Request to the HUT's link-local address. TR2 and TR3 responds to any Neighbor Solicitations from the HUT with a Neighbor Advertisement with the solicited bit set to 1 causing the HUT to update its NCE for TR2 and TR3 to state REACHABLE. The Common Test Cleanup procedure is performed after each part.

Procedure:

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request from TN1 to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop, as it is the only router in the HUT's Default Router List.
2.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2.	
3.	TR1 forwards an Echo Request from TN1 to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR2 as a first hop, indicating the HUT processed the Redirect message.
4.	TR2 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR3.	
5.	TR1 forwards an Echo Request from TN1 to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR3 as a first hop, indicating the HUT processed the Redirect message.

Possible Problems: None.

Test v6LC.2.3.8: Invalid Option (Hosts Only)

Purpose: Verify that a host ignores invalid options in Redirect messages and processes the remainder of the Redirect normally.

Reference:

- [ND] – Sections 8.1
- [ICMPv6] – Section 2.4

Test Setup: Common Test Setup 1.1 is performedTR2 transmits an Echo Request to the HUT's link-local address. TR2 responds to any Neighbor Solicitations from the HUT with a Neighbor Advertisement with the solicited bit set to 1 causing the HUT to update its NCE for TR2 to state REACHABLE. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Path MTU Option

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
2.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains a Path MTU option.	
3.	TR1 forwards an Echo Request from TN1 to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	
4.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	The HUT should respond to the second Echo Request using TR2 as a first hop, indicating the HUT ignored the invalid option and processed the Redirect message.

Part B: Prefix Information Option

Step	Action	Expected Behavior
5.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The	The HUT should respond to the Echo Request using TR1 as a first hop.

	Destination Address is the global address of the HUT.	
6.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains a Prefix Information Option.	
7.	TR1 forwards an Echo Request from TN1 to the HUT. The Source Address is the off-link global address of TN1. The Redirect message contains a Prefix Information option.	
8.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	The HUT should respond to the second Echo Request using TR2 as a first hop, indicating the HUT ignored the invalid option and processed the Redirect message.

Part C: Source Link-layer Address Option

Step	Action	Expected Behavior
9.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
10.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains a Source Link-layer Address Option.	
11.	TR1 forwards an Echo Request from TN1 to the HUT. The Source Address is the off-link global address of TN1. The Redirect message contains a Source Link-layer Address option.	
12.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	The HUT should respond to the second Echo Request using TR2 as a first hop, indicating the HUT ignored the invalid option and processed the Redirect message.

Possible Problems: None.

Test v6LC.2.3.9: No Destination Cache Entry (Hosts Only)

Purpose: Verify that a host properly processes a Redirect message when there is no entry for the destination in the host's Destination Cache.

Reference:

- [ND] – Sections 8.3

Test Setup: Common Test Setup 1.1 is performed. TR2 transmits an Echo Request to the HUT's link-local address. TR2 responds to any Neighbor Solicitations from the HUT with a Neighbor Advertisement with the solicited bit set to 1 causing the HUT to update its NCE for TR2 to state REACHABLE. The Common Test Cleanup procedure is performed after each part.

Procedure:

Step	Action	Expected Behavior
1.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-Layer option with the link-layer address of TR2.	
2.	TR1 forwards an Echo Request from TN1 to the HUT. The IPv6 Source Address is the off-link global address of TN1. The IPv6 Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR2 as the first-hop, indicating the HUT processed the Redirect message and created a Destination Cache entry.

Possible Problems: None

Test v6LC.2.3.10: Neighbor Cache Updated, No Neighbor Cache Entry (Hosts Only)

Purpose: Verify that a host properly updates its Neighbor Cache entry upon receipt of a valid ICMP Redirect Message.

Reference:

- [ND] – Sections 8.3

Test Setup: Common Test Setup 1.1 is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. The Common Test Cleanup procedure is performed after each part. The following table details the Redirect message transmitted in each Part:

TLLA Option	Redirected Packet Option	New NC State	Link-layer Address	Part
No	No	No NCE	Unchanged	A
Yes	No	STALE	Updated	B
Yes	Yes	STALE	Updated	C
Yes	Yes, packet > 1280	STALE	Updated	D

Procedure:

Part A: No TLLA Option, No Redirected Packet Option, Link-layer Address Unchanged

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
2.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
3.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
4.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should wait to send a multicast Neighbor Solicitation for TR2 until it receives the Echo Request, indicating the HUT had no NCE for TR2.

Part B: TLLA Option, No Redirected Packet Option, Link-layer Address Updated

Step	Action	Expected Behavior
5.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
6.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
7.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
8.	TR2 transmits a link-local Echo Request to the HUT.	Because the HUT's NCE for TR2 is in state **STALE**, the HUT should send an Echo Reply to TR2 using the new Link-Layer address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the HUT should send a unicast Neighbor Solicitation to TR2.

Part C: TLLA Option, Redirected Packet Option, Link-layer Address Updated

Step	Action	Expected Behavior
9.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
10.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
11.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
12.	TR2 transmits a link-local Echo Request to the HUT.	Because the HUT's NCE for TR2 is in state **STALE**, the HUT should send an Echo Reply to TR2 using the new Link-Layer

		address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the HUT should send a unicast Neighbor Solicitation to TR2.

Part D: TLLA Option, Oversized Redirected Packet Option, Link-layer Address Updated

Step	Action	Expected Behavior
13.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
14.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
15.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
16.	TR2 transmits a link-local Echo Request to the HUT.	Because the HUT's NCE for TR2 is in state **STALE**, the HUT should send an Echo Reply to TR2 using the new Link-Layer address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the HUT should send a unicast Neighbor Solicitation to TR2.

Possible Problems: None.

Test v6LC.2.3.11: Neighbor Cache Updated from State INCOMPLETE (Hosts Only)

Purpose: Verify that a host properly updates its Neighbor Cache entry upon receipt of a valid ICMP Redirect Message.

Reference:

- [ND] – Sections 8.3

Test Setup: Common Test Setup 1.1 is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. The Common Test Cleanup procedure is performed after each part. The following table details the Redirect message transmitted in each Part:

TLLA Option	Redirected Packet Option	New NC State	Link-layer Address	Part
No	No	INCOMPLETE	Unchanged	A
Yes	No	STALE	Updated	B
Yes	Yes	STALE	Updated	C
Yes	Yes, packet > 1280	STALE	Updated	D

Procedure:

Part A: No TLLA Option, No Redirected Packet Option, Link-layer Address Unchanged

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
2.	TR2 transmits a link-local Echo Request to the HUT. TR2 does not reply to Neighbor Solicitations.	The HUT should send a multicast Neighbor Solicitation for TR2, indicating the HUT has an NCE for TR2 in state **INCOMPLETE**.
3.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
4.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT) (3 seconds)	The HUT should still send multicast Neighbor Solicitations for TR2, indicating the HUT still has an NCE for TR2 in state **INCOMPLETE**.

Part B: TLLA Option, No Redirected Packet Option, Link-layer Address Updated

Step	Action	Expected Behavior
5.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
6.	TR2 transmits a link-local Echo Request to the HUT. TR2 does not reply to Neighbor Solicitations.	The HUT should send a multicast Neighbor Solicitation for TR2, indicating the HUT has an NCE for TR2 in state **INCOMPLETE**.
7.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above	Because the HUT's NCE for TR2 is in state **STALE**, the HUT should send an Echo Reply to TR2 using the new Link-Layer address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the HUT should send a unicast Neighbor Solicitation to TR2.

Part C: TLLA Option, Redirected Packet Option, Link-layer Address Updated

Step	Action	Expected Behavior
8.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
9.	TR2 transmits a link-local Echo Request to the HUT. TR2 does not reply to Neighbor Solicitations.	The HUT should send a multicast Neighbor Solicitation for TR2, indicating the HUT has an NCE for TR2 in state **INCOMPLETE**.
10.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above	Because the HUT's NCE for TR2 is in state **STALE**, the HUT should send an Echo Reply to TR2 using the new Link-Layer address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the HUT should send a unicast Neighbor Solicitation to TR2.

Part D: TLLA Option, Oversized Redirected Packet Option, Link-layer Address Updated

Step	Action	Expected Behavior
11.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.

12.	TR2 transmits a link-local Echo Request to the HUT. TR2 does not reply to Neighbor Solicitations.	The HUT should send a multicast Neighbor Solicitation for TR2, indicating the HUT has an NCE for TR2 in state **INCOMPLETE**.
13.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above	Because the HUT's NCE for TR2 is in state **STALE**, the HUT should send an Echo Reply to TR2 using the new Link-Layer address and enter state **DELAY**. After DELAY_FIRST_PROBE_TIME, the HUT should send a unicast Neighbor Solicitation to TR2.

Possible Problems: None.

Test v6LC.2.3.12: Neighbor Cache Updated from State REACHABLE (Hosts Only)

Purpose: Verify that a host properly updates its Neighbor Cache entry upon receipt of a valid ICMP Redirect Message.

Reference:

- [ND] – Sections 8.3

Test Setup: Common Test Setup 1.1 is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. The Common Test Cleanup procedure is performed after each part. The following table details the Redirect message transmitted in each Part:

TLLA Option	Redirected Packet Option	New NC State	Link-layer Address	Part
No	No	REACHABLE	Unchanged	A
Same	No	REACHABLE	Unchanged	B
Different	No	STALE	Updated	C
Different	Yes	STALE	Updated	D
Different	Yes, packet > 1280	STALE	Updated	E

Procedure:

Part A: No TLLA Option, No Redirected Packet Option, Link-layer Address Unchanged

Step	Action	Expected Behavior
1.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should create a Neighbor Cache Entry for TR2 and set the state of the Entry to INCOMPLETE. The HUT should transmit multicast Neighbor Solicitations to TR2.
2.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	After receiving the solicited Neighbor Advertisement from TR2, the HUT should update its Neighbor Cache Entry for TR2 to REACHABLE and transmit an Echo Reply. After DELAY_FIRST_PROBE_TIME, the HUT should not send a unicast Neighbor Solicitation to TR2.
3.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
4.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target	

	Link-layer Address option or Redirected Packet option according to the table above.	
5.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
6.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should respond with an Echo Reply.
7.	Observe the packets transmitted by the HUT.	
8.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds)	The HUT should not send any Neighbor Solicitations, indicating the HUT had an NCE for TR2 in state REACHABLE.

Part B: TLLA Option, No Redirected Packet Option, Link-layer Address Unchanged

Step	Action	Expected Behavior
9.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should create a Neighbor Cache Entry for TR2 and set the state of the Entry to INCOMPLETE. The HUT should transmit multicast Neighbor Solicitations to TR2.
10.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	After receiving the solicited Neighbor Advertisement from TR2, the HUT should update its Neighbor Cache Entry for TR2 to REACHABLE and transmit an Echo Reply. After DELAY_FIRST_PROBE_TIME, the HUT should not send a unicast Neighbor Solicitation to TR2.
11.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
12.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
13.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
14.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should respond with an Echo Reply.
15.	Observe the packets transmitted by the HUT.	

16.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds)	The HUT should not send any Neighbor Solicitations, indicating the HUT had an NCE for TR2 in state REACHABLE.

Part C: TLLA Option, No Redirected Packet Option, Link-layer Address Updated

Step	Action	Expected Behavior
17.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should create a Neighbor Cache Entry for TR2 and set the state of the Entry to INCOMPLETE. The HUT should transmit multicast Neighbor Solicitations to TR2.
18.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	After receiving the solicited Neighbor Advertisement from TR2, the HUT should update its Neighbor Cache Entry for TR2 to REACHABLE and transmit an Echo Reply. After DELAY_FIRST_PROBE_TIME, the HUT should not send a unicast Neighbor Solicitation to TR2.
19.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
20.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
21.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
22.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should respond with an Echo Reply sent to the updated link-layer address.
23.	Observe the packets transmitted by the HUT.	
24.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds)	The HUT should send a unicast Neighbor Solicitation for TR2, indicating the HUT had an NCE for TR2 in state STALE.

Part D: TLLA Option, Redirected Packet Option, Link-layer Address Updated

Step	Action	Expected Behavior
25.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should create a Neighbor Cache Entry for TR2 and set the state of the Entry

		to INCOMPLETE. The HUT should transmit multicast Neighbor Solicitations to TR2.
26.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	After receiving the solicited Neighbor Advertisement from TR2, the HUT should update its Neighbor Cache Entry for TR2 to REACHABLE and transmit an Echo Reply. After DELAY_FIRST_PROBE_TIME, the HUT should not send a unicast Neighbor Solicitation to TR2.
27.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
28.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
29.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
30.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should respond with an Echo Reply sent to the updated link-layer address.
31.	Observe the packets transmitted by the HUT.	
32.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds)	The HUT should send a unicast Neighbor Solicitation for TR2, indicating the HUT had an NCE for TR2 in state STALE.

Part E: TLLA Option, Oversized Redirected Packet Option, Link-layer Address Updated

Step	Action	Expected Behavior
33.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should create a Neighbor Cache Entry for TR2 and set the state of the Entry to INCOMPLETE. The HUT should transmit multicast Neighbor Solicitations to TR2.
34.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	After receiving the solicited Neighbor Advertisement from TR2, the HUT should update its Neighbor Cache Entry for TR2 to REACHABLE and transmit an Echo Reply. After DELAY_FIRST_PROBE_TIME, the HUT should not send a unicast Neighbor Solicitation to TR2.
35.	TR1 forwards an Echo Request to the HUT. The Source Address is the	The HUT should respond to the Echo Request using TR1 as a first hop.

	off-link global address of TN1. The Destination Address is the global address of the HUT.	
36.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
37.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
38.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should respond with an Echo Reply sent to the updated link-layer address.
39.	Observe the packets transmitted by the HUT.	
40.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds)	The HUT should send a unicast Neighbor Solicitation for TR2, indicating the HUT had an NCE for TR2 in state STALE.

Possible Problems: None.

Test v6LC.2.3.13: Neighbor Cache Updated from State STALE (Hosts Only)

Purpose: Verify that a host properly updates its Neighbor Cache entry upon receipt of a valid ICMP Redirect Message.

Reference:
- [ND] – Sections 8.3

Test Setup: Common Test Setup 1.1 is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. The Common Test Cleanup procedure is performed after each part. The following table details the Redirect message transmitted in each Part:

TLLA Option	Redirected Packet Option	New NC State	Link-layer Address	Part
No	No	STALE	Unchanged	A
Same	No	STALE	Unchanged	B
Different	No	STALE	Updated	C
Different	Yes	STALE	Updated	D
Different	Yes, packet > 1280	STALE	Updated	E

Procedure:

Part A: No TLLA Option, No Redirected Packet Option, Link-layer Address Unchanged

Step	Action	Expected Behavior
1.	TR2 transmits a link-local Echo Request to the HUT.	
2.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	The HUT should respond with an Echo Reply.
3.	Wait (REACHCABLE_TIME * MAX_RANDOM_FACTOR). (45 seconds)	
4.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
5.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	

6.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
7.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should respond with an Echo Reply.
8.	Observe the packets transmitted by the HUT.	
9.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds)	The HUT should send a unicast Neighbor Solicitation for TR2, indicating the HUT had an NCE for TR2 in state **STALE**.

Part B: TLLA Option, No Redirected Packet Option, Link-layer Address Unchanged

Step	Action	Expected Behavior
10.	TR2 transmits a link-local Echo Request to the HUT.	
11.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	The HUT should respond with an Echo Reply.
12.	Wait (REACHCABLE_TIME * MAX_RANDOM_FACTOR). (45 seconds)	
13.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
14.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
15.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
16.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should respond with an Echo Reply.
17.	Observe the packets transmitted by the HUT.	
18.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds)	The HUT should send a unicast Neighbor Solicitation for TR2, indicating the HUT had an NCE for TR2 in state **STALE**.

Part C: TLLA Option, No Redirected Packet Option, Link-layer Address Updated

Step	Action	Expected Behavior

19.	TR2 transmits a link-local Echo Request to the HUT.	
20.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	The HUT should respond with an Echo Reply.
21.	Wait (REACHCABLE_TIME * MAX_RANDOM_FACTOR). (45 seconds)	
22.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
23.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
24.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
25.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should respond with an Echo Reply sent to the updated link-layer address.
26.	Observe the packets transmitted by the HUT.	
27.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds)	The HUT should send a unicast Neighbor Solicitation for TR2, indicating the HUT had an NCE for TR2 in state **STALE.**

Part D: TLLA Option, Redirected Packet Option, Link-layer Address Updated

Step	Action	Expected Behavior
28.	TR2 transmits a link-local Echo Request to the HUT.	
29.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	The HUT should respond with an Echo Reply.
30.	Wait (REACHCABLE_TIME * MAX_RANDOM_FACTOR). (45 seconds)	
31.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.

32.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
33.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
34.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should respond with an Echo Reply sent to the updated link-layer address.
35.	Observe the packets transmitted by the HUT.	
36.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds)	The HUT should send a unicast Neighbor Solicitation for TR2, indicating the HUT had an NCE for TR2 in state **STALE.**

Part E: TLLA Option, Oversized Redirected Packet Option, Link-layer Address Updated

Step	Action	Expected Behavior
37.	TR2 transmits a link-local Echo Request to the HUT.	
38.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	The HUT should respond with an Echo Reply.
39.	Wait (REACHCABLE_TIME * MAX_RANDOM_FACTOR). (45 seconds)	
40.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
41.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
42.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
43.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should respond with an Echo Reply sent to the updated link-layer address.

44.	Observe the packets transmitted by the HUT.	
45.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds)	The HUT should send a unicast Neighbor Solicitation for TR2, indicating the HUT had an NCE for TR2 in state **STALE.**

Possible Problems: None.

Test v6LC.2.3.14: Neighbor Cache Updated from State PROBE (Hosts Only)

Purpose: Verify that a host properly updates its Neighbor Cache entry upon receipt of a valid ICMP Redirect Message.

Reference:
- [ND] – Sections 8.3

Test Setup: Common Test Setup 1.1 is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. The Common Test Cleanup procedure is performed after each part. The following table details the Redirect message transmitted in each Part:

TLLA Option	Redirected Packet Option	New NC State	Link-layer Address	Part
No	No	PROBE	Unchanged	A
Same	No	PROBE	Unchanged	B
Different	No	STALE	Updated	C
Different	Yes	STALE	Updated	D
Different	Yes, packet > 1280	STALE	Updated	E

Procedure:

Part A: No TLLA Option, No Redirected Packet Option, Link-layer Address Unchanged

Step	Action	Expected Behavior
1.	TR2 transmits a link-local Echo Request to the HUT.	
2.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	The HUT should respond with an Echo Reply.
3.	Wait (REACHCABLE_TIME * MAX_RANDOM_FACTOR). (45 seconds)	
4.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
5.	TR2 transmits an Echo Request from its link-local address to the HUT.	
6.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds).	
7.	TR1 transmits a Redirect message to the NUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the	The HUT should transmit a unicast Neighbor Solicitation for TR2, indicating the HUT had an NCE for TR2 in state **PROBE.**

	link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	

Part B: TLLA Option, No Redirected Packet Option, Link-layer Address Unchanged

Step	Action	Expected Behavior
8.	TR2 transmits a link-local Echo Request to the HUT.	
9.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	The HUT should respond with an Echo Reply.
10.	Wait (REACHCABLE_TIME * MAX_RANDOM_FACTOR). (45 seconds)	
11.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
12.	TR2 transmits an Echo Request from its link-local address to the HUT.	
13.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds).	
14.	TR1 transmits a Redirect message to the NUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	The HUT should transmit a unicast Neighbor Solicitation for TR2, indicating the HUT had an NCE for TR2 in state **PROBE.**

Part C: TLLA Option, No Redirected Packet Option, Link-layer Address Updated

Step	Action	Expected Behavior
15.	TR2 transmits a link-local Echo Request to the HUT.	
16.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	The HUT should respond with an Echo Reply.
17.	Wait (REACHCABLE_TIME * MAX_RANDOM_FACTOR). (45 seconds)	
18.	TR1 forwards an Echo Request to the HUT. The Source Address is the	The HUT should respond to the Echo Request using TR1 as a first hop.

	off-link global address of TN1. The Destination Address is the global address of the HUT.	
19.	TR2 transmits an Echo Request from its link-local address to the HUT.	The HUT should respond with an Echo Reply.
20.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds).	
21.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
22.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
23.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should respond with an Echo Reply sent to the updated link-layer address.
24.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds)	The HUT should send a unicast Neighbor Solicitation for TR2, indicating the HUT had an NCE for TR2 in state **STALE.**

Part D: TLLA Option, Redirected Packet Option, Link-layer Address Updated

Step	Action	Expected Behavior
25.	TR2 transmits a link-local Echo Request to the HUT.	
26.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	The HUT should respond with an Echo Reply.
27.	Wait (REACHCABLE_TIME * MAX_RANDOM_FACTOR). (45 seconds)	
28.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
29.	TR2 transmits an Echo Request from its link-local address to the HUT.	The HUT should respond with an Echo Reply.
30.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds).	
31.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the	

	link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
32.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
33.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should respond with an Echo Reply sent to the updated link-layer address.
34.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds)	The HUT should send a unicast Neighbor Solicitation for TR2, indicating the HUT had an NCE for TR2 in state **STALE.**

Part E: TLLA Option, Oversized Redirected Packet Option, Link-layer Address Updated

Step	Action	Expected Behavior
35.	TR2 transmits a link-local Echo Request to the HUT.	
36.	TR2 transmits a solicited Neighbor Advertisement in response to any Neighbor Solicitations from the HUT.	The HUT should respond with an Echo Reply.
37.	Wait (REACHCABLE_TIME * MAX_RANDOM_FACTOR). (45 seconds)	
38.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
39.	TR2 transmits an Echo Request from its link-local address to the HUT.	The HUT should respond with an Echo Reply.
40.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds).	
41.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN2. The Target Address is the link-local address of TR2. The Redirect message contains a Target Link-layer Address option or Redirected Packet option according to the table above.	
42.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
43.	TR2 transmits a link-local Echo Request to the HUT.	The HUT should respond with an Echo Reply sent to the updated link-layer address.

44.	Wait DELAY_FIRST_PROBE_TIME. (5 seconds)	The HUT should send a unicast Neighbor Solicitation for TR2, indicating the HUT had an NCE for TR2 in state **STALE.**

Possible Problems: None.

Test v6LC.2.3.15: Invalid Redirect does not Update Neighbor Cache (Hosts Only)

Purpose: Verify that a host properly processes invalid Redirect messages when redirected on-link.

Reference:

- [ND] – Sections 8.1

Test Setup: Common Test Setup 1.1 is performed. Wait at least 3 seconds (MAX_MULTICAST_SOLICIT * RETRANS_TIMER) after any previous cleanup to make sure all previous NCE's are in state No NCE. The Common Test Cleanup procedure is performed after each part.

Procedure:

Part A: Redirect Source Address is Global

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
2.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains an incorrect IPv6 Source Address (the off-link global address of TN2).	
3.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
4.	TR2 transmits a link-local Echo Request to the HUT.	
5.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT) (3 seconds).	The HUT should transmit a multicast Neighbor Solicitation for TR2, indicating the HUT did not create an NCE for TR2 upon reception of an invalid Redirect message.

Part B: Redirect Source Address is not the current first-hop router

Step	Action	Expected Behavior
6.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.

7.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains an incorrect IPv6 Source Address (the link-local address of TR2).	
8.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
9.	TR2 transmits a link-local Echo Request to the HUT.	
10.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT) (3 seconds).	The HUT should transmit a multicast Neighbor Solicitation for TR2, indicating the HUT did not create an NCE for TR2 upon reception of an invalid Redirect message.

Part C: Hop Limit is not 255

Step	Action	Expected Behavior
11.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
12.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains an incorrect IPv6 Hop Limit of 254.	
13.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
14.	TR2 transmits a link-local Echo Request to the HUT.	
15.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT) (3 seconds).	The HUT should transmit a multicast Neighbor Solicitation for TR2, indicating the HUT did not create an NCE for TR2 upon reception of an invalid Redirect message.

Part D: ICMPv6 Code is not 0

Step	Action	Expected Behavior
16.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.

17.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains an incorrect ICMPv6 Code of 1.	
18.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
19.	TR2 transmits a link-local Echo Request to the HUT.	
20.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT) (3 seconds).	The HUT should transmit a multicast Neighbor Solicitation for TR2, indicating the HUT did not create an NCE for TR2 upon reception of an invalid Redirect message.

Part E: ICMPv6 Checksum is invalid

Step	Action	Expected Behavior
21.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
22.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains an incorrect ICMPv6 Checksum.	
23.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
24.	TR2 transmits a link-local Echo Request to the HUT.	
25.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT) (3 seconds).	The HUT should transmit a multicast Neighbor Solicitation for TR2, indicating the HUT did not create an NCE for TR2 upon reception of an invalid Redirect message.

Part F: ICMPv6 Destination Address is Multicast

Step	Action	Expected Behavior
26.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
27.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination	

	Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains an ICMPv6 Destination Address of the all-nodes multicast address.	
28.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
29.	TR2 transmits a link-local Echo Request to the HUT.	
30.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT) (3 seconds).	The HUT should transmit a multicast Neighbor Solicitation for TR2, indicating the HUT did not create an NCE for TR2 upon reception of an invalid Redirect message.

Part G: Target Address is Multicast

Step	Action	Expected Behavior
31.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
32.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains a Target Address of the All-nodes multicast address.	
33.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
34.	TR2 transmits a link-local Echo Request to the HUT.	
35.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT) (3 seconds).	The HUT should transmit a multicast Neighbor Solicitation for TR2, indicating the HUT did not create an NCE for TR2 upon reception of an invalid Redirect message.

Part H: ICMPv6 length is less than 40 Octets

Step	Action	Expected Behavior
36.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
37.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination	

	Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains an invalid IPv6 Length of 39 bytes.	
38.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
39.	TR2 transmits a link-local Echo Request to the HUT.	
40.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT) (3 seconds).	The HUT should transmit a multicast Neighbor Solicitation for TR2, indicating the HUT did not create an NCE for TR2 upon reception of an invalid Redirect message.

Part I: Option has Length Zero

Step	Action	Expected Behavior
41.	TR1 forwards an Echo Request to the HUT. The Source Address is the off-link global address of TN1. The Destination Address is the global address of the HUT.	The HUT should respond to the Echo Request using TR1 as a first hop.
42.	TR1 transmits a Redirect message to the HUT. The ICMPv6 Destination Address is the global address of TN1. The Target Address is the link-local address of TR2. The Redirect message contains an Option with length 0.	
43.	Wait DELAY_FIRST_PROBE_TIME (5 seconds).	
44.	TR2 transmits a link-local Echo Request to the HUT.	
45.	Wait (RETRANS_TIMER * MAX_*CAST_SOLICIT) (3 seconds).	The HUT should transmit a multicast Neighbor Solicitation for TR2, indicating the HUT did not create an NCE for TR2 upon reception of an invalid Redirect message.

Possible Problems: None.

Test v6LC.2.3.16: Redirect – Transmit (Routers Only)

Purpose: Verify that a router properly handles transmission of Redirect messages.

Reference:

- [ND] – Sections 8.2

Test Setup: Common Test Setup 1.1 is performed. The Common Test Cleanup procedure is performed after each part. TN2 is an on-link neighbor on Link A to TN1 (instead of residing on Link B depicted in Common Topology). RUT advertises prefix X on Link A.

Procedure:

Part A: Send Redirect

Step	Action	Expected Behavior
1.	TN1 transmits an Echo Request to TN2's unicast global address with prefix X and a first hop through the RUT.	The RUT should transmit a Redirect message with the following values: **IPv6 Source -** Link-Local address of RUT **IPv6 Destination -** TN1's address **IPv6 Hop Limit –** 255 **Target -** TN2's unicast global address with prefix X. **Destination -** TN2's unicast global address with prefix X. **TLL Option -** TN2's link-layer address if known **Redirected Header -** TN1's Echo Request without total packet exceeding 1280 bytes.

Part B: Send Redirect to Alternate Router

Step	Action	Expected Behavior
2.	TN1 transmits an Echo Request to TN2 using a Destination Address not associated with Link A or Link B and a first hop through the RUT.	The RUT should transmit a Redirect message with the following values: **IPv6 Source -** Link-Local address of RUT **IPv6 Destination -** TN1's address **IPv6 Hop Limit –** 255 **Target –** TR1's link-local address **Destination -** TN2's global address not associated with Link A or Link B. **TLL Option –** TR1's link-layer address if known **Redirected Header -** TN1's Echo Request without total packet exceeding 1280 bytes.

Part C: Source not neighbor

Step	Action	Expected Behavior
3.	TN1 transmits an Echo Request to TN2 using a Destination Address not associated with Link A or Link B and a first hop through the RUT.	The RUT should not send a Redirect message.

Part D: Destination Multicast

Step	Action	Expected Behavior
4.	TN1 transmits an Echo Request to TN2's solicited-node multicast address with a first hop through the RUT.	The RUT should not send a Redirect message.

Possible Problems: None.

Test v6LC.2.3.17: Redirect – Receive (Routers Only)

Purpose: Verify that a router properly handles reception of Redirect messages.

Reference:

- [ND] – Sections 8.2

Test Setup: Common Test Setup 1.2 is performed. The Common Test Cleanup procedure is performed after each part. Configure the RUT with a static route to TN4's Link C prefix through TR1.

Procedure:

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request from TN4 to the RUT. The Destination Address is the global address of the RUT.	The RUT should send an Echo Reply with a first hop through TR1.
2.	TR1 transmits a Redirect message to the RUT. The ICMPv6 Destination Address is the global address of TN4. The Target Address is the link-local address of TR2.	
3.	TN2 transmits an Echo Request to TN4's off link address using the RUT has its first hop.	The RUT should still forward an Echo Request on to Link A with a first hop through TR1, indicating the RUT did not change its routing table with information from TR1's Redirect message.

Possible Problems: None.

Test v6LC.2.3.18: Atomic Fragments in Redirect (Host Only)

Purpose: Verify that the NUT doesn't process Redirect messages with atomic fragments.

Reference:

- [RFC-6980] – Section 5

Test Setup: Common Test Setup 1.1 is performed. The Common Test Cleanup procedure is performed after each part.

Redirect

IPv6 Header Next Header: 44 Source Address: TN1's Global Address Destination Address: NUT's Global Address
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 0
ICMPv6 Redirect
Target Link-Layer Option
Redirected Header Option

Procedure:

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request to the DUT.	Observe the HUT transmitting an Echo Reply using TR1 as the first hop.
2.	TR1 transmits Redirect.	
3.	TR1 forwards an Echo Request to the DUT.	Observe the HUT transmitting an Echo Reply using TR1 as the first hop indicating it didn't process the Redirect.

Possible Problems: None.

Test v6LC.2.3.19: Fragment Header in Redirect (Host Only)

Purpose: Verify that the NUT doesn't process Redirect messages with fragments.

Reference:

- [RFC-6980] – Section 5

Test Setup: Common Test Setup 1.1 is performed. The Common Test Cleanup procedure is performed after each part.

Redirect	Redirect Fragment
IPv6 Header Next Header: 44 Source Address: TR1's Global Address Destination Address: NUT's Global Address	IPv6 Header Next Header: 44 Source Address: TR1's Global Address Destination Address: NUT's Global Address
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 1	Fragment Header Next Header: 58 Fragment Offset: 2 More Fragments flag: 0 Fragment Data: 32 Bytes
ICMPv6 Redirect	
Target Link-Layer Option	
Redirected Header Option	

Procedure:

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request to the DUT.	Observe the HUT transmitting an Echo Reply using TR1 as the first hop.
2.	TR1 transmits Redirect and Redirect fragment	
3.	TR1 forwards an Echo Request to the DUT.	Observe the HUT transmitting an Echo Reply using TR1 as the first hop indicating it didn't process the Redirect.

Possible Problems: None.

Section 3: 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.

Default Packets

Echo Request

IPv6 Header Payload Length: 136 bytes Next Header: 58
ICMPv6 Header Type: 128 Code: 0

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 Hop Limit: 255 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

Group 1: Address Autoconfiguration and Duplicate Address Detection

Scope

The following tests cover Address autoconfiguration and duplicate address detection in IPv6.

Overview

The tests in this group verify conformance of the Address autoconfiguration and duplicate address detection with the IPv6 Stateless Address Autoconfiguration Specification.

Test v6LC.3.1.1: Address Autoconfiguration and Duplicate Address Detection

Purpose: Verify that a node can properly initialize on a network using address autoconfiguration and communicate with other on-link partners.

Reference:
- [SLAAC] – Sections 1, 5.3, 5.4
- [IPv6-ARCH] – Section 2.5.1, 2.5.2, 2.7.1

Test Setup: No Common Test Setup is performed. Default values include DupAddrDetectTransmits=1 and RetransTimer=1 second.

Procedure:

Step	Action	Expected Behavior
1.	Initialize all the devices on Link A.	
2.	Allow time for all devices on Link A to perform stateless address autoconfiguration and DAD.	The NUT should perform DAD on its tentative address for its interface on Link B sending DupAddrDetectTransmits Neighbor Solicitations, every RetransTimer. The NUT should assign the tentative address to its interface. Interface IDs are required to be 64 bits long.
3.	TN1 to transmit a DAD Neighbor Solicitation from the unspecified address with the Target Address set to the NUT's link-local address.	The NUT must transmit a DAD NA for its autoconfigured link-local address.

Possible Problems: None.

Test v6LC.3.1.2: Receiving DAD Neighbor Solicitations and Advertisements

Purpose: To verify that a node can properly process neighbor solicitations and advertisements performing Duplicate Address Detection while the node is also performing DAD.

Reference:

- [SLAAC] – 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. Default values include DupAddrDetectTransmits=1 and RetransTimer=1 second.

Neighbor Solicitation A
IPv6 Header Next Header: 58 Source Address: Unspecified Address Destination Address: Solicited multicast of the NUT's tentative Link-local Address Hop Limit: 255
Neighbor Solicitation Target Address: (See Below)

Neighbor Advertisement B
IPv6 Header Next Header: 58 Source Address: NUT'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: NUT receives DAD NS (target != NUT)

Step	Action	Expected Behavior
1.	Initialize all devices on Link A.	
2.	After TN1 receives a DAD NS message from the NUT. 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 Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the DAD NS. The NUT should complete the DAD process and assign the tentative address to its interface.
4.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.
5.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part B: NUT receives DAD NS (target == NUT)

Step	Action	Expected Behavior
6.	Initialize all devices on Link A.	
7.	After TN1 receives a DAD NS message from the NUT. TN1 to transmit DAD Neighbor Solicitation A with the Target Address set to the NUT's tentative link-local address.	
8.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should receive more DAD NS messages than expected with its tentative link-local address as the Target address. The NUT should determine its tentative address is a duplicate and should not assign the tentative address to its interface.
9.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must NOT transmit a Solicited NA for its autoconfigured link-local address.
10.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must NOT transmit a Solicited NA for its autoconfigured link-local address.

Part C: NUT receives DAD NA (target != NUT)

Step	Action	Expected Behavior
11.	Initialize all devices on Link A.	
12.	After TN1 receives a DAD NS message from the NUT. TN1 to transmit DAD Neighbor Advertisement B with a Target Address set to TN1's link-local address.	
13.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the DAD NA. The NUT should complete the DAD process and assign the tentative address to its interface.
14.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.
15.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part D: NUT receives DAD NA (target == NUT)

Step	Action	Expected Behavior
16.	Initialize all devices on Link A.	
17.	After TN1 receives a DAD NS message from the NUT. Configure TN1 to transmit DAD Neighbor Advertisement B from the NUT's link-local address with a Target Address set to the NUT's tentative link-local address and no TLL Option.	
18.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT must determine its tentative address is not unique and should not assign the tentative address to its interface.
19.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must NOT transmit a Solicited NA for its autoconfigured link-local address.
20.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must NOT transmit a Solicited NA for its autoconfigured link-local address.

Possible Problems: None.

Test v6LC.3.1.3: Validation of DAD Neighbor Solicitations

Purpose: Verify that a node can properly ignore invalid neighbor solicitations while performing Duplicate Address Detection.

Reference:

- [SLAAC] – Sections 5.4.1 and 5.4.5
- [ND] – Section 7.1.1

Test Setup: No Common Test Setup is performed. Default values include DupAddrDetectTransmits=1 and RetransTimer=1 second.

Neighbor Solicitation A
IPv6 Header Next Header: 58 Source Address: Unspecified Address Destination Address: Solicited multicast of the NUT's tentative Link-local Address Hop Limit: 255
Neighbor Solicitation Target Address: NUT's tentative link-local address

Procedure:

Part A: NUT receives invalid DAD NS (ICMP length < 24 octets)

Step	Action	Expected Behavior
1.	Initialize all devices on Link A.	
2.	After TN1 receives a DAD NS message from the NUT, configure TN1 to transmit Neighbor Solicitation A with the ICMP length set to 16.	
3.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the invalid DAD NS. The NUT should complete the DAD process and assign the tentative address to its interface.
4.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

5.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part B: NUT receives invalid DAD NS (HopLimit !=255)

Step	Action	Expected Behavior
6.	Initialize all devices on Link A.	
7.	After TN1 receives a DAD NS message from the NUT, configure TN1 to transmit Neighbor Solicitation A with the Hoplimit set to 254.	
8.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the invalid DAD NS. The NUT should complete the DAD process and assign the tentative address to its interface.
9.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.
10.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part C: NUT receives invalid DAD NS (Dst = NUT's tentative address)

Step	Action	Expected Behavior
11.	Initialize all devices on Link A.	
12.	After TN1 receives a DAD NS message from the NUT, configure TN1 to transmit Neighbor Solicitation A with the Destination address set to the NUT's tentative link-local address.	
13.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the invalid DAD NS. The NUT should complete the DAD process and assign the tentative address to its interface.
14.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.
15.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part D: NUT receives invalid DAD NS (Dst = allnode)

Step	Action	Expected Behavior
16.	Initialize all devices on Link A.	
17.	After TN1 receives a DAD NS message from the NUT, configure TN1 to transmit Neighbor Solicitation A with Destination address set to the all-nodes multicast address.	
18.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the invalid DAD NS. The NUT should complete the DAD process and assign the tentative address to its interface.
19.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.
20.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part E: NUT receives invalid DAD NS (ICMP code != zero)

Step	Action	Expected Behavior
21.	Initialize all devices on Link A.	
22.	After TN1 receives a DAD NS message from the NUT, configure TN1 to transmit Neighbor Solicitation A with the ICMP code set to 1.	
23.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the invalid DAD NS. The NUT should complete the DAD process and assign the tentative address to its interface.
24.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.
25.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part F: NUT receives invalid DAD NS (Invalid Checksum)

Step	Action	Expected Behavior
26.	Initialize all devices on Link A.	
27.	After TN1 receives a DAD NS message from the NUT, configure TN1 to transmit Neighbor Solicitation A with an invalid ICMP Checksum.	
28.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the invalid DAD NS. The NUT should complete the DAD process and assign the tentative address to its interface.
29.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.
30.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part G: NUT receives invalid DAD NS (target == multicast address)

Step	Action	Expected Behavior
31.	Initialize all devices on Link A.	
32.	After TN1 receives a DAD NS message from the NUT, configure TN1 to transmit Neighbor Solicitation A with the Target Address set to the solicited multicast of the NUT's tentative link-local address.	
33.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the invalid DAD NS. The NUT should complete the DAD process and assign the tentative address to its interface.
34.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.
35.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part H: NUT receives invalid DAD NS (contains SLL)

Step	Action	Expected Behavior
36.	Initialize all devices on Link A.	
37.	After TN1 receives a DAD NS message from the NUT, configure TN1 to transmit Neighbor Solicitation A containing a SLL Option set to TN1's MAC address.	
38.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the invalid DAD NS. The NUT should complete the DAD process and assign the tentative address to its interface.
39.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.
40.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part I: NUT receives valid DAD NS (Reserved Field)

Step	Action	Expected Behavior
41.	Initialize all devices on Link A.	
42.	After TN1 receives a DAD NS message from the NUT, configure TN1 to transmit Neighbor Solicitation A with the Reserved field set to 0xFFFFFFFF.	
43.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should ignore the contents of the Reserved field. The NUT should not assign the tentative address to its interface.
44.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must NOT transmit a Solicited NA for its autoconfigured link-local address.
45.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must NOT transmit a Solicited NA for its autoconfigured link-local address.

Part J: NUT receives valid DAD NS (contains TLL)

Step	Action	Expected Behavior

46.	Initialize all devices on Link A.	
47.	After TN1 receives a DAD NS message from the NUT, configure TN1 to transmit Neighbor Solicitation A containing a TLL Option set to TN1's MAC address.	
48.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should ignore any options they do not recognize and continue processing the message. The NUT should not assign the tentative address to its interface.
49.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must NOT transmit a Solicited NA for its autoconfigured link-local address.
50.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must NOT transmit a Solicited NA for its autoconfigured link-local address.

Possible Problems: None.

Test v6LC.3.1.4: Validation of DAD Neighbor Advertisements

Purpose: Verify that a node can properly ignore invalid neighbor advertisements while performing Duplicate Address Detection.

Reference:

- [SLAAC] – Sections 5.4.1 and 5.4.5
- [ND] – Section 7.1.2

Test Setup: No Common Test Setup is performed. Default values include DupAddrDetectTransmits=1 and RetransTimer=1 second.

Neighbor Advertisement A
IPv6 Header Next Header: 58 Source Address: NUT'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: NUT's tentative link-local address TLLOPT: TN1's MAC address

Procedure:

Part A: NUT receives invalid DAD NA (ICMP length < 24 octets)

Step	Action	Expected Behavior
1.	Initialize all devices on Link A.	
2.	After TN1 receives a DAD NS message from the NUT, TN1 transmits Neighbor Advertisement A with the ICMP length set to 16.	
3.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the invalid DAD NA. The NUT should complete the DAD process and assign the tentative address to its interface.
4.	Transmit a NS from TN1 to the solicited-node multicast address of	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

	the NUT's link-local address with the Target Address set to the NUT's link-local address.	
5.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part B: NUT receives invalid DAD NA (HopLimit != 255)

Step	Action	Expected Behavior
6.	Initialize all devices on Link A.	
7.	After TN1 receives a DAD NS message from the NUT, TN1 transmits Neighbor Advertisement A with the Hoplimit set to 254.	
8.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the invalid DAD NA. The NUT should complete the DAD process and assign the tentative address to its interface.
9.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.
10.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part C: NUT receives invalid DAD NA (ICMP code != zero)

Step	Action	Expected Behavior
11.	Initialize all devices on Link A.	
12.	After TN1 receives a DAD NS message from the NUT, TN1 transmits Neighbor Advertisement A with the ICMP code set to 1.	
13.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the invalid DAD NA. The NUT should complete the DAD process and assign the tentative address to its interface.
14.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.
15.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part D: NUT receives invalid DAD NA (Invalid Checksum)

Step	Action	Expected Behavior
16.	Initialize all devices on Link A.	
17.	After TN1 receives a DAD NS message from the NUT, TN1 transmits Neighbor Advertisement A with an invalid ICMP Checksum.	
18.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the invalid DAD NA. The NUT should complete the DAD process and assign the tentative address to its interface.
19.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.
20.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part E: NUT receives invalid DAD NA (SolicitedFlag ==1)

Step	Action	Expected Behavior
21.	Initialize all devices on Link A.	
22.	After TN1 receives a DAD NS message from the NUT, TN1 transmits Neighbor Advertisement A with the Solicited flag set to 1.	
23.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the invalid DAD NA. The NUT should complete the DAD process and assign the tentative address to its interface.
24.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.
25.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part F: NUT receives invalid DAD NA (target == multicast address)

Step	Action	Expected Behavior
26.	Initialize all devices on Link A.	

27.	After TN1 receives a DAD NS message from the NUT, TN1 transmits Neighbor Advertisement A with the Target Address set to the solicited multicast of the NUT's tentative link-local address.	
28.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the invalid DAD NA. The NUT should complete the DAD process and assign the tentative address to its interface.
29.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.
30.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part G: NUT receives invalid DAD NA (option length ==zero)

Step	Action	Expected Behavior
31.	Initialize all devices on Link A.	
32.	After TN1 receives a DAD NS message from the NUT, TN1 transmits Neighbor Advertisement A with the TLLOPT Length set to 0.	
33.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the invalid DAD NA. The NUT should complete the DAD process and assign the tentative address to its interface.
34.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.
35.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part H: NUT receives valid DAD NA (Reserved Field)

Step	Action	Expected Behavior
36.	Initialize all devices on Link A.	
37.	After TN1 receives a DAD NS message from the NUT, TN1 transmits Neighbor Advertisement A with the Reserved field set to 0x1FFFFFFF.	

38.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should ignore any options they do not recognize and continue processing the message. The NUT should not assign the tentative address to its interface.
39.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must NOT transmit a Solicited NA for its autoconfigured link-local address.
40.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must NOT transmit a Solicited NA for its autoconfigured link-local address.

Part I: NUT receives valid DAD NA (contains SLL)

Step	Action	Expected Behavior
41.	Initialize all devices on Link A.	
42.	After TN1 receives a DAD NS message from the NUT, TN1 transmits Neighbor Advertisement A containing a SLL Option set to TN1's MAC address.	
43.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should ignore any options they do not recognize and continue processing the message. The NUT should not assign the tentative address to its interface.
44.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must NOT transmit a Solicited NA for its autoconfigured link-local address.
45.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must NOT transmit a Solicited NA for its autoconfigured link-local address.

Possible Problems: None.

Test v6LC.3.1.5: Receiving Neighbor Solicitations for Address Resolution

Purpose: Verify that a node can properly ignore Neighbor Solicitations from a node performing address resolution while performing Duplicate Address Detection.

Reference:
- [SLAAC] – Sections 1, 5.4.3

Test Setup: No Common Test Setup is performed. Default values include DupAddrDetectTransmits=1 and RetransTimer=1 second.

Neighbor Solicitation A
IPv6 Header Next Header: 58 Source Address: TN's Link-local Address Destination Address: Solicited multicast of the NUT's tentative Link-local Address Hop Limit: 255
Neighbor Solicitation Target Address: NUT's tentative link-local address SLLOPT: TN1's MAC address

Procedure:

Part A: NUT receives NS (src == unicast)

Step	Action	Expected Behavior
1.	Initialize all devices on Link A.	
2.	After TN1 receives a DAD NS message from the NUT. Configure TN1 to transmit Neighbor Solicitation A.	
3.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the NS. The NUT should complete the DAD process and assign the tentative address to its interface.
4.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

5.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Part B: NUT receives NS (Src == unicast && Dst == NUT's tentative address)

Step	Action	Expected Behavior
6.	Initialize all devices on Link A.	
7.	After TN1 receives a DAD NS message from the NUT. Configure TN1 to transmit Neighbor Solicitation A with the Destination Address set to the NUT's tentative link-local address.	
8.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should silently ignore the NS. The NUT should complete the DAD process and assign the tentative address to its interface.
9.	Transmit a NS from TN1 to the solicited-node multicast address of the NUT's link-local address with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.
10.	Transmit a NS from TN1 to the link-local address of the NUT with the Target Address set to the NUT's link-local address.	The NUT must transmit a Solicited NA for its autoconfigured link-local address.

Possible Problems: None.

Group 2: Router Advertisement Processing and Address Lifetime

Scope

The following tests cover Router Advertisement processing and address lifetime expiry in IPv6.

Overview

The tests in this group verify conformance creating global addresses, processing Router Advertisements and expiring an address with the IPv6 Stateless Address Autoconfiguration Specification.

Test v6LC.3.2.1: Global Address Autoconfiguration and DAD

Purpose: Verify that a node performs DAD on its autoconfigured unicast address.

Reference:
- [SLAAC] – Sections 5.4
- [IPv6-ARCH] – Section 2, 2.5.7

Test Setup: No Common Test Setup is performed. Default values include DupAddrDetectTransmits=1 and RetransTimer=1 second.

Procedure:

Part A: Unicast Autoconfigured Address – Global

Step	Action	Expected Behavior
1.	Initialize all devices on Link A.	
2.	Configure TR1 to send out ONE Router Advertisement on Link A with Prefix "X" with a valid lifetime set to the length longer than the test. If the NUT is a Router, configure a global address with Prefix "X"..	
3.	Allow time for all devices on Link A to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should perform DAD on its tentative global address for its interface on Link A sending DupAddrDetectTransmits Neighbor Solicitations, every RetransTimer. The NUT should assign the tentative global address to its interface.
4.	Transmit a DAD NS from TN1 to the solicited-node multicast address of the NUT's global address with the Target Address set to the NUT's global address.	The NUT must transmit an NA for its autoconfigured global address.

Part B: Unicast Autoconfigured Address – Prefix ending in zero valued fields

Step	Action	Expected Behavior
5.	Initialize all devices on Link A.	
6.	Configure TR1 to send out ONE Router Advertisement on Link A with Prefix "8000:0000::/64" with a valid lifetime set to 40 seconds. If the NUT is a Router, configure a global address with Prefix "8000:0000::/64".	

7.	Allow time for the NUT to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should perform DAD on its tentative global address for its interface on Link A sending DupAddrDetectTransmits Neighbor Solicitations, every RetransTimer. The NUT should assign the tentative global address to its interface.
8.	Transmit a DAD NS from TN1 to the solicited-node multicast address of the NUT's 8000:0000::/64 address with the Target Address set to the NUT's 8000:0000::/64 address.	The NUT must transmit an NA for its autoconfigured 8000:0000::/64 address.

Part C: Unicast Autoconfigured Address – Site-Local

Step	Action	Expected Behavior
9.	Initialize all devices on Link A.	
10.	Configure TR1 to send out ONE Router Advertisement on Link A with Prefix "FEC0::/64" with a valid lifetime set to 40 seconds. If the NUT is a Router, configure a global address with Prefix "FEC0::/64".	
11.	Allow time for the NUT to perform stateless address autoconfiguration and Duplicate Address Detection.	The NUT should perform DAD on its tentative global address for its interface on Link A sending DupAddrDetectTransmits Neighbor Solicitations, every RetransTimer. The NUT should assign the tentative global address to its interface.
12.	Transmit a DAD NS from TN1 to the solicited-node multicast address of the NUT's FEC0::/64 address with the Target Address set to the NUT's FEC0::/64 address.	The NUT must transmit an NA for its autoconfigured FEC0::/64 address.

Possible Problems: None.

Test v6LC.3.2.2: Address Lifetime Expiry (Hosts Only)

Purpose: Verify that a host can properly handle expired or invalid addresses.

Reference:

- [SLAAC] – Sections 4.1 and 5.5.4

Test Setup: No Common Test Setup is performed.

Procedure:

Step	Action	Expected Behavior
1.	Initialize all devices on Link A.	
2.	TR1 sends out ONE Router Advertisement on Link A with Prefix "X" with a valid lifetime set to 40 seconds.	
3.	Allow time for the HUT to perform stateless address autoconfiguration and Duplicate Address Detection.	The HUT must transmit a DAD NS for its autoconfigured global address.
4.	TR1 transmits a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must transmit a Solicited NA for its autoconfigured global address.
5.	Wait 35 seconds.	
6.	TR1 transmits a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must transmit a Solicited NA for its autoconfigured global address.
7.	Wait 10 seconds.	
8.	TR1 to transmits a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must NOT transmit a Solicited NA for its autoconfigured global address using Prefix "X".

Possible Problems: None.

Test v6LC.3.2.3: Multiple Prefixes and Network Renumbering (Hosts only)

Purpose: To verify that a host configured with multiple prefixes can communicate with another host on a different network when its site has been renumbered.

Reference:

- [SLAAC] – Sections 4.1
- [IPv6-ARCH] – Section 2.1
- [ND] – Section 6.3.4, 6.3.5, 12

Test Setup: Perform Common Test Setup 1.1 with a prefix lifetime that will expire during the duration of the test.

Procedure:

Step	Action	Expected Behavior
1.	Configure TR1 to discontinue sending RA's for Prefix "X".	
2.	TR1 sends a Router Advertisement on Link A with Prefix "Y" with a Valid Lifetime greater than that of Prefix "X".	The HUT should configure a new global address with the new prefix, Prefix "Y".
3.	Configure TR1 to discontinue sending RA's for Prefix "Y".	
4.	Allow time for the HUT to configure a new global address with the new prefix and for Duplicate Address Detection to be performed.	
5.	TR1 transmits a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must transmit a Solicited NA for its autoconfigured global address with Prefix "X".
6.	TR1 transmits a NS message for address resolution with the target address set to the HUT's global address for Prefix "Y".	The HUT must transmit a Solicited NA for its autoconfigured global address with Prefix "Y".
7.	Wait and allow enough time to elapse so that Prefix "X" has timed out and Prefix "Y" has not timed out.	
8.	TR1 transmits a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "X".
9.	TR1 transmits a NS message for address resolution with the target address set to the HUT's global address for Prefix "Y".	The HUT must transmit a Solicited NA for its autoconfigured global address with Prefix "Y".

10.	Wait and allow enough time to elapse so that Prefix "Y" has timed out.	
11.	TR1 transmits a NS message for address resolution with the target address set to the HUT's global address for Prefix "Y".	The HUT must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "Y".

Possible Problems: None.

Test v6LC.3.2.4: Prefix-Information Option Processing (Hosts Only)

Purpose: Verify that a host properly processes the Prefix Information Option in the Router Advertisement.

Reference:
- [SLAAC] – Section 5.5.3
- [ND] – Section 4.6.2

Test Setup: No Common Test Setup is performed. Default values include DupAddrDetectTransmits=1 and RetransTimer=1 second.

Procedure:

Part A: Router Advertisement with multiple Prefix Options

Step	Action	Expected Behavior
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.	The HUT should process the Prefix Information Options and form an address for each prefix.
2.	TR1 transmits a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must transmit a Solicited NA for its autoconfigured global address with Prefix "X".
3.	TR1 to transmit a NS message for address resolution with the target address set to the HUT's global address for Prefix "Y".	The HUT must transmit a Solicited NA for its autoconfigured global address with Prefix "Y".
4.	Wait for 21s so the lifetime expires for Prefix "X".	
5.	TR1 transmits a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "X".
6.	Wait for 20s so the lifetime expires for Prefix "Y".	
7.	TR1 to transmit a NS message for address resolution with the target address set to the HUT's global address for Prefix "Y".	The HUT must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "Y".

Part B: Autonomous Flag not set

Step	Action	Expected Behavior

8.	TR1 transmits a Router Advertisement A with the Autonomous flag not set.	The HUT should silently ignore the Prefix Information Option and not form an address using Prefix "X".
9.	TR1 to transmit a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "X".

Part C: prefix is set to link-local prefix

Step	Action	Expected Behavior
10.	TR1 transmits Router Advertisement A with the prefix set the link-local prefix.	The HUT should silently ignore the Prefix Information Option and not form an address using Prefix "X".
11.	TR1 to transmit a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "X".

Part D: preferred lifetime > valid lifetime

Step	Action	Expected Behavior
12.	TR1 transmits Router Advertisement A with the preferred lifetime set to 30 seconds.	The HUT should silently ignore the Prefix Information Option and not form an address using Prefix "X".
13.	TR1 to transmit a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "X".

Part E: prefix length > 128 bits

Step	Action	Expected Behavior
14.	The HUT must have an interface identifier of length greater than zero. TR1 transmits Router Advertisement A with a Prefix Length set to 128.	The HUT should silently ignore the Prefix Information Option and not form an address using Prefix "X".
15.	TR1 to transmit a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "X".

Part F: prefix length < 64 bits

Step	Action	Expected Behavior
16.	The HUT must have an interface identifier of length greater than zero. TR1 transmits Router Advertisement A with a Prefix Length set to zero.	The HUT should silently ignore the Prefix Information Option and not form an address using Prefix "X".

17.	TR1 to transmit a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "X".

Part G: (64 bits < prefix length < 128 bits)

Step	Action	Expected Behavior
18.	The HUT must have an interface identifier of length greater than zero. TR1 transmits Router Advertisement A with a Prefix Length set to 120.	The HUT should silently ignore the Prefix Information Option and not form an address using Prefix "X".
19.	TR1 to transmit a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "X".

Part H: Valid Lifetime is zero

Step	Action	Expected Behavior
20.	TR1 transmits Router Advertisement A with the Valid Lifetime set to zero.	The HUT should silently ignore the Prefix Information Option and not form an address using Prefix "X".
21.	TR1 to transmit a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "X".

Part I: Invalid RA with Hop Limit 254

Step	Action	Expected Behavior
22.	TR1 transmits Router Advertisement A with a Hop Limit set to 254.	The HUT should silently ignore the Prefix Information Option and not form an address using Prefix "X".
23.	TR1 to transmit a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "X".

Part J: Valid Lifetime is 0xffffffff

Step	Action	Expected Behavior
24.	TR1 transmits Router Advertisement A with the Valid Lifetime set to 0xffffffff.	
25.	TR1 to transmit a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT should process the Prefix Information Options and form an address for Prefix "X". The HUT must transmit a Solicited NA for its autoconfigured global address with Prefix "X".

Possible Problems: None.

Test v6LC.3.2.5: Prefix-Information Option Processing, Lifetime (Hosts Only)

Purpose: Verify that a host properly processes the Prefix Information Option in the Router Advertisement.

Reference:

- [SLAAC] – Section 5.5.3

Test Setup: No Common Test Setup is performed. Initialize the HUT before 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

Step	Action	Expected Behavior
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.	TR1 transmits a NS message for address resolution with the target	The HUT must update its Remaining Lifetime and must not timeout Prefix "X' after 30 seconds. The HUT must transmit a

	address set to the HUT's global address for Prefix "X".	Solicited NA for its autoconfigured global address with Prefix "X".

Part B: Prefix Lifetime greater than 2 hours

Step	Action	Expected Behavior
6.	TR1 transmits Router Advertisement A with a Valid Lifetime of 3hrs.	
7.	TR1 transmits a Router Advertisement with a prefix of TR1's Global Prefix and a Valid Lifetime of 2hrs 30s.	
8.	Wait 2hrs 45 seconds.	
9.	TR1 transmits a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "X".

Part C: Prefix Lifetime less than the Remaining Lifetime and the Remaining Lifetime is less than 2 hours

Step	Action	Expected Behavior
10.	TR1 transmits Router Advertisement A with a Valid Lifetime of 60 seconds.	
11.	TR1 transmits a Router Advertisement with a prefix of TR1's Global Prefix and a Valid Lifetime of 30 seconds.	
12.	Wait 35 seconds.	
13.	TR1 transmits a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must transmit a Solicited NA for its autoconfigured global address with Prefix "X".

Part D: Prefix Lifetime less than 2 hours and the Remaining Lifetime is greater than 2 hours

Step	Action	Expected Behavior
14.	TR1 transmits Router Advertisement A with a Valid Lifetime of 2hrs 30s.	
15.	TR1 transmits a Router Advertisement with a prefix of TR1's Global Prefix and a Valid Lifetime of 10 seconds.	
16.	Wait 11 seconds.	
17.	TR1 transmits a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The HUT must transmit a Solicited NA for its autoconfigured global address with Prefix "X".

18.	Wait 2hrs 15 second.	
19.	TR1 transmits a NS message for address resolution with the target address set to the HUT's global address for Prefix "X".	The Remaining Lifetime should time out the global Prefix "X". The HUT must NOT transmit a Solicited NA for its autoconfigured global address with Prefix "X".

Possible Problems: None.

Test v6LC.3.2.6: Stable addresses (Host Only)

Purpose: Verify that the HUT keeps the network interface constant across system network events.

Reference:

- [STABLE-ID] – Section 5

Test Setup: No Common Test Setup is performed. Initialize the HUT before each part.

Router Advertisement A	Router Advertisement B
IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address Destination Address: All-nodes Multicast Address	IPv6 Header Next Header: 58 Source Address: TR1's Link-local Address Destination Address: All-nodes Multicast Address
Router Advertisement Router Lifetime: 9000 seconds Reachable Time: 30 seconds Retransmit Interval: 1 second	Router Advertisement Router Lifetime 9000 seconds Reachable Time: 30 seconds Retransmit Interval: 1 second
Prefix Information Option Prefix Length: 64 L Bit: 1 (on-link) A Bit: 1 (autonomous) Prefix: Global Prefix "X"	Prefix Information Option Prefix Length: 64 L Bit: 1 (on-link) A Bit: 1 (autonomous) Prefix: Global Prefix "Y"

Procedure:

Part A: Link-Local vs. Global (Host Only)

Step	Action	Expected Behavior
1.	Initialize the interface on the HUT.	
2.	Allow time for the HUT to perform stateless address autoconfiguration and DAD.	The HUT should perform DAD on its tentative address for its interface by sending DAD Neighbor Solicitations. The HUT should assign the tentative address to its interface. Interface IDs are required to be 64 bits long and use the algorithm from RFC 7217.
3.	TR1 transmits a Router Advertisement A on Link A.	
4.	Allow time for the DUT to perform stateless address autoconfiguration and DAD.	The HUT should perform DAD on its tentative global address for its interface on Link A. Interface IDs are required to be 64 bits long and use the algorithm from RFC

		7217. The Interface ID should be different then the id used in Step 2.

Part B: Bootstrapping Event

Step	Action	Expected Behavior
5.	Initialize the interface on the HUT.	
6.	Allow time for the HUT to perform stateless address autoconfiguration and DAD.	The HUT should perform DAD on the tentative address for its interface by sending DAD Neighbor Solicitations. The HUT should assign the tentative address to its interface. Interface IDs are required to be 64 bits long and use the algorithm from RFC 7217.
7.	TR1 transmits a Router Advertisement A on Link A.	
8.	Allow time for the DUT to perform stateless address autoconfiguration and DAD.	The HUT should perform DAD on the tentative global address for its interface on Link A. Interface IDs are required to be 64 bits long and use the algorithm from RFC 7217.
9.	Re-initialize the interface on the HUT.	
10.	Allow time for the DUT to perform stateless address autoconfiguration and DAD.	The HUT should perform DAD on the tentative link-local address for its interface by sending DAD Neighbor Solicitations for the same address used in Step 6.
11.	TR1 transmits a Router Advertisement B on Link A.	
12.	Allow time for the DUT to perform stateless address autoconfiguration and DAD.	The HUT should perform DAD on the tentative global address for its interface by sending DAD Neighbor Solicitations for a different global address than the one used in step 8.
13.	Re-initialize the interface on the HUT.	
14.	Allow time for the DUT to perform stateless address autoconfiguration and DAD.	The HUT should perform DAD on the tentative link-local address for its interface by sending DAD Neighbor Solicitations for the same address used in step 6.
15.	TR1 transmits a Router Advertisement A on Link A.	
16.	Allow time for the DUT to perform stateless address autoconfiguration and DAD.	The HUT should perform DAD on the tentative global address for its interface by sending DAD Neighbor Solicitations for the same global address used in step 8.

Possible Problems: None.

Test v6LC.3.2.7: Resolving DAD Conflicts (Host Only)

Purpose: Verify that the HUT properly resolves DAD conflicts by regenerating interface IDs when its tentative addresses are not unique.

Reference:

- [STABLE-ID] – Section 6

Test Setup: The devices are setup according to Common Test Setup.

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: 9000 seconds Reachable Time: 30 seconds Retransmit Interval: 1 second
Prefix Option L bit: 1 (on-link) A bit: 1 (autonomous) Prefix: Global Prefix "X"

Procedure:

Part A: Link-Local

Step	Action	Expected Behavior
1.	Initialize the interface on the HUT.	
2.	Allow time for the HUT to perform stateless address autoconfiguration and DAD.	The HUT should perform DAD on its tentative address for its interface by sending DAD Neighbor Solicitations. The HUT should assign the tentative address to its interface. Interface IDs are required to be 64 bits long and use the algorithm from RFC 7217.
3.	After TN1 receives a DAD NS message from the NUT. TN1 transmits DAD Neighbor Advertisement with the Target Address set to the NUT's tentative link-local address.	

4.	Wait IDGEN_DELAY (1 second)	The HUT should transmit a DAD NS message with an in the Target Address set to a different tentative link-local address then in Step 2.

Part B: Global

Step	Action	Expected Behavior
5.	Initialize the interface on the HUT.	
6.	Allow time for the HUT to perform stateless address autoconfiguration and DAD.	The HUT should perform DAD on its tentative address for its interface by sending DAD Neighbor Solicitations. The HUT should assign the tentative address to its interface. Interface IDs are required to be 64 bits long and use the algorithm from RFC 7217.
7.	TR1 transmits a Router Advertisement A on Link A.	
8.	Allow time for the DUT to perform stateless address autoconfiguration and DAD.	The HUT should perform DAD on its tentative global address for its interface on Link A. Interface IDs are required to be 64 bits long and use the algorithm from RFC 7217. The Interface ID should be different than the id used in Step 2.
9.	After TN1 receives a DAD NS message from the NUT. TN1 transmits DAD Neighbor Advertisement with the Target Address set to the NUT's tentative global address.	
10.	Wait IDGEN_DELAY (1 second)	The HUT should transmit a DAD NS message with a in the Target Address set to a different tentative global address than in Step 2.

Possible Problems: None.

Section 4: RFC 8201

Scope

The following tests cover the Path MTU Discovery for IP version 6, Request For Comments 8201. 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 is 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.

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: 1400 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

*Note, if the media type is not Ethernet (MTU is not 1500), the payload in the Echo Request Packet should be adjusted so that it fits the default MTU.

Test v6LC.4.1.1: Confirm Ping

Purpose: Verify that a node can reply to variable sized ICMP Echo Requests.

Reference:

- [ICMPv6] – Section 4.2
- [IPv6-SPEC] – Section 5

Test Setup: Common 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: ICMPv6 Echo Request 64 octets

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request from TN2 to the NUT. The packet size of the Echo Request is 64 octets.	The NUT sent an Echo Reply to TR1 64 octets in packet size.

Part B: ICMPv6 Echo Request 1280 octets

Step	Action	Expected Behavior
2.	TR1 forwards an Echo Request from TN2 to the NUT. The packet size of the Echo Request is 1280 octets.	The NUT sent an Echo Reply to TR1 1280 octets in packet size.

Part C: ICMPv6 Echo Request 1500 octets

Step	Action	Expected Behavior
3.	TR1 forwards an Echo Request from TN2 to the NUT. The packet size of the Echo Request is 1500 octets. (If the associated media type MTU default value is less than this, use that value instead.)	The NUT should send an Echo Reply to TR1 1500 octets in packet size. (If the Echo Request was sent with a different size due to the associated media type default MTU value, than the Echo Reply sent should equal that size.)

Possible Problems: None.

Test v6LC.4.1.2: Stored PMTU

Purpose: Verify that a node can store Path MTU information for multiple destinations.

Reference:

- [PMTU] – Section 5.2

Test Setup: Common Setup 1.1 is performed at the beginning of each test part. The Common Test Cleanup procedure is performed after each part.

Procedure:

Step	Action	Expected Behavior
1.	TN1 sends an Echo Request on-link to the NUT with packet size equal to 1500 octets.	The NUT should transmit an Echo Reply to TN1.
2.	TR1 forwards an Echo Request from TN2 to the NUT with packet size equal to 1500 octets.	The NUT should transmit an Echo Reply to TN2.
3.	TR1 forwards an Echo Request from TN3 to the NUT with packet size equal to 1500 octets.	The NUT should transmit an Echo Reply to TN3.
4.	TR1 transmits a Packet Too Big message to the NUT for the Echo Reply to TN2, which contains an MTU field with a value of 1400.	
5.	TN1 sends an Echo Request on-link to the NUT with packet size equal to 1500 octets.	The NUT should transmit an Echo Reply to TN1 with a packet no larger than 1500 octets. The NUT does not have to fragment these packets.
6.	TR1 forwards an Echo Request from TN2 to the NUT with packet size equal to 1500 octets.	The NUT should correctly fragment its Echo Reply to TN2 with each fragment no larger than 1400 octets. These fragments may be smaller.
7.	TR1 forwards an Echo Request from TN3 to the NUT with packet size equal to 1500 octets.	The NUT should transmit an Echo Reply to TN3 with a packet no larger than 1500 octets. The NUT does not have to fragment these packets.
8.	TR1 transmits a Packet Too Big message to the NUT for the Echo Reply to TN3, which contains an MTU field with a value of 1280.	
9.	TN1 sends an Echo Request on-link to the NUT with packet size equal to 1500 octets.	The NUT should transmit an Echo Reply to TN1 with a packet no larger than 1500 octets. The NUT does not have to fragment these packets.

10.	TR1 forwards an Echo Request from TN2 to the NUT with packet size equal to 1500 octets.	The NUT should correctly fragment its Echo Reply to TN2 with each fragment no larger than 1400 octets. These fragments may be smaller.
11.	TR1 forwards an Echo Request from TN3 to the NUT with packet size equal to 1500 octets.	The NUT should correctly fragment its Echo Reply to TN3 with each fragment no larger than 1280 octets. These fragments may be smaller.

Possible Problems: None.

Test v6LC.4.1.3: Non-zero ICMPv6 Code

Purpose: Verify that a node properly processes a Packet Too Big message with a non-zero ICMPv6 Code field.

Reference:
- [PMTU]
- [ICMPv6] – Section 3.2

Test Setup: Common Setup 1.1 is performed at the beginning of each test part. The Common Test Cleanup procedure is performed after each part. TR1's link MTU on its interface to Link B (to TN2) is configured to be 1280 octets. This link MTU is smaller than the link MTU on its interface to Link A.

Procedure:

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request from TN2 to the NUT.	The NUT should respond to the Echo Request using TR1 as a first hop.
2.	TR1 transmits a Packet Too Big message to the NUT, which contains an invalid ICMPv6 Code field value of 0xFF. The MTU field is set to 1280.	
3.	TR1 forwards an Echo Request from TN2 to the NUT.	The NUT should correctly fragment its response to the Echo Request using TR1 as a first hop, indicating the NUT ignored the invalid ICMPv6 Code field and processed the Packet Too Big message. The fragmented packets must not be larger than 1280 octets in size.

Possible Problems: None.

Test v6LC.4.1.4: Reduce PMTU On-link

Purpose: Verify that a node properly processes a Packet Too Big message indicating a reduction in Path MTU for an on-link destination.

Reference:

- [PMTU] – Section 3, 5.1

Test Setup: Common 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: Link-Local

Step	Action	Expected Behavior
1.	TR1 transmits a 1500 byte link-local Echo Request to the NUT.	The NUT should respond to the Echo Request.
2.	TR1 transmits a Packet Too Big message to the NUT with an MTU of 1280.	
3.	TR1 transmits a 1500 byte link-local fragmented Echo Request to the NUT. The fragmented packets are no larger than 1280 octets in size.	The NUT should 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: Global

Step	Action	Expected Behavior
4.	TR1 transmits a 1500 byte on-link global Echo Request to the NUT.	The NUT should respond to the Echo Request.
5.	TR1 transmits a Packet Too Big message to the NUT with an MTU of 1280.	
6.	TR1 transmits a 1500 byte on-link global fragmented Echo Request to the NUT. The fragmented packets are no larger than 1280 octets in size.	The NUT should 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 v6LC.4.1.5: Reduce PMTU Off-link

Purpose: Verify that a node properly reduces its estimate of the MTU for a path due to a Packet Too big message indicating a reduction in the Path MTU for a global destination.

Reference:

- [PMTU] – Sections 4, 5.1

Test Setup: Common Setup 1.1 is performed at the beginning of each test part. The Common Test Cleanup procedure is performed after each part. TR1's link MTU on its interface to Link B (to TN2) is configured to be 1280 octets. This link MTU is smaller than the link MTU on its interface to Link A.

Procedure:

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request from TN2 to the NUT.	The NUT should respond to the Request using TR1 as the first hop.
2.	TR1 transmits a Packet Too Big message to the NUT with an MTU field set to 1400 octets.	
3.	TR1 forwards an Echo Request from TN2 to the NUT with a packet size of 1500 octets.	The NUT should correctly fragment its response to the Echo Request using TR1 as a first hop, indicating the NUT processed the Packet Too Big message. The fragmented packets must not be larger than 1400 octets in size.
4.	TR1 transmits another Packet Too Big message containing an MTU field set to 1280 octets.	
5.	TR1 forwards an Echo Request from TN2 to the NUT with a packet size of 1500 octets.	The NUT should correctly fragment its response to the Echo Request using TR1 as a first hop, 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 v6LC.4.1.6: Packet Too Big Less than IPv6 MTU

Purpose: Verify that the DUT does not process a Packet Too Big with an MTU less than 1280.

Reference:
- [PMTU] – Section 4

Test Setup: Common 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: MTU equal to 56

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request from TN2 to the NUT. The packet size is 1400 octets.	The NUT should respond to the Echo Request using TR1 as a first hop.
2.	TR1 transmits a Packet Too Big message to the NUT, which contains an MTU field of 56 octets.	
3.	TR1 forwards an Echo Request from TN2 to the NUT. The packet size is 1400 octets.	The NUT should respond to the Echo Request. The NUT must neither reduce the size of packets to below the IPv6 minimum link MTU nor include a Fragment Header in the Echo Reply.

Part B: MTU equal to 1279

Step	Action	Expected Behavior
4.	TR1 forwards an Echo Request from TN2 to the NUT. The packet size is 1500 octets.	The NUT should respond to the Echo Request using TR1 as a first hop.
5.	TR1 transmits a Packet Too Big message to the NUT, which contains an MTU field of 1279 octets.	
6.	TR1 forwards an Echo Request from TN2 to the NUT. The packet size is 1400 octets.	The NUT should respond to the Echo Request. The NUT must neither reduce the size of packets to below the IPv6 minimum link MTU nor include a Fragment Header in the Echo Reply.

Possible Problems: None.

Test v6LC.4.1.7: Increase Estimate

Purpose: Verify that a node does not increase its estimate of the MTU for a path due to a Packet Too Big message.

Reference:

- [PMTU] – Section 4

Test Setup: Common 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: MTU increase

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request from TN2 to the NUT with a packet size equal to 1500 octets.	The NUT should respond to the Echo Request using TR1 as a first hop.
2.	TR1 transmits a Packet Too Big message to the NUT. The MTU field is 1304 octets.	
3.	TR1 forwards an Echo Request from TN2 to the NUT with packet size equal to 1500 octets.	The NUT should fragment the response to the Echo Request using TR1 as a first hop, indicating the NUT processed the Packet Too Big message.
4.	TR1 transmits a Packet Too Big message to the NUT. The MTU field is 1500 octets	
5.	TR1 forwards an Echo Request from TN2 to the NUT. The packet size is 1500 octets.	The NUT must correctly fragment the response to the Echo Request using TR1 as a first hop so the packet size is equal to or under 1304 octets. The NUT should not process the second Packet Too Big message indicating an increase in the PMTU.

Part B: MTU equal to 0x1FFFFFFF

Step	Action	Expected Behavior
6.	TR1 forwards an Echo Request from TN2 to the NUT with packet size equal to 1500 octets.	The NUT should respond to the Echo Request using TR1 as a first hop.
7.	TR1 transmits a Packet Too Big message to the NUT. The MTU field is 1304 octets.	
8.	TR1 forwards an Echo Request from TN2 to the NUT with packet size equal to 1500 octets.	The NUT should fragment the response to the Echo Request using TR1 as a first hop, indicating the NUT processed the Packet Too Big message.

9.	TR1 transmits a Packet Too Big message to the NUT. The MTU field of 0x1FFFFFFF.	
10.	TR1 forwards an Echo Request from TN2 to the NUT. The packet size is 1500 octets.	The NUT must correctly fragment the response to the Echo Request using TR1 as a first hop so the packet size is equal to or under 1304 octets. The NUT should not process the second Packet Too Big message indicating an increase in the PMTU.

Possible Problems: None.

Test v6LC.4.1.8: Router Advertisement with MTU Option (Hosts Only)

Purpose: Verify that a node does not increase its estimate of the MTU for a path due to a Packet Too Big message.

Reference:
- [PMTU] – Section 2
- [ND] – Sections 4.2 and 6.3.4

Test Setup: Common Setup 1.1 is performed at the beginning of each test part. The Common Test Cleanup procedure is performed after each part.

Procedure:

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request from TN3 with an off-link source address to the HUT with packet size equal to 1500 octets.	The HUT should reply to the Request. The HUT does not have to fragment the reply.
2.	TR1 transmits a Router Advertisement with an MTU option set to 1280 to the all-nodes multicast address.	
3.	TR1 forwards a fragmented Echo Request from TN2 to the HUT with reassembled packet size equal to 1500 octets.	The HUT should update its Link MTU for TR1 to 1280 octets. The HUT should correctly fragment the response to the Echo Request, indicating the HUT 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: None.

Test v6LC.4.1.9: Checking or Increase in PMTU

Purpose: Verify that a node waits the proper amount of time to check for PMTU increases.

Reference:
- [PMTU] – Section 4

Test Setup: Common Setup 1.1 is performed at the beginning of each test part. The Common Test Cleanup procedure is performed after each part.

Procedure:

Step	Action	Expected Behavior
1.	TR1 forwards a 1500 octet Echo Request from TN2 to the NUT.	The NUT should respond to the Echo Request.
2.	TR1 transmits a Packet Too Big message to the NUT. The MTU field is 1304 octets.	
3.	TR1 forwards a 1500 octet Echo Request from TN2 to the NUT.	The NUT should 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 1304 octets in size.
4.	TR1 forwards a 1500 octet Echo Request from TN2 every 30 seconds for 5 minutes after the Packet Too Big Message was sent.	The NUT must not transmit any packets larger than 1304 octets for 5 minutes from the time it received the Packet Too Big Message from TR1 in step 2.

Possible Problems: None.

Test v6LC.4.1.10: Multicast Destination – One Router

Purpose: Verify that a node properly chooses the PMTU for multicast destinations.

Advanced Functionality:

- Configuring Multicast Packet Size
- Transmitting Echo Requests (Passive Node)

Reference:

- [IPv6-ARCH] – Section 2.7
- [PMTU] – Section 3

Test Setup: The Common Test Cleanup procedure is performed after each part.

1. TR1's Link MTU on its interface to TN1 is configured to be 1300 octets.
2. TR1's Link MTU on its interface to TN2 is configured to be 1400 octets.
3. TR1's Link MTU on its interface to TN3 is configured to be 1450 octets.
4. All other Link MTU's are set to the default for the associated media type.
5. TN1, TN2, and TN3 are all Listeners for the multicast group FF1E::1:2.

If the NUT is a Host TR1 transmits a Router Advertisement with MTU set to 1500 on the network with the NUT

Procedure:

Step	Action	Expected Behavior
1.	Transmit an ICMPv6 Echo Request from the NUT with packet size equal to 1500 octets and a destination to the multicast address of FF1E::1:2.	
2.	TR1 transmits a Packet Too Big Message to the NUT including an MTU field of 1450.	
3.	Transmit an ICMPv6 Echo Request from the NUT with packet size equal to 1500 octets and a destination to the multicast address of FF1E::1:2.	The NUT should correctly fragment its Echo Request to the multicast address of FF1E::1:2, indicating it processed the Packet Too Big Messages from TR1. The fragmented packets must not be larger than 1450 octets in size.
4.	TR1 transmits a Packet Too Big Message to the NUT including an MTU field of 1400.	
5.	Transmit an ICMPv6 Echo Request from the NUT with packet size equal to 1500 octets and a destination to the multicast address of FF1E::1:2.	The NUT should correctly fragment its Echo Request to the multicast address of FF1E::1:2, indicating it processed the Packet Too Big Messages from TR1. The

		fragmented packets must not be larger than 1400 octets in size.
6.	Transmit an ICMPv6 Echo Request from the NUT with packet size equal to 1400 octets and a destination to the multicast address of FF1E::1:2.	
7.	TR1 transmits a Packet Too Big Message to the NUT including an MTU field of 1300.	
8.	Transmit an ICMPv6 Echo Request from the NUT with packet size equal to 1400 octets and a destination to the multicast address of FF1E::1:2.	The NUT should correctly fragment its Echo Request to the multicast address of FF1E::1:2, indicating it processed the Packet Too Big Messages from TR1. The fragmented packets must not be larger than 1300 octets in size.
9.	TR1 transmits a Packet Too Big Message to the NUT including an MTU field of 1350.	
10.	Transmit an ICMPv6 Echo Request from the NUT with packet size equal to 1400 octets and a destination to the multicast address of FF1E::1:2.	The NUT should correctly fragment its Echo Request to the multicast address of FF1E::1:2, indicating it processed the Packet Too Big Messages from TR1. The fragmented packets must not be larger than 1300 octets in size.

Possible Problems:

- This test may be omitted if the NUT does not support transmitting multicast pings bigger than 1280.
- This test may be omitted if the NUT is using 1280 bytes as its constant MTU size. It is not expected to transmit packets larger than 1280 bytes.

Test v6LC.4.1.11: Multicast Destination – Two Router

Purpose: Verify that a node properly chooses the PMTU for multicast destinations when receiving PTB messages from more than one router.

Advanced Functionality:

- Configuring Multicast Packet Size
- Transmitting Echo Requests (Passive Node)

Reference:

- [IPv6-ARCH] – Section 2.7
- [PMTU] – Section 3

Test Setup: The Common Test Cleanup procedure is performed after each part.

1. All Link MTU's are set to the default for the associated media type.
2. TN1, TN2, and TN3 are all Listeners for the multicast group FF1E::1:2.
3. If the NUT is a Host TR1 transmits a Router Advertisement with MTU set to 1500 on Link A.

Procedure:

Step	Action	Expected Behavior
1.	Transmit an ICMPv6 Echo Request from the NUT with packet size equal to 1500 octets and a destination to the multicast address of FF1E::1:2.	
2.	TR1 transmits a Packet Too Big Message to the NUT including an MTU field of 1480.	
3.	Transmit an ICMPv6 Echo Request from the NUT with packet size equal to 1500 octets and a destination to the multicast address of FF1E::1:2.	The NUT should correctly fragment its Echo Request to the multicast address of FF1E::1:2, indicating it processed the Packet Too Big Messages from TR1. The fragmented packets must not be larger than 1480 octets in size.
4.	TR1 transmits a Packet Too Big Message to the NUT including an MTU field of 1440.	
5.	Transmit an ICMPv6 Echo Request from the NUT with packet size equal to 1500 octets and a destination to the multicast address of FF1E::1:2.	The NUT should correctly fragment its Echo Request to the multicast address of FF1E::1:2, indicating it processed the Packet Too Big Messages from TR1. The fragmented packets must not be larger than 1440 octets in size.

6.	TR1 transmits a Packet Too Big Message to the NUT including an MTU field of 1400.	
7.	TR2 transmits a Packet Too Big Message to the NUT including an MTU field of 1360.	
8.	Transmit an ICMPv6 Echo Request from the NUT with packet size equal to 1500 octets and a destination to the multicast address of FF1E::1:2.	The NUT should correctly fragment its Echo Request to the multicast address of FF1E::1:2, indicating it processed the Packet Too Big Messages from TR1 and TR2. The fragmented packets must not be larger than 1360 octets in size.
9.	TR1 transmits a Packet Too Big Message to the NUT including an MTU field of 1280.	
10.	TR2 transmits a Packet Too Big Message to the NUT including an MTU field of 1320.	
11.	Transmit an ICMPv6 Echo Request from the NUT with packet size equal to 1500 octets and a destination to the multicast address of FF1E::1:2.	The NUT should correctly fragment its Echo Request to the multicast address of FF1E::1:2, indicating it processed the Packet Too Big Messages from TR1 and TR2. The fragmented packets must not be larger than 1280 octets in size.

Possible Problems:

- This test may be omitted if the NUT does not support transmitting multicast pings bigger than 1280.
- This test may be omitted if the NUT is using 1280 bytes as its constant MTU size. It is not expected to transmit packets larger than 1280 bytes.

Test v6LC.4.1.12: Validate Packet Too Big

Purpose: Verify that the DUT validates the payload of ICMPv6 PTB Messages to ensure they are properly received.

Advanced Functionality:

- Tracking Connections for ICMPv6

Reference:

- [PMTU] – Section 4

Test Setup: The devices are setup according to Common Test Setup.

Procedure:

Step	Action	Expected Behavior
1.	TR1 forwards an Echo Request from TN2 to the NUT. The packet size is 1500 octets.	The NUT should respond without fragmenting the packet to the Echo Request using TR1 as a first hop.
2.	TR1 transmits a Packet Too Big message to the NUT with an ICMPv6 Identifier does not match the Echo Reply in Step 1.	
3.	TR1 forwards an Echo Request from TN2 to the NUT. The packet size is 1500 octets.	The NUT should respond without fragmenting the packet to the Echo Request using TR1 as a first hop.

Possible Problems: None.

Section 5: RFC 4443

Scope

The following tests cover the Internet Control Message Protocol for IP version 6, Request For Comments 4443.

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: 1400 bytes Next Header: 58
ICMPv6 Header Type: 128 Code: 0

<table>
<tr><th>Packet Too Big message</th><th>Redirect message</th></tr>
<tr><td>IPv6 Header
Next Header: 58
Source Address: TR1’s Link Local Address
Destination Address: NUT’s Link Local Address</td><td>IPv6 Header
Next Header: 58
Source Address: TR1’s Link Local Address
Destination Address: NUT’s Link Local Address</td></tr>
<tr><td>ICMPv6 Header
Type: 2
Code: 0
MTU: 1280</td><td>ICMPv6 Header
Type: 137
Code: 0</td></tr>
<tr><td>Invoking Packet</td><td>Invoking Packet</td></tr>
</table>

*Note, if the media type is not Ethernet (MTU is not 1500), the payload in the Echo Request Packet should be adjusted so that it fits the default MTU.

Test v6LC.5.1.1: Transmitting Echo Requests

Purpose: Verify that a node properly transmits ICMPv6 Echo Requests.

Advanced Functionality:

- Transmitting Echo Requests (Passive Node)

Reference:

- [ICMPv6] – Section 2.2, 4.1

Test Setup: Common Setup 1.1 is performed at the beginning of each test part. The Common Test Cleanup procedure is performed after each part.

Procedure:

Step	Action	Expected Behavior
1.	Use Ping (or any available application for sending Echo Requests) to send an Echo Request from the NUT to TN1's Link-Local address.	The NUT must send an Echo Request to TN1. The Destination Address of the Packet must be the same as TN1's Link-Local Address. The checksum must be valid. The Type field must be equal to 128 and the Code field must be equal to 0.

Possible Problems: None.

Test v6LC.5.1.2: Replying to Echo Request

Purpose: Verify that a node properly transmits ICMPv6 Echo Requests.

Reference:

- [ICMPv6] – Section 2.2, 4.2
- [IPv6-ARCH] – Section 2.1, 2.5.2, 2.7, 2.7.1 ,2.8

Test Setup: Common 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: Request sent to Link-Local address

Step	Action	Expected Behavior
1.	TN1 transmits an ICMPv6 Echo Request to the NUT's Link-Local address. The source address is TN1's Link-Local address.	The NUT must send an Echo Reply to TN1. The Source Address of the Packet must be same as the Link-Local Destination Address of TN1's Echo Request packet, while the Destination Address must be the same as the Link-Local Source Address of TN1's Echo Request packet. The NUT must send an Echo Reply to TN1 with a valid checksum.

Part B: Request sent to global address

Step	Action	Expected Behavior
2.	TN1 transmits an ICMPv6 Echo Request to the NUT's Global address. The source address is TN1's Global address.	The NUT must send an Echo Reply to TN1. The Source Address of the Packet must be same as the Global Destination Address of TN1's Echo Request packet, while the Destination Address must be the same as the Global Source Address of TN1's Echo Request packet. The NUT must send an Echo Reply to TN1 with a valid checksum.

Part C: Request sent to multicast address – All-Nodes Address

Step	Action	Expected Behavior
3.	TN1 transmits an ICMPv6 Echo Request to the All-Nodes Link-Local Scope Multicast address (FF02::1). The source address is TN1's Link-Local address.	The NUT should send an Echo Reply to TN1. The Source Address of the Packet must be one of the NUT's unicast addresses belonging to the interface on which the Echo Request was received. This could be either a Link-Local or Global address. The Destination Address must be TN1's local address Echo Request packet. The NUT

		must send an Echo Reply to TN1 with a valid checksum.

Part D: Request sent to multicast address – All-Routers Address (Routers Only)

Step	Action	Expected Behavior
4.	TN1 transmits an ICMPv6 Echo Request to the All-Routers address (FF02::2). The source address is TN1's Link-Local address.	The NUT should send an Echo Reply to TN1. The Source Address of the Packet must be one of the NUT's unicast addresses belonging to the interface on which the Echo Request was received. This could be either a Link-Local or Global address. The Destination Address must be TN1's local address Echo Request packet. The NUT must send an Echo Reply to TN1 with a valid checksum.

Part E: Request sent to unspecified address

Step	Action	Expected Behavior
5.	TN1 transmits an ICMPv6 Echo Request to the Unspecified address (0:0:0:0:0:0:0:0). The source address is TN1's Link-Local address.	The NUT must not send an Echo Reply in response to the Echo Request from TN1.

Part F: Request sent to Loopback address

Step	Action	Expected Behavior
6.	TN1 transmits an ICMPv6 Echo Request to the Loopback address (0:0:0:0:0:0:0:1). The source address is TN1's Link-Local address.	The NUT must not send an Echo Reply in response to the Echo Request from TN1.

Part G: Request sent to Site-Local address

Step	Action	Expected Behavior
7.	TR1 transmits a Router Advertisement with a site-local prefix FEC0::/64. If the NUT is a router, configure the RUT to transmit Router Advertisement with a site-local prefix FEC0::/64 and configure a site-local address on its interface.	
8.	TN1 transmits an ICMPv6 Echo Request to the site-local address. The source address is TN1's Link-Local address.	The NUT must send an Echo Reply to TN1. The Source Address of the Packet must be same as the Site-Local Address of TN1's Echo Request packet, while the Destination Address must be the same as the Link Local Address of TN1's Echo Request packet. The NUT must send an Echo Reply to TN1 with a valid checksum.

Possible Problems: None.

Test v6LC.5.1.3: Destination Unreachable Message Generation

Purpose: Verify that a node properly generates Destination Unreachable Messages.

Advanced Functionality:
- Beyond Scope of Source Address

Reference:
- [ICMPv6] – Section 2.2, 3.1, 2.4
- [IPv6-ARCH] – Section 2, 2.5.6

Test Setup: Common Setup 1.1 is performed at the beginning of each test part. The Common Test Cleanup procedure is performed after each part.

1. The Payload Length of the ICMP Request Default Packets is 64 bytes.

Procedure:

Part A: Route Unreachable – Routers Only

Step	Action	Expected Behavior
1.	If the RUT has any default routes in its routing table, delete them.	
2.	TN1 transmits an ICMPv6 Echo Request to an off-link address with a prefix that does not exist.	The RUT should send a Destination Unreachable Message to TN1. The Source Address of the Packet should be one of the RUT's unicast addresses, while the Destination Address should be the same as the Source Address in TN1'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.

Part B: Address Unreachable – Routers Only

Step	Action	Expected Behavior
3.	TN1 transmits an ICMPv6 Echo Request to an on-link address that does not exist. The prefix should be set to the prefix assigned by the RUT.	The RUT should send a Destination Unreachable Message to TN1. The Source Address of the Packet should be one of the RUT's unicast addresses, while the Destination Address should be the same as the Source Address in TN1's Echo Request packet. The Code field should be set to "3". The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU.

Part C: Port Unreachable – Link-Local Address – All Nodes

Step	Action	Expected Behavior
4.	Make sure the NUT is not listening on port 9000.	
5.	TN1 transmits a UDP Packet with the destination port field set to 9000. The source address is TN1's Global address.	The NUT should send a Destination Unreachable Message to TN1. The Source Address of the Packet should be one of the NUT's unicast addresses, while the Destination Address should be the same as the Link-Local Source Address in TN1's packet. The Code field should be set to "4". The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU.

Part D: Port Unreachable – Global Address – All Nodes

Step	Action	Expected Behavior
6.	Make sure the NUT is not listening on port 9000.	
7.	TN1 transmits a UDP Packet with the destination port field set to 9000. The source address is TN1's Global address.	The NUT should send a Destination Unreachable Message to TN1. The Source Address of the Packet should be one of the NUT's unicast addresses, while the Destination Address should be the same as the Global Source Address in TN1's packet. The Code field should be set to "4". The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU.

Part E: Beyond Scope of Source Address – Routers Only

Step	Action	Expected Behavior
8.	Enable the RUT's interface to Link B (to TN2).	
9.	TN1 transmits an ICMPv6 Echo Request with the Source address set to TN1 Link-local address to TN2 address on Link B.	The RUT should send a Destination Unreachable Message to TN1. The Source Address of the Packet should be one of the RUT's unicast addresses, while the Destination Address should be the same as the Source Address in TN1's Echo Request packet. The Code field should be set to "2". The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU.

Possible Problems: None.

Test v6LC.5.1.4: Packet Too Big Message Generation (Routers Only)

Purpose: Verify that a router properly generates Packet Too Big Messages.

Advanced Functionality:

- MTU Configuration

Reference:

- [ICMPv6] – Section 2.2, 2.4, 3.2
- [IPv6-ARCH] – Section 2.7
- [PMTU] – Section 3

Test Setup: Common Setup 1.1 is performed at the beginning of each test part. The Common Test Cleanup procedure is performed after each part.

1. Configure the RUT with a link MTU equal to the IPv6 minimum link MTU (1280 octets) on its interface to Link B (to TN2).
2. Configure all other interfaces on the RUT with the default link MTU for its associated media type. The link MTU for RUT's interface to Link B should be smaller than its link MTU to Link A.
3. TN1 transmits an Echo Request to the RUT with global scope and responds to Neighbor Solicitations from the RUT creating an NCE for TN1 in state REACHABLE.
4. TN2 transmits an Echo Request to the RUT with global scope and responds to Neighbor Solicitations from the RUT creating an NCE for TN2 in state REACHABLE.

Procedure:

Part A: Unicast Destination

Step	Action	Expected Behavior
1.	TN1 transmits an Echo Request to TN2 using the RUT as the first-hop with a packet size of 1500 octets.	The RUT must transmit a Packet Too Big message to TN1, 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 TN1'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.

Part B: Multicast Destination – Routers Only

Step	Action	Expected Behavior
2.	Configure a multicast routing protocol on the RUT.	
3.	TN2 is an MLD Listener for the multicast group FF1E::1:2.	
4.	TN1 transmits an Echo Request to the FF1E::1:2 address with a packet size of 1500 octets.	The RUT must transmit a Packet Too Big message to TN1, 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 TN1'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: For Part B, PIM-SM may need to be enabled on routers that perform RPF lookups.

Test v6LC.5.1.5: Hop Limit Exceeded (Time Exceeded Generation) (Routers Only)

Purpose: Verify that a router properly generates Time Exceeded Messages the Hop Limit was exceeded in transit.

Reference:

- [ICMPv6] – Section 2.2, 3.3, 2.4

Test Setup: Common Setup 1.1 is performed at the beginning of each 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

Step	Action	Expected Behavior
1.	TN1 transmits the Packet A Echo Request to TN2 with a first hop of the RUT.	The RUT must discard the ICMPv6 Echo Request from TN1. Therefore, it must not forward the Echo Request to TN2. The RUT should send a Time Exceeded Message to TN1 with a code field value of 0 (Hop Limit Exceeded in transit). • The Source Address of the Packet should be one of the RUT's unicast addresses used for packet forwarding.

		• The Destination Address should be the same as TN1's Source Address. • The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU.

Part B: Address Unreachable – Routers Only

Step	Action	Expected Behavior
2.	TN1 transmits the Packet B Echo Request to TN2 with a first hop of the RUT.	The RUT must discard the ICMPv6 Echo Request from TN1. Therefore, it must not forward the Echo Request to TN2. The RUT should decrement the Hop Limit to 0 and send a Time Exceeded Message to TN1 with a code field value of 0 (Hop Limit Exceeded in transit). • The Source Address of the Packet should be one of the RUT's unicast addresses used for packet forwarding. • The Destination Address should be the same as TN1's Source Address. • The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU.

Possible Problems: None.

Test v6LC.5.1.6: Erroneous Header Field (Parameter Problem Generation)

Purpose: Verify that a node properly generates Parameter Problem Messages for an Erroneous Header Field.

Reference:

- [ICMPv6] – Section 2.2, 3.4, 2.4
- [IPv6-SPEC] – Section 4.5

Test Setup: Common Setup 1.1 is performed at the beginning of each test part. The Common Test Cleanup procedure is performed after each part.

Packet A
IPv6 Header Next Header: 44 Payload Length: 37
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 1
ICMPv6 Echo Request Data Length: 5

Procedure:

Step	Action	Expected Behavior
1.	TN1 transmits the Packet A Echo Request to the NUT. The Source Address of the Packet is set to TN1's Global address. The Destination Address of the packet is set to the NUT's Global address.	The NUT must discard the ICMPv6 Echo Request from TN1. Therefore, it must not send an Echo Reply. The NUT should send a Parameter Problem Message to TN1 with a code field value of 0 (Erroneous Header Field encountered) because the Payload Length is not a multiple of 8 octets. • The Pointer Field should be 0x04 (offset of the Payload Length field). • The Source Address of the Packet must be the same as the Global Destination Address of TN1's Echo Request packet. • The Destination Address should be the same as the Global Source Address of TN1's Echo Request packet.

		• The invoking Echo Request packet included in the Error Message must not exceed minimum IPv6 MTU.

Possible Problems: None.

Test v6LC.5.1.7: Unrecognized Next Header (Parameter Problem Generation)

Purpose: Verify that a node properly generates Parameter Problem Messages when an Unrecognized Next Header type is encountered.

Reference:

- [ICMPv6] – Section 2.2, 3.3, 2.4
- [IPv6-SPEC] – Section 4.5

Test Setup: Common Setup 1.1 is performed at the beginning of each test part. The Common Test Cleanup procedure is performed after each part.

Packet A
IPv6 Header Next Header: 60
Destination Options Header Next Header: 252 (Unknown) Ext. Header Length: 0 Option: PadN Opt. Data Length: 4
ICMPv6 Echo Request Data Length: 1

Procedure:

Step	Action	Expected Behavior
1.	TN1 transmits Packet A, an Echo Request to the NUT. The Source Address of the Packet is set to TN1's Global address. The Destination Address of the packet is set to the NUT's Global address.	The NUT must discard the ICMPv6 Echo Request from TN1. Therefore, it must not send an Echo Reply. The NUT should send a Parameter Problem Message to TN1 with a code field value of 1 (Unrecognized Next Header type encountered). • The Pointer Field should be 0x28 (offset of the Next Header field). • The Source Address of the Packet must be the same as the Global Destination Address of TN1's Echo Request packet. • The Destination Address should be the same as the Global Source Address of TN1's Echo Request packet. • The invoking Echo Request packet included in the Error

		Message must not exceed minimum IPv6 MTU.

Possible Problems: None.

Test v6LC.5.1.8: Unknown Informational Message Type

Purpose: Verify that a node properly handles the reception of an ICMPv6 Packet with an Unknown Informational Message Type value.

Reference:

- [ICMPv6] – Section 2.4

Test Setup: Common Setup 1.1 is performed at the beginning of each test part. The Common Test Cleanup procedure is performed after each part.

Packet A
IPv6 Header Next Header: 44 Payload Length: 37
Fragment Header Next Header: 58 Fragment Offset: 0 More Fragments flag: 1
ICMPv6 Echo Request Data Length: 5

Procedure:

Step	Action	Expected Behavior
1.	TN1 transmits an ICMPv6 Information Message with a type field value of 254 to the NUT.	The NUT must silently discard the ICMPv6 Informational Message from TN1.

Possible Problems: None.

Test v6LC.5.1.9: Error Condition with ICMPv6 Error Message (Routers Only)

Purpose: Verify that a router properly handles the reception and processing of an ICMPv6 Error Message that invokes an error.

Reference:
- [ICMPv6] – Section 2.4

Test Setup: Common 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: Reception of Flawed Destination Unreachable Code 0 with Address Unreachable

Step	Action	Expected Behavior
1.	TN1 transmits a Destination Unreachable Error Message for “No Route to Destination” to the RUT with the Destination Address set to an on-link address that does not exist.	The RUT must not send a Destination Unreachable Error Message with Code 3 to TN1 when it receives a Destination Unreachable Message with Code 0 for which it cannot resolve a destination address.

Part B: Reception of Flawed Destination Unreachable Code 3 with Hop Limit = 0

Step	Action	Expected Behavior
2.	TN1 transmits a Destination Unreachable Error Message for “Address Unreachable” to the RUT with the Hop Limit set to Zero in the IPv6 header and with a Destination Address set to an off-link address.	The RUT must not send a Time Exceeded message with Code 0 to TN1 when it receives a Destination Unreachable Message with Code 3 that contains a Hop Limit of 0.

Part C: Reception of Flawed Time Exceeded Code 0 with No Route To Destination

Step	Action	Expected Behavior
3.	Remove the default route from the RUT.	
4.	TN1 transmits a Time Exceeded Error Message for “Hop Limit Exceeded in Transit” to the RUT with the Destination Address set to an off-link address that does not exist.	The RUT 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: Reception of Flawed Time Exceeded Code 1 with No Route To Destination

Step	Action	Expected Behavior

5.	Remove the default route from the RUT.	
6.	TN1 transmits a Time Exceeded Error Message for "Fragment Reassembly Time Exceeded" to the RUT with the Destination Address set to an off-link address that does not exist.	The RUT 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: Reception of Flawed Packet Too Big with Address Unreachable

Step	Action	Expected Behavior
7.	TN1 transmits a Packet Too Big Error Message to the RUT with the Destination Address set to an on-link address that does not exist.	The RUT 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: Reception of Flawed Parameter Problem with Hop Limit = 0

Step	Action	Expected Behavior
8.	TN1 transmits a Parameter Problem Error Message to the RUT with the Hop Limit set to Zero in the IPv6 header and with a Destination Address set to an off-link address.	The RUT 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.

Test v6LC.5.1.10: Error Condition with Multicast Destination

Purpose: Verify that a node properly handles the reception of an error condition caused by a packet with a Multicast Destination Address.

Reference:
- [ICMPv6] – Section 2.4

Test Setup: Common 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: UDP Port Unreachable

Step	Action	Expected Behavior
1.	TN1 transmits a UDP packet on Link A with the Destination Address set to the all-nodes link-local multicast address. The destination port is set to 9000. (Make sure the NUT is not listening on port 9000.)	The NUT must not send a Destination Unreachable Error Message to TN1 when it receives a UDP packet for an unreachable port.

Part B: Echo Request Reassembly Timeout

Step	Action	Expected Behavior
2.	TN1 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.	The NUT must not send a Time Exceeded Error Message to TN1 60 seconds after it receives the first fragment of an ICMPv6 Echo Request.

Possible Problems: None.

Test v6LC.5.1.11: Error Condition with Non-Unique Source - Unspecified

Purpose: Verify that a node properly handles the reception of an error condition caused by a packet with a source address that does not uniquely identify a single node.

Reference:

- [ICMPv6] – Section 2.4

Test Setup: Common 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: UDP Port Unreachable (Routers and Hosts)

Step	Action	Expected Behavior
1.	TN1 transmits a UDP Packet to the NUT's Global address with a Source Address set to the unspecified address (::). The destination port is set to 9000. (Make sure the NUT is not listening on port 9000.)	The NUT must not send a Destination Unreachable Error Message to TN1 when it receives a UDP packet for an unreachable port.

Part B: Echo Request Too Big (Routers Only)

Step	Action	Expected Behavior
2.	Configure the RUT with a link MTU equal to the IPv6 minimum link MTU (1280 octets) on its interface to Link B (to TN2).	
3.	Enable the RUT's interface to Link B (to TN2).	
4.	Configure all other interfaces on the RUT with the default link MTU for its associated media type. The link MTU for RUT's interface to Link A should be smaller than its link MTU to Link B.	
5.	TN1 transmits an ICMPv6 Echo Request with a total message size of 1500 octets to TN2 with a first hop through the RUT. The Source Address is set to the unspecified address (::).	The RUT must not send a Packet Too Big Error Message to TN1 when it receives an ICMPv6 Echo Request that is too large for it to send on its outgoing interface.

Part C: Echo Request Reassembly Timeout (Routers and Hosts)

Step	Action	Expected Behavior

6.	TN1 transmits an ICMPv6 Echo Request Fragment to the NUT. 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 (::).	The NUT must not send a Time Exceeded Error Message to TN1 60 seconds after it receives the first fragment of an ICMPv6 Echo Request.

Part D: Echo Request with Unknown Option in Destination Options (Routers and Hosts)

Step	Action	Expected Behavior
7.	TN1 transmits an ICMPv6 Echo Request to the NUT. 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_b).	The NUT must not send a Parameter Problem Error Message when it receives an ICMPv6 Echo Request with an unknown option with highest bits 10_b.

Possible Problems: None.

Test v6LC.5.1.12: Error Condition with Non-Unique Source - Multicast

Purpose: Verify that a node properly handles the reception of an error condition caused by a packet with a source address that does not uniquely identify a single node.

Reference:

- [ICMPv6] – Section 2.4

Test Setup: Common 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: UDP Port Unreachable (Routers and Hosts)

Step	Action	Expected Behavior
1.	TN1 transmits a UDP Packet to the NUT's Global Address with a Source Address set to TN1's Solicited-Node Multicast address. The destination port is set to 9000. (Make sure the NUT is not listening on port 9000.)	The NUT must not send a Destination Unreachable Error Message to TN1 when it receives a UDP packet for an unreachable port.

Part B: Echo Request Too Big (Routers Only)

Step	Action	Expected Behavior
2.	Configure the RUT with a link MTU equal to the IPv6 minimum link MTU (1280 octets) on its interface to Link B (to TN2).	
3.	Enable the RUT's interface to Link B (to TN2).	
4.	Configure all other interfaces on the RUT with the default link MTU for its associated media type. The link MTU for RUT's interface to Link A should be smaller than its link MTU to Link B.	
5.	TN1 transmits an ICMPv6 Echo Request with a total message size of 1500 octets to TN2 with a first hop through the RUT. The Source Address is set to TN1's Solicited-Node Multicast address.	The RUT must not send a Packet Too Big Error Message to TN1 when it receives an ICMPv6 Echo Request that is too large for it to send on its outgoing interface.

Part C: Echo Request Reassembly Timeout (Routers and Hosts)

Step	Action	Expected Behavior

6.	TN1 transmits an ICMPv6 Echo Request Fragment to the NUT. The offset of the fragment is 0 (the first fragment) and the More Fragments Flag is set. The Source Address is set to TN1's Solicited-Node Multicast address.	The NUT must not send a Time Exceeded Error Message to TN1 60 seconds after it receives the first fragment of an ICMPv6 Echo Request.

Part D: Echo Request with Unknown Option in Destination Options (Routers and Hosts)

Step	Action	Expected Behavior
7.	TN1 transmits an ICMPv6 Echo Request to the NUT. The Source Address is set to TN1's Solicited-Node Multicast address. It includes a Destination Options Header with the unrecognized Option of type 135. (Highest Order bits set to 10_b).	The NUT must not send a Parameter Problem Error Message when it receives an ICMPv6 Echo Request with an unknown option with highest bits 10_b.

Possible Problems: None.

Test v6LC.5.1.13: Error Condition with Non-Unique Source - Anycast (Routers Only)

Purpose: Verify that a node properly handles the reception of an error condition caused by a packet with a source address that does not uniquely identify a single node.

Reference:

- [ICMPv6] – Section 2.4
- [IPv6-ARCH] – Section 2, 2.5.6, 2.6, 2.6.1

Test Setup: Common 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: UDP Port Unreachable

Step	Action	Expected Behavior
1.	TR1 transmits a UDP Packet to the NUT's Global Address with a Source Address set to TR1's Subnet-Router Anycast Address. The destination port is set to 9000. (Make sure the NUT is not listening on port 9000.)	The NUT must not send a Destination Unreachable Error Message to TR1 when it receives a UDP packet for an unreachable port.

Part B: Echo Request Too Big

Step	Action	Expected Behavior
2.	Configure the RUT with a link MTU equal to the IPv6 minimum link MTU (1280 octets) on its interface to Link B (to TN2).	
3.	Enable the RUT's interface to Link B (to TN2).	
4.	Configure all other interfaces on the RUT with the default link MTU for its associated media type. The link MTU for RUT's interface to Link A should be smaller than its link MTU to Link B.	
5.	TN1 transmits an ICMPv6 Echo Request with a total message size of 1500 octets to TN2 with a first hop through the RUT. The Source Address is set to TR1's Subnet-Router Anycast Address. (Because the RUT has an address configured with TR1's prefix, TR1's Subnet-	The RUT must not send a Packet Too Big Error Message to TN1 when it receives an ICMPv6 Echo Request that is too large for it to send on its outgoing interface.

	Router Anycast Address is also the RUT's.).	

Part C: Echo Request Reassembly Timeout

Step	Action	Expected Behavior
6.	TN1 transmits an ICMPv6 Echo Request Fragment to the NUT. The offset of the fragment is 0 (the first fragment) and the More Fragments Flag is set. The Source Address is set to TR1's Subnet-Router Anycast Address.	The NUT must not send a Time Exceeded Error Message to TN1 60 seconds after it receives the first fragment of an ICMPv6 Echo Request.

Part D: Echo Request with Unknown Option in Destination Options (Routers and Hosts)

Step	Action	Expected Behavior
7.	TN1 transmits an ICMPv6 Echo Request to the NUT. The Source Address is set to TR1's Subnet-Router Anycast Address. It includes a Destination Options Header with the unrecognized Option of type 135. (Highest Order bits set to 10_b).	The NUT must not send a Parameter Problem Error Message when it receives an ICMPv6 Echo Request with an unknown option with highest bits $10_{b.}$

Possible Problems: None.

Modification Record

Version 5.1.4 November 8, 2024

- Update 1.1.7 Packet B with proper next header and fragment offset
- Update 1.1.7A and 1.2.3A to start at next header 146 due to 144 and 145 being assigned by IANA
- Update 1.1.9 Packet A hop limit to match Step 1 Action
- Added a possible problem for multicast tests 1.1.10H, I, J, K, 1.2.7G, H, and 5.1.4B
- Specify global scope multicast address for 1.2.7 Packet G and H
- Update 1.3.1 Purpose to the correct purpose of the test
- Clarify fragment offsets for 1.3.5C, D, G, H to match packet definitions
- Add Packet A definition for 2.1.3
- Remove possible problems from 2.1.11 and 2.1.19
- Clarified in 2.1.13 Neighbor Solicitation D and Part C uses an update MAC address, now called Y.
- Updated 2.2.1 Expected Behavior to specify no more than MAX_RTR_SOLICITATIONS as defined in [ND] Section 6.3.7
- Updated 3.2.3 to no longer include specific prefix lifetimes
- Update 5.1.2G to /64 prefix
- Update references for 5.1.4. Reordered [ICMPv6] sections and updated [PMTU] to Section 3 as Section 3.2 does not exist

Version 5.1.3 January 4, 2024

- Added Advanced Functionality header to tests that contain advanced functionality.
- Changed 3.2.6B procedure to allow for generic "Bootstrapping Events" rather than reboots. Also added steps to ensure uniqueness in Interface IDs for different global prefixes (i.e. uniqueness across networks).
- Added packet descriptions for Router Solicitations A and B used in 2.2.6.
- Updated 2.3.10-2.3.15 to wait DELAY_FIRST_PROBE_TIME after certain Redirect transmissions to ensure NCE's don't enter both INCOMPLETE and DELAY.
- Updated 1.1.7B to use Destination Options extension headers instead of Hop-by-Hop Options since they are not required per RFC 8200.
- Added step to 2.1.14 for configuring the RUT with a Subnet-Router anycast address.
- Updated 2.2.21E step 2 action to be more generic, match language in 2.2.8.
- Added a Possible Problem Summary page.
- Added Functionality Tag to each test case to indicate mandatory vs. conditionally mandatory (covered by advanced functionality) tests.
- (TYPO) Remove extra Redirect from 2.3.7
- (TYPO) Removed incorrect step number mention from expected behavior in 2.1.18, 2.1.19, and 2.1.20.
- (TYPO) Fixed Part D description for 2.1.15.

- (TYPO) Fixed incorrect Router Advertisement description in 2.2.2G.
- (TYPO) Fixed then/than typo in 2.2.24 expected behavior.
- (TYPO) Removed extraneous table from test setup section of 2.3.2.
- (TYPO) Fixed 2.3.5 test case title.
- (TYPO) Fixed descriptions of invalid Redirect options used in 2.3.8B & C.
- (TYPO) Fixed 3.1.5 to have accurate test purpose text.
- (TYPO) Fixed packet description for 5.1.7 to include an NH value of 252.
- Updated 2.2.24 part A and B lifetime field = 3 * MaxRtrAdvInterval. Added possible problem to allow for RUTs that have no default lifetime.
- Clarified TN1/TN2 link and destination addresses in v6LC.2.3.16 procedure.
- (TYPO) Fixed IsRouter flag/IsRouterFlag in test case titles.
- (TYPO) Fixed sate/state in test setup of section 2.3.4, 2.3.5, 2.3.6, 2.3.7, 2.3.8, & 2.3.9
- (TYPO) Fixed then/than in 3.2.7B expected behavior.

Version 5.1.2 January 26, 2022

- Added Beyond Scope of Source Address to Advanced Functionality list.
- Added Tracking Connections for ICMPv6 to Advanced Functionality list.

Version 5.1.1 November 3, 2021

- Detailed the values required in RDNSS and DNSSL Options in Router Advertisement.
- (TYPO) Fixed in 3.2.1A to match 3.2.1B (leftover error from 4.0.8 to 5.0.0).
- (TYPO) Added DAD NS removed from 4.0.8.
- (TYPO) Updated M Flag should be clear in the second fragments (A.2, B.2, C.2, D.2)
- (TYPO) Fixed reserved field from 0 to F in 1.1.10k.

Version 5.1.0 June 1, 2021

- Added 2.2.25 as advanced functionality for Host, as all devices don’t need to support DNS.
- Added test 1.1.11 for RFC 7608 to test RUT supports routes of any length.
- Removed unknown next header 143 from 1.1.7a & 1.2.3a, as it has been assigned and should be removed from the unrecognized next headers tests.
- Added possible problem to 1.2.6 for nodes that do not process Hop-by-Hop options. This possible problem was present in 4.0.8 for nodes that implement 8200.
- Added test 2.2.23J for Hosts processing an RIO for ::/0 with the lifetime set to 0.
- Updated RDNSS Option lifetime in 2.2.25F to last the entire test.
- (TYPO) Updated title of 2.1.6D to match test case.
- (TYPO) Fixed title of 2.1.14.
- (TYPO) Replaced "CE Router" with "HUT" in Expected Behavior of 2.2.1
- (TYPO) Updated expected behavior of 2.2.2G to indicate a valid RA.
- (TYPO) Removed duplicated test 2.2.3.

- (TYPO) Changed procedure in 2.2.13b to configure the RUT to have a Cur Hop Limit of 100.
- (TYPO) Added a check to 2.2.26B & 2.2.27B that the RUT does not send a unicast RA in response to the fragmented RS. Changed TR1 to TN1.
- (TYPO) Changed NS to NA in title of 3.1.4A, added missing parenthesis to title of 3.1.4E.
- (TYPO) Updated packets in 3.2.1 to refer to the correct addresses for each part.
- (TYPO) Clarified expected behavior in 4.1.6.
- (TYPO) Updated 5.1.2E to be a request sent to the unspecified address.
- (TYPO) Fixed typo in title of 5.1.13.

Version 5.0.1 August 18, 2020

- Added 1.3.5C and G to advanced functionality since detecting duplicate overlapping fragments is a SHOULD.
- Updated 1.3.5B and F to use two fragmented packets instead of 3 fragmented packets to avoid Time Exceeded messages.
- (TYPO) Fixed several mislabeled PRF values in 2.2.23.
- (TYPO) Updated typo 1.1.10G to forward packet.
- (TYPO) Updated typo 1.1.10 I,J to not forward packet.
- (TYPO) Fixed 5.1.6 ICMPV6 reference from 3.3 to 3.4.
- (TYPO) Fixed typo of extra text in observable of 1.3.5D,H.
- (TYPO) Updated 3.1.3J Step 48 to use TTL option instead of reserved field.
- (TYPO) Title was unicast changed in multicast in 1.2.6.H, 1.2.7H, and 1.2.8H.

Version 5.0.0 February 6, 2020 (Major Version Release)

- Updated to RFC 8200 from RFC 2460.
  - Changed name of 1.3.4 to Atomic Fragment.
  - Added 1.3.5 for Overlapping Fragments.
  - Added 1.3.6 for Headers in first packet.
- Updated to RFC 8201 from RFC 1981.
  - Changed 4.1.6 to NOT process the Packet Too Big with a MTU less than 1280.
  - Added 4.1.12 for validating Packet Too Big.
- Added RFC 4191 for Default Route Selection.
  - Added 2.2.20, 2.2.21, 2.2.22, 2.2.23
- Added RFC 6980 for Security of IPv6 fragments with IPv6 Neighbor Discovery.
  - Added 2.1.22, 2.1.23, 2.2.26, 2.2.27, 2.3.18, and 2.3.19.
- Added RFC 7212 for Stable-ids.
  - Removed EUI-64 requirements.
  - Added 3.2.6 and 3.2.7.
- Added RFC 8106 for DNS in Router Advertisements.
  - Added 2.2.24 and 2.2.25
- Updated [ADDRCONF] to [SLAAC] for references.
- Updated Link B to Link A (since it's the first interface).
- Clarified that the Echo Request to be size 1500 in 4.1.9.

- Updated 2.2.1 to clarify that RS's must not be transmitted faster than 4 seconds apart.
- Removed Reference to RFC 5095, it's included in RFC 8200.

Version 4.0.8 September 28, 2018

- Allowed for devices to not process Hop-by-Hop Options
- Allowed for device to not Packet Too Big with MTU less than 1280 for atomic fragments.
- Allowed devices to transmit more than 3 RS due to RFC 7559.
- Updated 4.1.8 to have separate destination for devices that base MTU on the Destination Cache.

Version 4.0.7 November 13, 2016

- Removed Phase-1 from the document.
- Removed Phase-2 from the document.
- Added a possible problem to 3.1.2B,D, 3.1.3 I-J, 3.1.4 H-I for devices that don't support EUI-64 address due to privacy concerns.
- Removed requirement for the unused field in a Time Exceeded message (1.3.2B-D, 5.1.5A-B) to be zero due to RFC 4884.
- Added a requirement to check the Hop Limit of 255 in IPv6 Header of Redirect.
- Updated 2.2.13b to increase the hop limit due to attack vector if the device is forced to lower the hop limit.
- Moved Modification Record to the end of the document.
- Updated 2.2.7A to not allow devices to send RAs at 16 intervals, since the values are smaller.
- Updated 2.2.18 to use the global address as the source.
- Typo in 2.1.6 B-D, Seconds packet was A when it should be B, C, and D respectively.
- Added a possible problem to 2.1.1C for RFC 7048 support.
- Typo in 1.1.10C packet set destination to TN2.
- Removed Global address from the Observable results of 1.3.2D.
- Typo in 2.1.10D and 2.1.12D, observable uses Neighbor Solicitation D.
- Updated Unknown Destination Header from 7 to 17 since 7 has been allocated.
- Clarified 1.2.6B, 1.2.7B, and 1.2.8B PadN option has 4 bytes of Option data.
- Typo in 3.1.5 Packet Format for the option from TLLOPT to SLLOPT.
- Removed Common Test Setup from 3.2.5.

Version 4.0.6 April 26, 2010

- Added Common Test Setup to 1.1 to 1.3.1
- Added Router Solicitation from source address of unspecified and link-local address to 2.2.6.
- Enable Link A and send the Echo Request to a destination address of TN2 in 5.1.3 (E).
- Changed observable results in 5.1.4 to accept any address from the DUT.
- Enable Link A on 5.1.9 (B) (C) (D) (F)
- Remove default route from 5.1.9 (C) (D)

- Changed 2.1.18 (J) (P), 2.1.19 (J) (P), 2.1.20 (J) (P) to observe the link-layer destination instead of Target Address.
- Added possible problem to 2.2.7 (C) (D) to support vendor-specific upper/lower limits for router configuration variables.

Version 4.0.5 June 29, 2009

- Added configuring a global address for all tests if the NUT is a router.

Version 4.0.4 January 27, 2009

- Added verification point to tests 3.1.2, 3.1.3, and 3.1.4 to verify the NUT does not transmit any RS after failing DAD for its link-local address. Added references for verification point.
- Added verification point to test 2.2.1 to verify the HUT does not transmit an RS from its link-local address before performing DAD. Added verification point to verify the HUT does not transmit an RS from the unspecified address that includes a Source Link-layer Address option. Added references for verification point.
- Added clarification to tests 3.1.2, 3.1.3, 3.1.4. Specified IPv6 Source Address for DAD NS packets as the unspecified address and the IPv6 Source Address for DAD NA packets as the link-local address of the NUT.
- Added clarification to tests 3.1.2, 3.1.3, 3.1.4, 3.1.5. Specified IPv6 Destination Address as the link-local address of the NUT for NS from TN1 and added NS from TN1 to the solicited-node multicast address of the NUT's link-local address.
- Fixed typo in test 1.1.10 parts A, B, G, and H. Observable results, the RUT must forward the Echo Request with a first hop through TR1.
- Changed multicast address used in v6LC.1.1.10J and K to a well-known multicast address (Part J = ff10::1:2 Part K = ff1f::1:2)
- Changed Echo Requests in test 1.1.10. All pings now originate from TN2 instead of TN1. Added Enabling the RUT's interface on Link A to test setup.
- Fixed typo in test 1.1.10. Changed from NUT to RUT in all parts.
- Fixed typo in tests v6LC.2.3.4A, and B. Observable, results should be the same as parts C and D.
- Fixed Bug: Test v6LC.4.1.10 and v6LC.4.1.11 – Added RA from TR1 with MTU 1500 in Test Setup.

Version 4.0.3 September 22, 2008

- Added test v6LC.1.2.10 to tests performed for Phase-1 Host Logo and Phase-1 Special Devices.
- Added tests v6LC.5.1.2E, F, G to tests performed for Phase-1 Host, Phase-1 Router, and Phase-1 Special Devices.
- Fixed typo in test v6LC.2.1.13.

Version 4.0.2 July 1, 2008

- Fixed Typos

Version 4.0.1 June 18, 2008

- v6LC.2.2.15 A, fixed typo to account for delay first probe time

Version 4.0.0 May 29, 2008 – Major Version Release

Version 4.0.0.b2 May 20, 2008 (Public Review Comments)

- Add test v6LC.3.2.4 Part J (Valid Lifetime is 0xffffffff
- v6LC.2.3.4, 2.3.5, 2.3.6, 2.3.7, 2.3.8, 2.3.9 (Added TR2 NCE to REACHABLE at setup procedure for those that support RFC 4191)

Version 4.0.0.b1 April 9, 2008 Major Version (Public Review)

- IP disable operation checks are not required for Phase-1 (Tests affected v6LC.3.1.2B,D, v6LC.3.1.3I, J, v6LC.3.1.4H,I)
- Phase-1 Requirements added all parts v6LC.3.1.2, v6LC3.1.3 and v6LC.3.1.4
- Removed following tests: v6LC.1.2.9, v6LC.1.2.12, v6LC.1.2.14, v6LC.1.2.15 [RFC 5095] (Removed from Phase-1 Requirements)
- Renumbered 1.2.10 Unrecognized Routing Type – End Node and 1.2.11 Unrecognized Routing Type – Intermediate Node (Added to Phase-1 Requirements)
- V6LC.3.2.1 broke test up into Parts A-C
- Added v6LC.3.2.1 for Router and Special Devices Phase-1 Requirements
- Added v6LC.2.2.7E(unsolicited RA with prefix ending in zero-value fields), F (unsolicited RA with site-local prefix) Added to Phase-1 requirements Routers
- Split Test v6LC.5.1.2: Replying to Echo Requests, into two tests. Added Test v6LC.1.1.10: IP Forwarding
- Added v6LC.1.1.0 H, I, J, K as Advanced Functionality
- Updated Common Topology to include separate Router Under Test and Host Under Test

Version 4.0.0.a1 March 18, 2008 Major Version Up(Internal Review)

- RFC 4291 Support
- v6LC.3.2.1 – Global Address Autoconfiguration – Added Steps 6, 7 (RFC 4291 Support)
- v6LC.5.1.2D – Replying to Echo Request, Unspecified Addr – Added New Test (RFC 4291 Support)
- v6LC.5.1.2E – Replying to Echo Request, Unspecified Addr, Intermediate Node (Routers Only) – Added New Test (RFC 4291 Support)
- v6LC.5.1.2F – Replying to Echo Request, Loopback Addr,– Added New Test (RFC 4291 Support)
- v6LC.5.1.2G – Replying to Echo Request, Loopback Addr, Intermediate Node (Routers Only) – Added New Test (RFC 4291 Support)
- v6LC.5.1.2H – Replying to Echo Request, Site-local Addr,– Added New Test (RFC 4291 Support)
- v6LC.5.1.2I – Replying to Echo Request, Site-local Addr, Intermediate Node (Routers Only) – Added New Test (RFC 4291 Support)
- v6LC.5.1.2J – Replying to Echo Request, Multicast Addr, (reserved=0) Intermediate Node (Routers Only) – Added New Test (RFC 4291 Support)
- v6LC.5.1.2K – Replying to Echo Request, Multicast Addr, (Reserved=F)Intermediate Node (Routers Only) – Added New Test (RFC 4291 Support)

- v6LC.2.1.17C,D – NA Processing, NCE State Incomplete – Removed last Echo Request in procedure in order to keep consistency with 2.1.12 and 2.1.20 state change tests
- Updated Common Topology to include Link C (v3.8.11)
- V6LC.2.3.17 –Redirect-Receive - Updated procedure step 4 and 5 to use Rut's routing table
- V6LC.2.1.2a, b –Resolution Wait Queue - changed to update the sequence number instead of the ID
- (Typo) Common Test Cleanup: modified state INCOMPLETE to state No NCE
- (Clarification) v6LC.2.1.1B, C – On-link Determination- Step 3 and 6 is performed if NUT is a host only.
- (Typo) V6LC.2.3.3 – Redirected on-link: Invalid - Updated Step 3 to match ICMP Destination Address and Target Address (TN1 off-link global)
- (Typo) v6LC.2.1.18-20 –NA Processing - Updated procedure and observable results to include Parts A-R
- (Typo) v6LC.2.1.16- NA Processing, No NCE - Parts A-H, Updated TR1 transmits NA to TN1 transmits NA
- Fixed editorial typos
- Updated references to draft-RH0 to RFC 5095

Version 3.9.4 January 15, 2008

- v6LC.3.1.2 B,D (Receiving DAD NS and NA),v6LC.3.1.3I,J (Validation of DAD NS), v6LC.3.1.4 H, I (Receiving invalid NA): added the transmission of NS to the NUT in the procedure to verify that IP operation was disabled. (RFC 4862 update)
- v6LC.3.2.1 (Global Address Autoconfiguration and DAD): Updated procedure to include Routers.

Version 3.9.3 November 28, 2007

- (Public Review)
- V6LC.2.2.16: Router Advertisement Processing, Neighbor Cache (Hosts Only) – updated NA C isRouter flag to true

Version 3.9.2 October 30, 2007 (Internal Review comments)

- Common Test Setup – Added the isRouter Flag set when NUT is a router.
- Fixed Typos.
- Added Advanced Functionality for IPv6 Error Message (2) Beyond scope of Source Address.

Version 3.9.1 October 15, 2007

- v6LC.3.1.2 B,D(Receiving DAD NS and NA),v6LC.3.1.3I,J(Validation of DAD NS), v6LC.3.1.4 H, I(Receiving invalid NA): added procedure to verify that IP operation was disabled. (RFC 4862 update)
- v6LC.2.1.1 B (On-link Determination, Global Address, No Default Router): Removed according to RFC 4861 [renumbered part c and d]
- Update reference to Stored Lifetime to Remaining Lifetime (RFC 4862 update)
- v6LC.2.2.19(Router Advertisement Processing, Prefix Length): Added test for on-link determination and invalid prefix length field according to RFC 4861

- v6LC.5.1.3 E(Destination Unreachable Message Generation): Added test for Destination Unreachable Message generation code field 2 – beyond scope of source addr according to RFC 4443.
- v6LC.5.1.8(Unknown Informational Message Type): updated the type field value to 254 according to RFC 4443.

Version 3.9.0 October 5, 2007

- Added Copyright
- Updated to RFC 4861
- Updated to RFC 4862 – added clarification to Test v6LC.3.1.2 B, D, v6LC.3.1.3 I, J and v6LC.3.1.4 H, I observable results to disable IP operation.
- Added Reference for [I-D.ietf-ipv6-deprecate-rh0]
- V6LC.2.3.6 and v6LC.2.3.8: added reference for updated RFC 4443
- V6LC.1.2.10: Added Part B: Unrecognized Routing Header Type 0, if supported – added possible problems
- V6LC.1.2.11: Added Part B: Unrecognized Routing Header Type 0, if supported – added possible problems
- V6LC.1.2.11: Updated procedure to reflect all nodes.
- Updated v6LC.1.2.11 to include all nodes.
- Added possible problems for [I-D.ietf-ipv6-deprecate-rh0] support in the following tests: v6LC1.2.9- v6LC1.2.15
- V6L.2.2.13a, b: Observable results add to check for RA
- V6LC.2.2.18: updated Echo Request B destination address to HUT's Link-Local Address
- Removed tests v6LC.2.3.1 Parts A-D and v6LC.2.3.4 Parts A-D due to over interpretation of the RFC 2461 section 8.1.
- Removed redundant test v6LC.2.3.4 Part I.
- Removed Router Advertisement from TR2 in tests v6LC.2.3.4, v6LC.2.3.5, v6LC.2.3.6, v6LC.2.3.7, v6LC.2.3.8, v6LC.2.3.13, and v6LC.2.3.14.
- Added off-link Echo Request from TN1 in tests v6LC.2.3.10, v6LC.2.3.11, v6LC.2.3.12, v6LC.2.3.13, v6LC.2.3.14, and v6LC.2.3.15.

Version 3.8.10 January 25, 2007

- v6LC.1.1.7: changed next header field values according to IANA protocol number assignment
- v6LC.1.2.3: changed next header field values according to IANA protocol number assignment
- Updated RFC 4443
- Removed V6LC1.2.6G,H from Advanced Functionality List
- v6LC.3.2.4: removed Common_Test_Setup_1.1

Version 3.8.9 October 25, 2006

- v6LC.2.1.5A: Step 4 changed to Phase-2 Only.
- v6LC.2.2.7C: AdvMTU can be any value for Phase-1.
- Fixed Typos: Observable Results of Test v6LC.1.2.15e, f, TN1 mistyped as TN2.

Version 3.8.8 June 22, 2006

- Removed Discussions

Version 3.8.7 June 16, 2006

- Updated all references of Phase II to Phase-1/Phase-2

Version 3.8.6 May 26, 2006

- Changed Observable Results of Test v6LC.2.2.16.h. HUT should not update the state of the neighbor cache after receiving an RA without an SLLA option.
- Fixed Typos in Test v6LC.2.2.16e, h, TR1 mistyped as TN1 in some Observable Results

Version 3.8.5 May 18, 2006

- Fixed Typos: Tests Performed Phase-1, Hosts: v6LC3.2.4, v6LC3.2.5

Version 3.8.4 May 8, 2006

- Fixed Typos

Version 3.8.3 April 26, 2006

- Updated v6LC.2.1.13
- Added Test v6LC.3.2.1, renumbered Section 3 Group 2

Version 3.8.2 April 18, 2006

- Added v6LC2.1.8(C)
- Added Tests: v6LC2.2.7(C)(D)

Version 3.8.1 March 10, 2006

- v6LC.5.1.4A: Added Steps 4 and Steps 5 to Test Setup.
- Added Tests: v6LC2.2.16E, H, K (Renumbered v6LC2.2.16)
- Added Tests Performed for Phase-I Logo Testing

Version 3.8.0 December 6, 2005

- Added tests: v6LC.1.1.5B, v6LC.1.3.2D, v6LC.2.1.6B,C,D, v6LC.2.1.9C, v6LC.2.1.13, v6LC.2.1.18Q,R, v6LC.2.1.19Q,R, v6LC.2.1.20Q,R, v6LC.2.1.21E,F,G,H, v6LC.2.2.7B, v6LC.2.2.10, v6LC.2.2.16G, H, v6LC.2.2.17, v6LC.2.2.18
- Re-numbered tests v6LC.2.1.13-v6LC.2.1.21
- Re-numbered tests v6LC.2.2.10-v6LC.2.2.18

Version 3.7.0 September 14, 2005

- Test v6LC.1.2.7 - Typo, Removed TR1 from Dest in Packet G.
- Part G- changed to off-link multicast destination
- Test v6LC.2.2.12 Part B, changed to common test setup 1.1
- Test v6LC.2.2.13 Part B and C, changed to retain 2 entries in default router list instead of 3.
- Test v6LC.4.1.6, Part A, changed MTU equal to 0x56
- Test v6LC.4.1.6, Part B, changed MTU equal to 0x1279
- Test v6LC.4.1.10, v6LC.4.1.11 added to possible problems
- Test v6LC.5.1.4 - Typo
- Added: Common Topology for one interface router
- Added One interface router option for the following tests: v6LC.1.1.3, v6LC.1.1.4B, v6LC.1.1.6B, v6LC.1.1.9, v6LC.1.2.2B, v6LC.1.2.7, v6LC.1.2.11, v6LC.1.2.13, v6LC.1.2.15, v6LC.2.2.6B, v6LC.5.1.4B
- Test v6LC.1.2.11, v6LC.1.2.13, v6LC.1.2.15: Changed Ping Direction from SRC=TN2 to SRC=TN1

- Added Hyperlinks for Common Test Setup/Cleanup for each test
- Reference RFC 3513 obsoletes RFC 2373

Version 3.6.0 June 10, 2005

- Removed Test v6LC2.1.4 Prefix Invalidation (Hosts Only), renumbered section 2, group 1
- Test v6LC2.3.12, changed common test setup to 1.1, added steps 1 through 4.

Version 3.5.1 May 9, 2005

- Test v6LC.2.1.10a, b: Added Steps 4 and 10
- Test v6LC.1.3.1f: Added Steps 11 and 12

Version 3.5.0 April 19, 2005

- Test v6LC.4.1.4, Added step for Global address scope. Purpose: changed "link-local" to "on-link"
- Test v6LC.2.3.14a,b: Removed Step 7

Version 3.4.2 March 10, 2005

- Test v6LC.1.3.2, Added Common Test Setup 1.1
- Test v6LC.4.1.4, Changed. Specified size of packets.
- Second Echo Request is Fragmented.

Version 3.4.1 January 11, 2005

- Test v6LC.1.1.7b, Observable Results. Changed Pointer field to 0x2e
- Removed Test v6LC.1.2.14 Part C
- Removed Test v6LC.2.2.8 Part B

Version 3.4 December 15, 2004

- Test v6LC.2.1.21, Observable Results. Added to Step 8: The HUT MUST not transmit multicast NS's with a target set to TR1's link-local address.
- Test v6LC.2.2.13a,b,c Observable Results. Added to Step 6, 17, 31: The HUT MUST not transmit multicast NS's with a target set to TR1's link-local address.

Version 3.3 December 9, 2004

- Test v6LC.5.1.13, Changed to Routers Only.
- Test v6LC.2.1.21, Packet A: Source Address= TN1's off-link Global Address. Removed Step 8 in Observable Results. Added Observable Results, Step 8: The HUT MUST not send an Echo Reply to Packet A using TR1 as the first hop.
- Test v6LC.2.2.13a,b,c Observable Results: Changed Step 6: …In response to the Echo Request, the HUT MUST not transmit an Echo Reply. Changed Step 17 and 31: The HUT MUST not transmit an Echo Reply.
- Test v6LC.2.2.14b Added five seconds to observable results.

Version 3.2 December 1, 2004

- Test v6LC.1.1.4, Observable Results Part B: fixed typo to forwarded Echo Request
- Test v6LC.1.2.2, Observable Results Part B: fixed typo to Link A

Version 3.1 November 22, 2004

- Test v6LC.2.2.14, split in to Part A (Host Only), and Part B (Router Only), to allow for RUT configuration

Version 3.0 November 19, 2004

- Deleted Test v6LC.4.1.8 Part B

- Test v6LC.2.1.6 added Reference ND-Section 6.2.1, separated Steps 1 and 5 for host and router setup.
- Test v6LC.2.2.12, removed (Host Only), added Reference ND-Section 6.2.1, added router configurations in Steps 3 and 8.
- Test v6LC.2.2.14, removed (Host Only), added Reference ND-Section 6.2.1, added router configurations in Steps 1 and 6.

Version 2.6.4 November 10, 2004

- Added Advanced Functionality Test List to the Introduction

Version 2.6.3 October 3, 2004

- v6LC.1.2.14A: changed Address[3]: First 8 octets of TR1's Address

Version 2.6.2 September 29, 2004

- Added Test v6LC.5.1.4 Part B

Version 2.6.1	September 14, 2004
Version 2.6	September 8, 2004
Version 2.5	August 31, 2004
Version 2.4	July 30, 2004
Version 2.3	June 15, 2004
Version 2.2	May 25, 2004
Version 2.1	April 9, 2004
Version 2.0	March 3, 2004
Version 1.0	January 28, 2004
Version 0.3	June 3, 2003
Version 0.2	May 9, 2003
Version 0.1	May 1, 2003