IPv6 CONSORTIUM TEST SUITE

Address Architecture
Conformance Test Specification

Technical Document

Version 2.4

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MODIFICATION RECORD

Version 2.4 — August 16, 2010

- Added possible problem for multicast ping.
- Removed Public Address Test case as this wasn't testable requiring a Echo Request be transmitted during DAD on most devices.
- Support passive node.
- Added test 2.3 to support forwarding test cases.

Version 2.3 — January 7, 2010

- Added possible problem for support 4941 in test 1.2

Version 2.2 — December 16, 2009

- Changed direction of pings in test 1.2. (going from the DUT to TN1)
- Added possible problem for mobility in test 1.3.
- Removed test 2.3 due to Routing Header zero.

Version 2.1 — November 30, 2009

- Organized Test Cases by RFC.

Version 2.0 — August 4, 2009

- Added Tests RFC 4291- IP Forwarding (Routers)
- Reorganized Section 2 for Default Address Selection

Version 1.0 — April 24, 2009

- Initial Version.

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INTRODUCTION

Overview

The University of New Hampshire's InterOperability Laboratory (IOL) is an institution designed to improve the interoperability of standards based products by providing an environment where a product can be tested against other implementations of a standard. This suite of tests has been developed to help implementers evaluate the functionality of their products that support IPv6 Address Architecture. This test suite has been designed to test the conformance of the device under test with the specification in RFC 4291, 4193, 4007, 3879, 3484, and 2526. Successful completion of all tests contained in this suite does not guarantee that the tested device will operate with other devices that implement IPv6 Address Architecture. However, these tests provide a reasonable level of confidence that the Node Under Test will function well in most multi-vendor environments with this implementation.

Abbreviations and Acronyms

DAD: Duplicate Address Detection
DHCP: Dynamic Host Configuration Protocol for IPv6
NS: Neighbor Solicitation
DUT: Device Under Test
TN: Testing Node
TR: Testing Router
ICMP: Internet Control Message Protocol

TEST ORGANIZATION

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

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

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

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

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

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

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

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

REFERENCES

The following documents are referenced in these texts:

[RFC 4193] R. Hinden, B.Haberman. “Unique Local IPv6 Unicast Addresses”. RFC 4193, October 2005.

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

[RFC 4007] S. Deering, B. Haberman, T. Jinmei, E. Nordmark, B. Zill, “IPv6 Scoped Address Architecture”, RFC 4007, March 2005.

[RFC 3879] C. Huitema, B. Carpenter, “Deprecating Site Local Addresses”. RFC 3879, September 2004.

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

[RFC 2526] D. Johnson, S. Deering, “Reserved IPv6 Subnet Anycast Addresses”, RFC 2526, March 1999

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

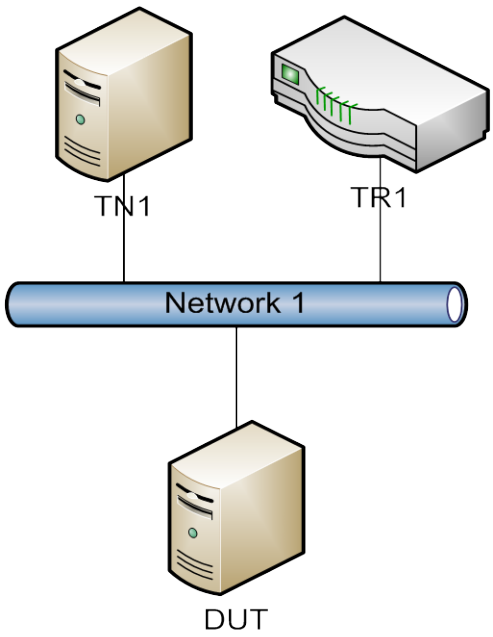
[RFC 3315] R. Droms, J. Bound, B. Volz, T. Lemon, C. Perkins, M. Carney. “Dynamic Host Configuration Protocol for IPv6 (DHCPv6)”. RFC 3315, July 2003.

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

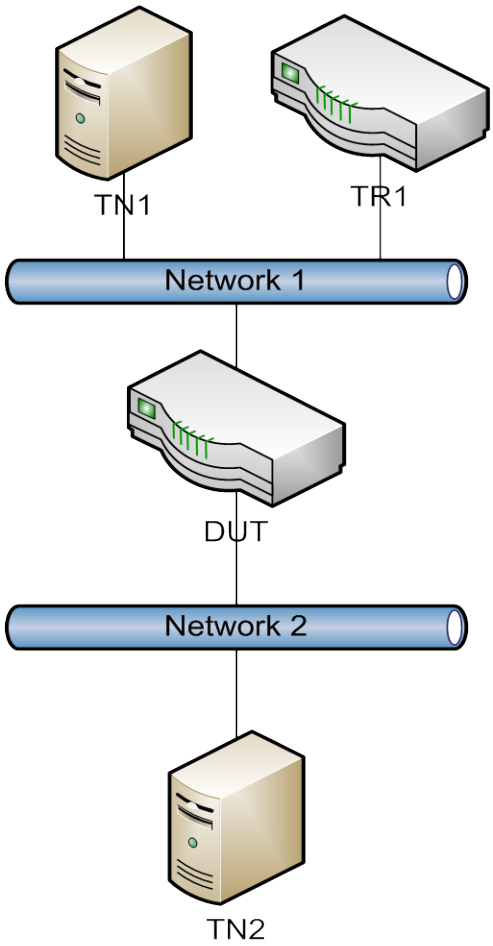
TABLE OF CONTENTS

Common Topology

The following topology is used for a Host.



The following topology is used for a Router.



Common Test Setup and Cleanup

Common Test Cleanup (for all tests)

Summary: The Cleanup procedure should cause the DUT to transition Neighbor Cache entries created in this test to state INCOMPLETE 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 DUT and waits for an Echo Reply.
4. Each TR or TN does not respond to further Neighbor Solicitations.

Group 1: IPv6 Address Architecture

Scope

These tests are designed to verify a device's behavior regarding IPv6 Address Architecture.

Overview

The tests in this group verify conformance of a device regarding the assignment of IPv6 addresses according to RFC 4291, 4007, 4193, 3879, and 2526.

Test Addr.1.1: IPv6 Scoped Address

Purpose: To verify that an IPv6 node can properly scope IPv6 addresses.

References:

- [RFC 4291]
- [RFC 4007] - Section 7 and 8

Test Setup: The network is setup according to Common Topology. The Common Test Cleanup is performed after each test. TR1 transmits Router Advertisements with a valid global prefix on Network 1. If the DUT is a router configure a valid global address on Network 1.

Procedure:

Part A: Link-local scope

1. TN1 transmits an ICMPv6 Echo Request to the link-local address of the DUT.
2. Observe the packets transmitted by the DUT.

Part B: Multicast scope

3. TN1 transmits an ICMPv6 Echo Request to the all nodes address.
4. Observe the packets transmitted by the DUT.

Part C: Global scope

5. TN1 transmits an ICMPv6 Echo Request to the global address of the DUT.
6. Observe the packets transmitted by the DUT.

Observable Results:

- *Part A:*
  Step 2: The DUT must transmit ICMPv6 Echo Reply to TN1.
- *Part B:*
  Step 4: The DUT must transmit ICMPv6 Echo Reply to TN1.
- *Part C:*
  Step 6: The DUT must transmit ICMPv6 Echo Reply to TN1.

Possible Problems:

- RFC 4443 states “An Echo Reply SHOULD be sent in response to an Echo Request message sent to an IPv6 multicast or anycast address.” The DUT may choose to omit Part B if they don’t support responding to a multicast packet.

Test Addr.1.2: Default Source Address Selection

Purpose: To verify that a node properly selects the correct address.

References:

- [RFC 3484] –Section 5

Test Setup: The network is setup according to Common Topology. The Common Test Cleanup is performed after each test.

Procedure:

Part A: Prefer appropriate scope

1. REF-Router1 to transmit valid Router Advertisement with Prefix X on Network 1. If the DUT is a router Prefix X is configured on Network 1.
2. The DUT transmits an ICMPv6 Echo Request to the global address of TN1.
3. Observe the packets transmitted by the DUT.

Part B: Avoid deprecated addresses (Host only)

4. Configure TR1 to transmit Router Advertisement with Prefix X and Y on Network1. Prefix X is configured with a preferred and valid lifetimes that last the entire test. Prefix Y is configured with a preferred lifetime shorter then valid lifetime.
5. Wait the period between the preferred and valid lifetime of Prefix Y.
6. The DUT transmits an ICMPv6 Echo Request to the global address of TN2.
7. Observe the packets transmitted by the DUT.

Part C: Prefer home addresses (Mobile Devices only)

8. Configure the DUT to have two addresses, one care-of address and one home address. This may be done by configuration or setting up Mobile IPv6.
9. The DUT transmits an ICMPv6 Echo Request with a global source address to the TN2.
10. Observe the packets transmitted by the DUT.

Part D: Use longest matching prefix

11. TR1 transmits a Router Advertisements with a Prefix of 3000::/64 and 3000:0001::/64 on Network 1. If the DUT is a router configure a prefix of 3000::/64 and 3000:0001::/64 on Network 1.
12. The DUT transmits ICMPv6 Echo Request to the TN2 with a destination address of 3000:0001:0002::1.
13. Observe the packets transmitted by the DUT.

Observable Results:

- *Part A*
  Step 2: The DUT must transmit an ICMPv6 Echo Request with a source address of the DUT's global address to TN1.
- *Part B*
  Step 7: The DUT must transmit an ICMPv6 Echo Request with a source address of the DUT's Prefix X address.
- *Part C*

Step 10: The DUT must transmit an ICMPv6 Echo Request with a source address of the DUT's home address to TN1.

- *Part D*

  Step 13: The DUT must transmit an ICMPv6 Echo Request with a 3000:0001::/64 source address to TN1.

Possible Problems:

- A passive node does not implement an application for sending Echo Request.
- This test may be omitted if the DUT is a passive node.
- Part B may be omitted if the node doesn't support mobility.
- Part D may be omitted if the node only has one physical interface.

Test Addr.1.3: Default Destination Address Selection

Purpose: To verify that a node properly selects the correct destination address.

References:

- [RFC 3484] –Section 6

Test Setup: The network is setup according to Common Topology. The Common Test Cleanup is performed after each test. DNS-Server is configured as the DNS server on the DUT.

Procedure:

Part A: Avoid deprecated addresses (Host only)

1. TR1 transmits a Router Advertisement with Prefix X and Y on Network1. Prefix X is configured with a preferred and valid lifetimes that last the entire test. Prefix Y is configured with a preferred lifetime shorter then valid lifetime.
2. Wait between the preferred lifetime and valid lifetime of Prefix Y.
3. The DUT transmits an ICMPv6 Echo Request for "node1.test.example.com".
4. In response to the DNS query from the DUT, DNS-Server transmits a DNS response with two records for TN1. One record with TN1 Prefix X and one record with TN2 Prefix Y.
5. Observe the packets transmitted by the DUT.

Part B: Prefer home addresses (Mobile Devices only)

6. Configure the DUT to have two addresses, one link local care-of address and one global home address.
7. The DUT transmits ICMPv6 Echo Requests for "node1.test.example.com".
8. In response to DNS query from the DUT, DNS1 transmits a DNS response with two records for TN1. One record for with TN1's global address and a record for TN1's link local address.
9. Observe the packets transmitted by the DUT.

Part C: Prefer smaller scope

10. TR1 transmits a Router Advertisements with Prefix X on Network1. If the DUT or any TAR-Node is a router configure Prefix X on Network 1.
11. The DUT transmits ICMPv6 Echo Requests for "node1.test.example.com".
12. In response to DNS query from the DUT, DNS1 transmits a DNS response with two records for TN1. One record for with Prefix X global address and a record for link local address.
13. Observe the packets transmitted by the DUT.

Part D: Use longest matching prefix

14. TR1 transmits a Router Advertisement with 3000::/64 and 3F44::/64 on Network 1. If the DUT is a router configure a global prefix of 3000::/64 and 3F44::/64 on Network 1 with a default router of TR1.
15. The DUT transmits ICMPv6 Echo Requests for "node1.test.example.com".
16. In response to DNS query from the DUT, DNS-Server transmits a DNS response with two records for TN1. One record with 3001::1 and one record with 3FFE::1.
17. Observe the packets transmitted by the DUT.

Observable Results:

- *Part A*

Step 5: The DUT must transmit ICMPv6 Echo Requests with a destination address of Prefix X.

- *Part B*

  Step 9: The DUT must transmit ICMPv6 Echo Requests with a global destination address of TN1.
- *Part C*

  Step 13: The DUT must transmit ICMPv6 Echo Requests with a link local destination address of TN1.
- *Part D*

  Step 17: The DUT must transmit ICMPv6 Echo Requests with a destination address of 3001::1.

Possible Problems:

- A passive node does not implement an application for sending Echo Request.
- This test may be omitted if the DUT is a passive node.
- Part B may be omitted if the node doesn't support mobility.
- If DUT doesn't support DNS another application that allows a list of destination address is acceptable.

Test Addr.1.4: Unique Local IPv6 Addresses

Purpose: To verify that a node properly uses unique local IPv6 address.

References:

- [RFC 4193] –Section 4

Test Setup: The network is setup according to Common Topology. The Common Test Cleanup is performed after each test.

Procedure:

Part A: Transmitting Unique Local IPv6 Address

1. The DUT transmits ICMPv6 Echo Request to unique local address of TN1.
2. Observe the packets transmitted by the DUT.

Part B: Receiving Unique Local IPv6 Address

3. TN1 transmits ICMPv6 Echo Request to unique local address of the DUT.
4. Observe the packets transmitted by the DUT.

Observable Results:

- *Part A*
  Step 2: The DUT must transmit an ICMPv6 Echo Request to TN1 with a unique local address as the destination.
- *Part B*
  Step 4: The DUT must transmit an ICMPv6 Echo Reply to TN1 with a unique local address as the source.

Possible Problems:

- A passive node does not implement an application for sending Echo Request.
- Part A may be omitted if the DUT is a passive node.

Test Addr.1.5: Deprecating Site Local Addresses

Purpose: To verify that a node properly deprecates IPv6 site local address.

References:

- [RFC 3879] –Section 4

Test Setup: The network is setup according to Common Topology. The Common Test Cleanup is performed after each test.

Procedure:

Part A: Transmitting Site Local IPv6 Address

1. The DUT transmits ICMPv6 Echo Request to site local address of TN1.
2. Observe the packets transmitted by the DUT.

Part B: Receiving Site Local IPv6 Address

3. TN1 transmits ICMPv6 Echo Request to site local address of the DUT.
4. Observe the packets transmitted by the DUT.

Observable Results:

- *Part A*
  Step 2: The DUT must transmit an ICMPv6 Echo Request to TN1 with a site local address as the destination.
- *Part B*
  Step 4: The DUT must transmit an ICMPv6 Echo Reply to TN1 with a site local address as the source.

Possible Problems:

- A passive node does not implement an application for sending Echo Request.
- Part A may be omitted if the DUT is a passive node.

Group 2: IPv6 Router

Scope

These tests are designed to verify a router behavior regarding IPv6 Address Architecture.

Overview

The tests in this group verify interoperability of a router regarding the assignment of IPv6 addresses according to RFC 4291, 4007, 4193, 3879, and 3484.

Test Addr.2.1: Routing Unique Local IPv6 Addresses (Router Only)

Purpose: To verify that a router properly uses unique local IPv6 address.

References:

- [RFC 4193] –Section 4.1

Test Setup: The network is setup according to Common Topology. The Common Test Cleanup is performed after each test. Connect the DUT to Network2.

Procedure:

1. TN2 transmits an Echo Request to TN1's unique local address with a first hop through the DUT. The source address is TN1's global unique local address.
2. Observe the packets transmitted by the DUT.

Observable Results:

Step 2: The DUT must forward the Echo Requests to TN1.

Possible Problems:

- None.

Test Addr.2.2: Routing Deprecated Site Local Addresses (Router Only)

Purpose: To verify that a node properly deprecates IPv6 site local address.

References:

- [RFC 3879] –Section 4

Test Setup: The network is setup according to Common Topology. The Common Test Cleanup is performed after each test. Connect the DUT to Network2.

Procedure:

1. TN2 transmits an Echo Request to TN1's site local addresses with a first hop through the DUT. The source address is TN2's global site local address.
2. Observe the packets transmitted by the DUT.

Observable Results:

Step 2: The DUT must forward the Echo Requests to TN1.

Possible Problems:

- None.

Test Addr.2.3: IP Forwarding – Source and Destination Address (Router Only)

Purpose: To verify that a router properly forwards the ICMPv6 Echo Request.

References:

- [RFC 4291] – Section 2.1, 2.5.2, 2.5.6, 2.7, 2.7.1, 2.8

Test Setup: The network is setup according to Common Topology. The Common Test Cleanup is performed after each test. Connect the DUT to Network2.

Procedure:

Part A: Request sent to Global Address

1. TN2 transmits an ICMPv6 Echo Request to TN1's global unicast address with a first hop through the DUT. The source address is TN2's global address.
2. Observe the packets transmitted by the DUT.

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

3. TN2 transmits an ICMPv6 Echo Request to TN1's global unicast address (prefix 8000::/64) with a first hop through the DUT. The source address is TN2's global address.
4. Observe the packets transmitted by the DUT.

Part C: Request sent from unspecified address

5. TN2 transmits an ICMPv6 Echo Request to TN1 with a first hop through the DUT. The source address is the unspecified address (::).
6. Observe the packets transmitted by the DUT.

Part D: Request sent to Loopback address

7. TN2 transmits an ICMPV6 Echo Request to TN1 to the loopback address (0:0:0:0:0:0:0:1) with a first hop through the DUT. The source address is TN2's global address.
8. Observe the packets transmitted on all networks.

Part E: Request sent from Link Local address

9. TN2 transmits an ICMPv6 Echo Request to TN1 with a first hop through the DUT. The source address is TN2's Link Local address.
10. Observe the packets transmitted by the DUT.

Part F: Request sent to Link Local address

11. TN2 transmits an ICMPv6 Echo Request to TN1's Link Local address with a first hop through the DUT. The source address is TN2's Global address.
12. Observe the packets transmitted by the DUT.

Part G: Request sent to Global Scope multicast address

13. Configure multicast routing on the DUT.
14. TN1 is a Listener for the multicast group FF1E::1:2.
15. TN2 transmits an ICMPv6 Echo Request to TN1's Global Scope multicast address (FF1E::1:2) with a first hop through the DUT. The source address is TN2's Global address.
16. Observe the packets transmitted by the DUT.

Part H: Request sent to Link-Local Scope multicast address

17. Configure multicast routing on the DUT.
18. TN1 is a Listener for the multicast group FF12::1:2.

19. TN2 transmits an ICMPv6 Echo Request to TN2's Link-Local Scope multicast address (FF12::1:2) with a first hop through the DUT. The source address is TN2's Global address.
20. Observe the packets transmitted by the DUT.

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

21. Configure multicast routing on the DUT.
22. TN1 is a Listener for the multicast group FF10::1:2.
23. TN2 transmits an ICMPv6 Echo Request to multicast address with a reserved field set to zero (FF10::1:2) with a first hop through the DUT. The source address is TN2's Global address.
24. Observe the packets transmitted by the DUT.

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

25. Configure multicast routing on the DUT.
26. TN1 is a Listener for the multicast group FF1F::1:2.
27. TN2 transmits an ICMPv6 Echo Request to TN1's multicast address with a reserved field set to zero (FF1F::1:2) with a first hop through the DUT. The source address is TN2's Global address.
28. Observe the packets transmitted by the DUT.

Observable Results:

- *Part A*
  Step 2: The DUT must forward the Echo Request to TN1.
- *Part B*
  Step 4: The DUT must forward the Echo Request to TR1.
- *Part C*
  Step 6: The DUT must not forward the Echo Request to TR1.
- *Part D*
  Step 8: The DUT must not forward the Echo Request to TR1.
- *Part E*
  Step 10: The DUT must not forward the Echo Request to TN1.
- *Part F*
  Step 12: The DUT must not forward the Echo Request to TN1.
- *Part G*
  Step 16: The DUT must forward the Echo Request to TN1.
- *Part H*
  Step 20: The DUT must not forward the Echo Request to TN1.
- *Part I*
  Step 24: The DUT must not forward the Echo Request to TN1.
- *Part J*
  Step 28: The DUT must forward the Echo Request to TN1.

Possible Problems:

- Parts G, H, I, and J may be omitted if DUT does not support multicast routing.