IPv6 CONSORTIUM TEST SUITE

Address Architecture
Conformance Test Specification

Technical Document

Version 2.1

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MODIFICATION RECORD

Version 2.1	November 30, 2009
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.

ACKNOWLEDGEMENTS

The University of New Hampshire would like to acknowledge the efforts of the following individuals in the development of this test suite.

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Note:

Development of this document was supported in part by a grant from NIST.

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
NUT: Node Under Test
RUT: Router 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 NUT is operating properly. When multiple observable results are possible, this section provides a short discussion on how to interpret them. The determination of a pass or fail for each test is usually based on how the NUT's behavior compares to the results described in this section.

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

REFERENCES

The following documents are referenced in these texts:

[RFC 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.

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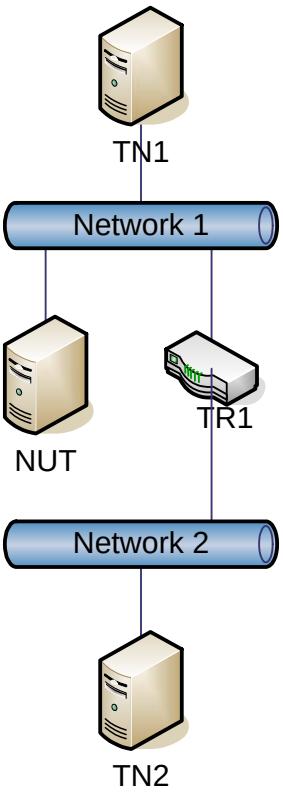
Common Topology

This topology is used for all tests in this test suite.



Common Test Setup and Cleanup

Common Test Cleanup (for all tests)

Summary: The Cleanup procedure should cause the NUT 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 NUT 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 4007] - Section 7 and 8

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

Procedure:

Part A: Link-local scope
1. TN1 transmits an ICMPv6 Echo Request to the link-local address of the NUT.
2. Observe the packets transmitted on all networks.

Part B: Multicast scope
3. TN1 transmits an ICMPv6 Echo Request to the all nodes address.
4. Observe the packets transmitted on all networks.

Part C: Global scope
5. TN1 transmits an ICMPv6 Echo Request to the global address of the NUT.
6. Observe the packets transmitted on all networks.

Observable Results:

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

Possible Problems:

- None.

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. TN1 transmits an ICMPv6 Echo Request with a source address of a global address to the NUT.
2. Observe the packets transmitted on all networks.

Part B: Prefer home addresses
3. Configure two global addresses on the NUT, a home address and a care-of address.
4. TN1 transmits an ICMPv6 Echo Request with a global source address to the NUT.
5. Observe the packets transmitted on all networks.

Part C: Prefer outgoing interface
6. Enable the NUT on Network2.
7. TN1 transmits an ICMPv6 Echo Request with a global source address to the NUT.
8. Observe the packets transmitted on all networks.

Part D: Prefer public addresses
9. Configure a global address on the NUT.
10. During Duplicate Address Detection, TN1 transmits an ICMPv6 Echo Request to the NUT.
11. Observe the packets transmitted on all networks.

Part E: Use longest matching prefix
12. Configure NUT to have two addresses of 3000::/64 and 3000:0001::/64.
13. TN1 transmits ICMPv6 Echo Request to the NUT with a source address of 3000:0001:0002::1.
14. Observe the packets transmitted on all networks.

Observable Results:

- *Part A*
  Step 2: The NUT must transmit an ICMPv6 Echo Request with a source address of NUT's global address to TN1.
- *Part B*
  Step 5: The NUT must transmit an ICMPv6 Echo Request with a source address of NUT's home address to TN1.
- *Part C*
  Step 8: The NUT must transmit an ICMPv6 Echo Request on Network 1 to TN1.
- *Part D*
  Step 11: The NUT must transmit an ICMPv6 Echo Request with a non-tentative source address to TN1.
- *Part E*

Step 14: The NUT must transmit an ICMPv6 Echo Request with a 3000:0001::/64 source address to TN1.

Possible Problems:

- Part B may be omitted if the node doesn't support mobility.
- Part C 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 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.

Procedure:

Part A: Avoid unusable destination

1. Enable the NUT on Network2.
2. Disconnect the NUT from Network1.
3. The NUT transmits ICMPv6 Echo Requests for "test.example.com".
4. In response to DNS query from the NUT, DNS1 transmits a DNS response with two records for TR1. One record for Network1 and a record for Network2.
5. Observe the packets transmitted on all networks.

Part B: Prefer matching scope

6. The NUT transmits ICMPv6 Echo Requests for "test.example.com".
7. In response to DNS query from the NUT, DNS1 transmits a DNS response with two records for TN1. One record for with global address and a record for unique local address.
8. Observe the packets transmitted on all networks.

Part C: Prefer home addresses

9. Configure the NUT to have two addresses, one unique local (care-of address) and one global (home address).
10. The NUT transmits ICMPv6 Echo Requests for "test.example.com".
11. In response to DNS query from the NUT, DNS1 transmits a DNS response with two records for TN1. One record for with global address and a record for unique local address.
12. Observe the packets transmitted on all networks.

Part D: Prefer smaller scope

13. Configure NUT to have two addresses, one global address and one unique local address.
14. The NUT transmits ICMPv6 Echo Requests for "test.example.com".
15. In response to DNS query from the NUT, DNS1 transmits a DNS response with two records for TN1. One record for with global address and a record for unique local address.
16. Observe the packets transmitted on all networks.

Part E: Use longest matching prefix

17. Configure NUT to have two permanent addresses of Prefix 3000::/64 and 3000:0001::/64.
18. In response to DNS query from the NUT, DNS1 transmits a DNS response with two records for TN1. One record for with 3000::1 and a record for 3000:0001::1.
19. The NUT transmits ICMPv6 Echo Requests for "test.example.com".
20. Observe the packets transmitted on all networks.

Observable Results:

- *Part A*
  Step 5: The NUT must transmit ICMPv6 Echo Requests with a destination address of TR1 on Network2.
- *Part B*
  Step 8: The NUT must transmit ICMPv6 Echo Requests with a global destination address of TN1.
- *Part C*
  Step 12: The NUT must transmit ICMPv6 Echo Requests with a home-address destination address of TN1.
- *Part D*
  Step 16: The NUT must transmit ICMPv6 Echo Requests with a unique local destination address of TN1.
- *Part E*
  Step 20: The NUT must transmit ICMPv6 Echo Requests with a destination address of 3000:0001::1.

Possible Problems:

- If NUT 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 NUT transmits ICMPv6 Echo Request to unique local address of TN1.
2. Observe the packets transmitted on all networks.

Part B: Receiving Unique Local IPv6 Address

3. TN1 transmits ICMPv6 Echo Request to unique local address of the NUT.
4. Observe the packets transmitted on all networks.

Observable Results:

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

Possible Problems:

- None.

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 NUT transmits ICMPv6 Echo Request to site local address of TN1.
2. Observe the packets transmitted on all networks.

Part B: Receiving Site Local IPv6 Address

3. TN1 transmits ICMPv6 Echo Request to unique local address of the NUT.
4. Observe the packets transmitted on all networks.

Observable Results:

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

Possible Problems:

- None.

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 NUT to Network2.

Procedure:

1. Transmit ICMPv6 Echo Request from TN1 to TN2 with unique local addresses for both the source and destination.
2. Observe the packets transmitted on all networks.

Observable Results:

Step 2: The RUT must forward the Echo Requests from TN1 to Network2.

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 NUT to Network2.

Procedure:

1. Transmit ICMPv6 Echo Request from TN1 to TN2 with site local addresses for both the source and destination address.
2. Observe the packets transmitted on Network1.

Observable Results:

Step 2: The RUT must forward the Echo Requests from TN1 to Network2.

Possible Problems:

- None.

Test Addr.2.3 – Routing Header Scope Check (Routers Only)

Purpose: Verify that the NUT properly processes a packet containing a routing header with IPv6 addresses of different scope.

References:

- [RFC 4007] – Section 9

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

Procedure:

Part A: Next Address Scope is Less Than Destination Address

1. TN1 transmits an Echo Request to the Global Address of the NUT. The Echo Request contains a Routing Header Type 0 with a Segments Left field of 1 and the next address is the Link-Local address of TN2.
2. Observe the packets transmitted by the NUT.

Part B: Next Address Scope is Greater Than Destination Address

3. TN1 transmits an Echo Request to the Link-Local Address of the NUT. The Echo Request contains a Routing Header Type 0 with a Segments Left field of 1 and the next address is the Global Address of TN2.
4. Observe the packets transmitted by the NUT.

Part C: Next Address Scope is the Same as Destination Address

5. TN1 transmits an Echo Request to the Link-Local Address of the NUT. The Echo Request contains a Routing Header Type 0 with a Segments Left field of 1 and the next address is the Link-Local Address TN2.
6. Observe the packets transmitted by the NUT.

Observable Results:

- *Part A*
  Step 2: The NUT must discard the packet and must not forward the Echo Request to TN2.
- *Part B*
  Step 4: The NUT must forward the Echo Request to TN2.
- *Part C*
  Step 6: The NUT must forward the Echo Request to TN2.

Possible Problems:

- None.