ROUTING CONSORTIUM

Intermediate System to Intermediate System
(IS-IS) Operations Test Suite

Technical Document

Revision 4.6

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MODIFICATION RECORD

Version 4.6 — January 12, 2009
- Updated Test 1.06 Possible Problems
- Updated Test 2.04 Observable Results to allow for jitter
- Rewrite of Test 3.07 with reference to RFC 5302
- Updated Test 3.03a to clarify that the SUT should not generate a pseudonode LSP
- Updated Tests 3.08a and 3.09a Observable Results to wait HelloTimer x 2 for the SUT to proclaim itself DIS to take jitter into account
- Updated Section 4 to reference RFC 5302 (Obseletes RFC 2966)
- Updated Section 5 to reference RFC 5304 (Obseletes RFC 3567)

Version 4.5 — June 4, 2007
- Removed Test 5.1d

Version 4.4 — March 15, 2006
- Revised test 3.3h into two parts
- Fixed Error 1.7 Possible Problems
- Removed TS1 from Test 1.9
- Fixed Typo 3.12

Version 4.3 — January 11, 2005
- Fixed reference for 5.2
- Fixed procedure for 5.2c

Version 4.2 — January 7, 2005
- Removed 4.9a, edited discussion and purpose, changed title

Version 4.1 — October 20, 2004
- Revised test 3.12
- Fixed procedure for 3.3f
- Removed unnecessary procedure in 3.7

Version 4.0 — September 8, 2004
- Removed ES from Abbreviations
- Replaced IETF drafts with RFC 3719 in References
- Changed the name of test 1.2
- Added quote from RFC 3719 section 3.2 to test 1.6
- Added in Level of PDUs and LSPs sent by Test Systems
- Changed Observable result for test 1.6c in accordance with RFC 3719 section 3.2
- Removed test 1.9
- Removed “ZeroAgeLifetime” from 2.1a as this is an architectural constant and doesn’t need to be specified.

- Added possible problem to test 3.1
- Added additional observable results to test 4.6b
- Added possible problem to test 5.5

Version 3.2 April 22, 2004

- Added information about packets sent by TRs
- Removed tests 1.10, 1.11, 2.2, 2.3, 2.5, 2.9.
- Combined tests 2.1 and 2.6
- Removed part b of test 2.3

Version 3.1 April 2-15, 2004

- Removed Tests 3.1-3.3, 3.11, 3.14, 3.15, 4.5 and 4.8
- Renamed Test 4.4
- Revised Test 3.1, 3.2, 3.4, 3.12 and 4.8
- Revised Test 3.6's Observable Results
- Removed and created a new Part C in tests 3.7 and 3.8

Version 3.0 March 15-19, 2004

- Removed Test 2.12 (ESH)
- Added Test 3.3
- Removed part B from test 3.4
- Edited and revised wording and typos in test 3.6
- Edited information concerning recieveLSPBuffersize in test 3.7
- Removed test 3.8 (Election LAN L1 DIS)
- Removed test 3.9 (Election LAN L2 DIS)
- Adjusted observable results for test 3.10
- Changed procedure and observable results for test 3.11 part c
- Removed test 3.14 (L1 and L2 DIS)
- Added tests 4.4, 4.5, 5.2, 5.3 and 5.4

Version 2.1 February 10-12, 2004

- Modified Observable Results in test 2.2
- Added Possible Problem to test 2.3
- Added Possible Problem to test 2.4
- Added more traffic to test 2.9
- Removed invalid IP address from test 3.1
- Added Possible Problem to test 3.3
- Changed Diagram and modified description in test 3.4
- Modified Observable Results of test 3.11
- Clarified procedure in test 3.12
- Removed "restart IS-IS" from test 4.2 part b
- Clarified use of up/down bit and added TLVs to test 4.4
- Clarified Observable Results in test 4.5
- Clarified the use of up/down bit and modified observable results in test 4.9

Version 2.0 January 30, 2004

- Fixed typos, edited text and diagrams.
- Added Section 4.
- Added Authentication to Section 5.

Version 1.3 — January 15, 2004

- Added definitions for levels.
- Added an exception for the configuration of MaximumAreaAddress
- Added Part C to test 1.8
- All Configuration put in procedure
- Revised Test Setup in test 1.12
- Explained the TS1's actions in test 1.13
- Added references for entire document

Version 1.2 Complete — November 25, 2003

- Allowed for jitter in 1.1
- Fixed typos in 1.6, changed values of MaximumAreaAddress field
- Removed former tests 1.10,1.11 and 1.12
- Added possible problems to 1.13
- Added a packet generator and step to 2.2
- Added possible problems to 2.13
- Removed invalid ip address from 3.1
- Added circuit type to 3.13
- Fixed typos 3.15
- Added possible problems to 3.18
- Added possible problems to 3.22 and changed test number to 3.19
- Removed former test 4.3

First Release Complete — November 11, 2003

First Version Complete — October 21, 2003

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Kari Revier	University of New Hampshire
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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 functioning of their Intermediate Systems to Intermediate Systems (IS-IS) products. The tests do not determine if a product conforms to the IS-IS Specification, nor are they purely interoperability tests. Rather, they provide one method to isolate problems within a device. Successful completion of all tests contained in this suite does not guarantee that the tested device will operate with other IS-IS devices. However, combined with satisfactory operation in the IOL's semi-production environment, these tests provide a reasonable level of confidence that the System Under Test will function well in most multi-vendor IS-IS environments.

Test Software and Descriptions

The UNH IOL Testing Software is not a full IS-IS implementation; it is simply a packet generator that can transmit and receive packets. This allows the Testing System to generate invalid packets. The Testing Software is not currently available to the public. The UNH IOL test descriptions outlined here are made available to members of the Routing/MPLS Consortium.

Abbreviations, Acronyms and Definitions

IS: Intermediate **S**ystem

DIS: Designated **I**ntermediate **S**ystem

TS: Test **S**ystem

SUT: System **U**nder **T**est

Level 1-2 System: A system configured to operate in both **L**evel **1** and **L**evel **2**. (ManualL2OnlyMode "false")

L1 System: A system configured to operate in **L**evel **1** only.

L2 System: A system configured to operate in **L**evel **2** only. (ManualL2OnlyMode "true")

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 by concatenating the short test suite name, the group number, and the test number within the group, separated by periods. The Test Number is the group and test number, also separated by a period. So, test label **IS-IS.1.2** refers to the second test of the first test group in the IS-IS Conformance suite. The test number is 1.2.

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.

Discussion: The Discussion is a general discussion of the test and relevant section of the specification, including any assumptions made in the design or implementation of the test as well as known limitations.

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: 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 transmitting packet 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 SUT 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 SUT'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 this text:

- ISO/IEC 10589 – Intermediate Systems to Intermediate Systems
- RFC 1195 – Use of OSI IS-IS for Routing in TCP / IP for Dual Environments
- RFC 3719 – Recommendations for Interoperable Networks using Intermediate System to Intermediate System (IS-IS)
- RFC 5302 – Domain-wide Prefix Distribution with Two-Level IS-IS
- RFC 5304 – Intermediate System to Intermediate System (IS-IS) Cryptographic Authentication

TABLE OF CONTENTS

1. INTERMEDIATE SYSTEM to INTERMEDIATE SYSTEM PROTOCOL DATA UNIT (IIH PDUs)

Overview

The following tests verify that a system properly handles the transmitting and receiving IIH PDUs as defined in ISO/IEC 10589.

Discussion

The Intermediate System to Intermediate System Protocol Data Units transmitted by the system are responsible for establishing and maintaining neighbor adjacencies.

Test Implementation:

In each test in this section, a test tool is used to transmit IS-IS packets. This simulates all test systems involved in the test procedure.

References:

- ISO/IEC 10589 – Sections 7, 8, 9 and 10

Test IS-IS.1.1: Hello Timer

Purpose: To verify that an Intermediate System properly transmits an IIH PDU every Hello Interval seconds.

References: [ISO 10589] – Section 8.4.4

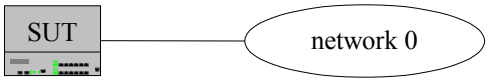
Last Modification: November 25, 2003

Discussion: A Level 1 IS shall transmit a Level 1 LAN IIH PDU immediately when any circuit whose externalDomain attribute is "False" has been enabled. A Level 2 Intermediate System shall transmit a Level 2 LAN IIH PDU. A Level 2 Intermediate System shall also transmit a Level 1 LAN IIH PDU unless the circuit is marked as manualL2OnlyMode "True".

The IS shall also transmit a LAN IIH PDU when at least 1 second has elapsed since the last transmission of a LAN IIH PDU of the same type on this circuit by this system and:

a) ISISHelloTimer seconds have elapsed since the last periodic LAN IIH PDU transmission. The Holding Time is set to ISISHoldingMultiplier × ISISHelloTimer. For a Designated Intermediate System the value of dRISISHelloTimer is used instead of ISISHelloTimer. The Holding Time for this PDU shall therefore be set to ISISHoldingMultiplier × dRISIS-HelloTimer seconds. This permits failing Designated Intermediate Systems to be detected more rapidly.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: Hello Timer set to 10 seconds

1. Configure the SUT as a Level 1-2 IS-IS system with a Hello Timer of 10 seconds.
2. Enable IS-IS on the systems.
3. Observe the packets transmitted on network 0.

Part B: Hello Timer set to 20 seconds

4. Configure the SUT's Hello Timer to be 20 seconds.
5. Re-start IS-IS on the systems.
6. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should transmit a Level 1 Hello PDU and a Level 2 Hello PDU approximately every 10 seconds (Allowing for Jitter).
- In Part B, the SUT should transmit a Level 1 Hello PDU and a Level 2 Hello PDU approximately every 20 seconds (Allowing for Jitter).

Possible Problems: None.

Test IS-IS.1.2: Area Address

Purpose: To verify that a Level 1 Intermediate System properly forms adjacencies based on Area ID.

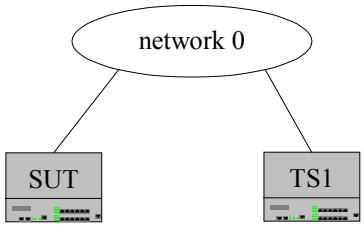
References: [ISO 10589] – Section 8.4.2.2

Last Modification: April 22, 2004

Discussion: On receipt of a Level 1 LAN IIH PDU on the multi-destination address AllL1ISs, the IS shall perform the following tests:

a) Compare each of the area addresses, from the Area Addresses field of the received IIH PDU with the set of area addresses in the manualAreaAddresses attribute. If a match is not found between any pair (i.e. the local and remote system have no area address in common), the IS shall reject the adjacency and generate an areaMismatch event.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: The SUT and TS1 in one area

1. Configure the SUT as a Level 1 IS-IS system in area 49.0001.
2. Enable IS-IS on the SUT.
3. TS1 transmits Level 1 IIH PDUs on network 0 in area 49.0001.
4. Observe the packets transmitted on network 0.

Part B: The SUT in two areas and TS1 in one area

5. Configure the SUT so that it is also in area 49.0002.
6. Re-start IS-IS on the SUT.
7. TS1 transmits Level 1 IIH PDUs on network 0 in area 49.001.
8. Observe the packets transmitted on network 0.

Part C: The SUT and TS1 in different areas

9. Configure the SUT so that it is no longer in area 49.0001.
10. Re-start IS-IS on the SUT.
11. TS1 transmits Level 1 IIH PDUs on network 0 in area 49.0001.
12. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should transmit Level 1 Hello PDUs listing area 49.0001. The SUT should become neighbors with TS1.
- In Part B, the SUT should transmit Level 1 Hello PDUs listing areas 49.0001 and 49.0002. TS1 and the SUT should remain neighbors.

- In Part C, the SUT should transmit Level 1 Hello PDUs listing area 49.0002. The SUT should no longer list TR1 as a neighbor in its IIH PDUs.

Possible Problems: None.

Test IS-IS.1.3: Level 2 Adjacency

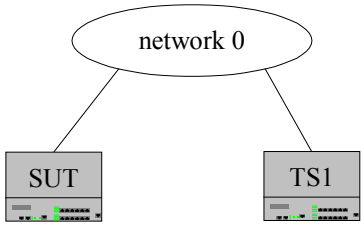
Purpose: To verify that a Level 2 system will form adjacencies with other Level 2 systems regardless of Area-ID.

References: [ISO 10589] – Section 8.4.2.3

Last Modification: April 22, 2004

Discussion: On receipt of a Level 2 LAN IIH PDU on the multi-destination address AllL2ISs, the IS shall accept the adjacency, and set the Adjacency neighbourSystemType to "L2 Intermediate System".

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: The SUT and TS1 in the same area

1. Configure the SUT as a Level 2 IS-IS system in area 49.0001.
2. Enable IS-IS on the SUT.
3. TS1 transmits level 2 IIH PDUs on network 0 in area 49.0001.
4. Observe the packets transmitted on network 0.

Part B: The SUT and TS1 in different areas

5. Re-start IS-IS on the SUT.
6. TS1 transmits level 2 IIH PDUs on network 0 in area 49.0002.
7. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should become neighbors with TS1.
- In Part B, TS1 and the SUT should remain neighbors.

Possible Problems: None.

Test IS-IS.1.4: Same Level Adjacency

Purpose: To verify that a system will only form adjacencies with other systems of the same level.

References: [ISO 10589] – Section 8.4.2

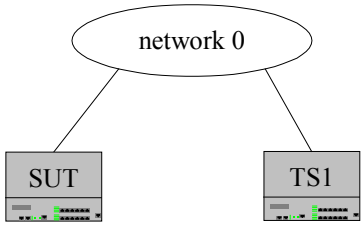
Last Modification: April 22, 2004

Discussion: Level 1 Intermediate systems shall transmit Level 1 LAN IIH PDUs to the multi-destination address AllL1ISs, and also listen on that address. They shall also listen for ESH PDUs on the multi-destination address AllIntermediateSystems. The list of neighbor Intermediate systems shall contain only Level 1 Intermediate Systems within the same area. (i.e. Adjacencies of neighbourSystemType "L1 Intermediate System".)

Level 2 Only Intermediate systems (i.e. Level 2 Intermediate systems which have the Circuit with an associated linkage manualL2OnlyMode characteristic set to the value "True") shall transmit Level 2 LAN IIH PDUs to the multi-destination address AllL2ISs, and also listen on that address. The list of neighbor Intermediate systems shall contain only Level 2 Intermediate systems. (i.e. adjacencies of neighbourSystemType "L2 Intermediate System".)

Level 2 Intermediate systems (with manualL2OnlyMode "False") shall perform both of the above actions. Separate Level 1 and Level 2 LAN IIH PDUs shall be sent to the multi-destination addresses AllL1ISs and AllL2ISs describing the neighbor Intermediate systems for Level 1 and Level 2 respectively. Separate adjacencies shall be created by the receipt of Level 1 and Level 2 LAN IIH PDUs.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: The SUT set as Level 1 system, TS1 set as Level 2 system

1. Configure the SUT as a Level 1 IS-IS system in area 49.0001.
2. Enable IS-IS on the SUT.
3. TS1 transmits level 2 IIH PDUs on network 0 in area 49.0001.
4. Observe the packets transmitted on network 0.

Part B: The SUT set as Level 2 system, TS1 set as Level 1 system

5. Configure the SUT as a Level 2 IS-IS system.
6. Re-start IS-IS on the SUT.
7. TS1 transmits level 1 IIH PDUs on network 0 in area 49.0001.
8. Observe the packets transmitted on network 0.

Observable Results:

- In Parts A and B, the SUT should not become neighbors with TS1.

Possible Problems: None.

Test IS-IS.1.5: Level 1-2 System Adjacency

Purpose: To verify a Level 1-2 system properly forms adjacencies with Level 1, Level 2, and other Level 1-2 systems.

References: [ISO 10589] – Section 8.4.2

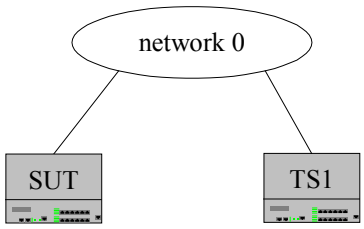
Last Modification: April 22, 2004

Discussion: Level 1 Intermediate systems shall transmit Level 1 LAN IIH PDUs to the multi-destination address AllL1ISs, and also listen on that address. They shall also listen for ESH PDUs on the multi-destination address AllIntermediateSystems. The list of neighbor Intermediate systems shall contain only Level 1 Intermediate Systems within the same area. (i.e. Adjacencies of neighbourSystemType "L1 Intermediate System".)

Level 2 Only Intermediate systems (i.e. Level 2 Intermediate systems which have the Circuit with an associated linkage manualL2OnlyMode characteristic set to the value "True") shall transmit Level 2 LAN IIH PDUs to the multi-destination address AllL2ISs, and also listen on that address. The list of neighbor Intermediate systems shall contain only Level 2 Intermediate systems. (i.e. adjacencies of neighbourSystemType "L2 Intermediate System".)

Level 2 Intermediate systems (with manualL2OnlyMode "False") shall perform both of the above actions. Separate Level 1 and Level 2 LAN IIH PDUs shall be sent to the multi-destination addresses AllL1ISs and AllL2ISs describing the neighbor Intermediate systems for Level 1 and Level 2 respectively. Separate adjacencies shall be created by the receipt of Level 1 and Level 2 LAN IIH PDUs.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: The SUT set as Level 1-2 system, TS1 set as Level 1 system

1. Configure the SUT as a Level 1-2 IS-IS system in area 49.0001.
2. Enable IS-IS on the SUT.
3. TS1 transmits level 1 IIH PDUs on network 0 in area 49.0001.
4. Observe the packets transmitted on network 0.

Part B: The SUT set as Level 1-2 system, TS1 set as Level 2 system

5. Re-start IS-IS on the SUT.
6. TS1 transmits level 2 IIH PDUs on network 0 in area 49.0001.
7. Observe the packets transmitted on network 0.

Part C: The SUT set as Level 1-2 system, TS1 set as Level 1-2 system

8. Re-start IS-IS on the SUT.
9. TS1 transmits level 1 and level 2 IIH PDUs on network 0 in area 49.0001.

10. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should become neighbors with TS1 in Level 1, but not in Level 2.
- In Part B, the SUT should become neighbors with TS1 in Level 2, but not in Level 1.
- In Part C, the SUT should become neighbors with TS1 in Level 1 and Level 2.

Possible Problems: None.

Test IS-IS.1.6: Maximum Area Address

Purpose: To verify that a Level 1 system properly forms adjacencies with other Level 1 systems based on Maximum Area Addresses.

References: [ISO 10589] – Sections 8.4.2.2 and 8.4.2.3
[RFC 3719] – Section 3.2

Last Modification: January 12, 2009

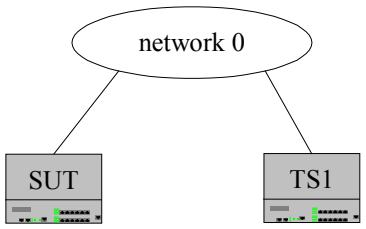
Discussion: On receipt of a Level 1 LAN IIH PDU on the multi-destination address AllL1ISs, the IS shall perform the following tests:

b) If the Maximum Area Addresses field of the PDU is not equal to the value of the IS's maximumAreaAddresses then the PDU shall be discarded and a maximumArea-AddressesMismatch event generated, unless the IS only implements a value of three for maximumAreaAddresses, in which case this check may be omitted. If the above tests succeed, the IS shall accept the adjacency and set the Adjacency neighbourSystemType to "L1 Intermediate System".

On receipt of a Level 2 LAN IIH PDU on the multi-destination address AllL2ISs, the IS shall accept the adjacency, and set the Adjacency neighbourSystemType to "L2 Intermediate System".

If a router receives a PDU with maximumAreaAddresses that is not 0 or 3, it MUST discard the PDU.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: Maximum Area Address set as the same value

1. Configure the SUT as a Level 1 IS-IS system in area 49.0001 with the Maximum Area Addresses field set to 3.
2. Enable IS-IS on the SUT.
3. TS1 transmits level 1 IIH PDUs on network 0 in area 49.0001, with the Maximum Area Addresses field set to 3.
4. Observe the packets transmitted on network 0.

Part B: Maximum Area Address set as different value.

5. Re-start IS-IS on the SUT.
6. TS1 transmits level 1 IIH PDUs on network 0 in area 49.0001, with the Maximum Area Addresses field set to 5.
7. Observe the packets transmitted on network 0.

Part C: SUT and TS1 Level 2 systems with different Maximum Area Address values.

8. Configure the SUT as a Level 2 IS-IS system.

9. Re-start IS-IS on the SUT.
10. TS1 transmits level 2 IIH PDUs on network 0 in area 49.0001, with the Maximum Area Addresses field set to 5.
11. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should become neighbors with TS1.
- In Part B, the SUT should not become neighbors with TS1.
- In Part C, the SUT should not become neighbors with TS1.

Possible Problems: The SUT may not support configuration of maximumAreaAddresses. [ISO 10589] states that if this is the case, the SUT must support the default value (0==3), and may ignore the check for maximumAreaAddresses and become neighbors with TS1 in parts B and C.

Test IS-IS.1.7: IIH PDU Fields

Purpose: To verify that a system's IIH PDUs contain the appropriate fields.

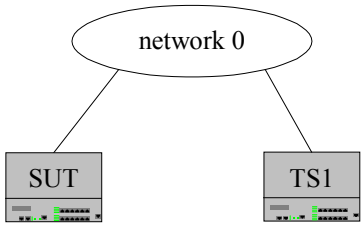
References: [ISO 10589] – Section 8.4.2

Last Modification: January 28, 2004

Discussion: Level *n* LAN IIH PDUs contain the transmitting Intermediate system's ID, holding timer, Level *n* Priority and manual-AreaAddresses, plus a list containing the lANAddresses of all the adjacencies of neighbourSystemType *"Ln* Intermediate System" (in adjacencyState "Initializing" or "Up") on this circuit.

The circuit type of a Level 1 only system shall be set to 1, the circuit type of a Level 2 only system shall be set to 2, and the circuit type of a Level 1-3 system shall be set to 3. Therefore, in a Level 1 IIH PDU the Circuit Type shall be either 1 or 3 and in a Level 2 IIH PDU the Circuit Type shall be either 2 or 3.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: Level 1 fields

1. Configure the SUT as a Level 1 IS-IS system in area 49.0001 with a System ID of 1111.2222.3333, a priority of 5, a Maximum Area Addresses of 5, a hello-interval of 10 and a hello-multiplier of 4.
2. Enable IS-IS on the SUT.
3. Observe the packets transmitted on network 0.

Part B: Level 2 fields

4. Configure the SUT as a Level 2 IS-IS system in area 49.0001 with a System ID of 1111.2222.3333, a priority of 5, a Maximum Area Addresses of 5, a hello-interval of 10 and a hello-multiplier of 4.
5. Re-start IS-IS on the SUT.
6. Observe the packets transmitted on network 0.

Part C: Level 1-2 fields

7. Configure the SUT as a Level 1-2 IS-IS system in area 49.0001 with a System ID of 1111.2222.3333, a priority of 5, a Maximum Area Addresses of 5, a hello-interval of 10 and a hello-multiplier of 4, for both levels.
8. Re-start IS-IS on the SUT.
9. Observe the packets transmitted on network 0.

Part D: Level 1-2 fields with adjacency

10. TS1 transmits Level 1 and Level 2 IIH PDUs on network 0, in area 49.0001 with the Maximum Area Addresses fields set to 5.

11. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT's IIH PDUs should include the following fields; the Circuit type set to Level 1 only, Maximum Area Addresses set to 5, System ID set to 1111.2222.3333, Hold Timer set to 40, priority set to 5, and area address(es) set to 49.0001.
- In Part B, the SUT's IIH PDUs should include the following fields; the Circuit type set to Level 2 only, Maximum Area Addresses set to 5, System ID set to 1111.2222.3333, Hold Timer set to 40, priority set to 5, and area address(es) set to 49.0001.
- In Part C, the SUT's IIH PDUs should include the following fields; the Circuit type set to Level 1-2, Maximum Area Addresses set to 5, System ID set to 1111.2222.3333, Hold Timer set to 40, priority set to 5, and area address(es) set to 49.0001.
- In Part D, the SUT should list TS1 as a neighbor in the IS Neighbor field of all IIH PDUs.

Possible Problems: The maximum-area-addresses field may not be configurable. In this case, the SUT's maximum-area-addresses field should be set to 3, and the SUT may not become adjacent with TS1 in Level 1.

Test IS-IS.1.8: ManualL2OnlyMode

Purpose: To verify that a system properly sets the manualL2OnlyMode.

References: [ISO 10589] – Sections 6.1 and 8.4.2

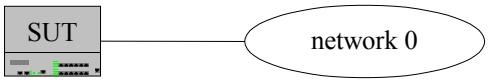
Last Modification: January 28, 2004

Discussion: Level 2 Intermediate Systems: These systems act as Level 1 Intermediate systems in addition to acting as a system in the subdomain consisting of Level 2 IS's. Systems in the Level 2 subdomain route towards a destination area, or another routing domain.

NOTE 2 Operation of a Level 2 IS may be restricted on a per circuit basis by setting manualL2OnlyMode to "True". This indicates that the circuit is to be used only for Level 2 traffic. If all circuits in a Level 2 IS have manualL2OnlyMode set to "True" then the IS does not operate as a Level 1 IS in the area.

Level 1 Intermediate systems shall transmit only Level 1 LAN IIH PDUs.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: manualL2OnlyMode set to true

1. Configure the SUT as a Level 1-2 IS-IS system. The SUT's interface to network 0 is set as a Level 2 only circuit.
2. Enable IS-IS on the SUT.
3. Observe the packets transmitted on network 0.

Part B: manualL2OnlyMode set to false

4. The SUT's interface to network 0 is set as a Level 1-2 circuit.
5. Re-start IS-IS on the SUT.
6. Observe the packets transmitted on network 0.

Part C: SUT as level 1 system.

7. Configure the SUT as a Level 1 system.
8. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should transmit Level 2 IIH PDUs, but not Level 1 IIH PDUs.
- In Part B, the SUT should transmit Level 1 and Level 2 IIH PDUs.
- In Part C, the SUT should transmit Level 1 IIH PDUs, but not Level 2 IIH PDUs.

Possible Problems: None.

Test IS-IS.1.9: LAN IIH PDU Multi-Destination Address

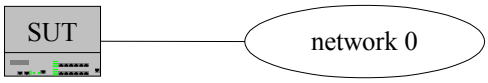
Purpose: To verify that an Intermediate System transmits its LAN IIH PDU to the correct multi-destination address, depending on the system's Level.

References: [ISO 10589] – Section 8.4.2

Last Modification: April 22, 2004

Discussion: Level 2 Intermediate systems (with manualL2OnlyMode "False") shall transmit both Level 1 and Level 2 LAN IIH PDUs to the multi-destination address AllL1Iss and AllL2Iss respectively. Separate Level 1 and Level 2 LAN IIH PDUs shall be sent to the multi-destination addresses AllL1ISs and AllL2ISs describing the neighbor Intermediate systems for Level 1 and Level 2 respectively. Separate adjacencies shall be created by the receipt of Level 1 and Level 2 LAN IIH PDUs.

Test Setup: Configure the SUT as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: System up in Level 1

1. Configure the SUT as a Level 1 IS-IS system.
2. Enable IS-IS on the SUT.
3. TS1 transmits Level 1 IIH PDUs on network 0 in area 49.0001.
4. Observe the MAC destination SNPA address in the SUT's LSP.

Part B: System up in Level 2

5. Configure the SUT as a Level 2 IS-IS system.
6. Re-start IS-IS on the SUT.
7. TS1 transmits Level 2 IIH PDUs on network 0 in area 49.0001.
8. Observe the MAC destination SNPA address in the SUT's LSP.

Part C: System up in Levels 1 and 2

9. Configure the SUT as a Level 1-2 IS-IS system.
10. Enable IS-IS on the SUT
11. TS1 transmits Level 1 and Level 2 IIH PDUs on network 0 in area 49.0001.
12. Observe the MAC destination SNPA addresses in the SUT's LSPs.

Observable Results:

- In Part A, the AllL1IS MAC destination SNPA address should be 01:80:c2:00:00:14 on the SUT.
- In Part B, the AllL2IS MAC destination SNPA address should be 01:80:c2:00:00:15 on the SUT.
- In Part C, the SUT to transmit level 1 IIH PDUs addressed to the AllL1IS MAC destination address, 01:80:c2:00:00:14, and level 2 IIH PDUS to the AllL2IS MAC destination address, 01:80:c2:00:00:15.

Possible Problems: None.

Test IS-IS.1.10: Reserved Circuit Type

Purpose: To verify that an Intermediate System ignores IIH PDUs with reserved value circuit type.

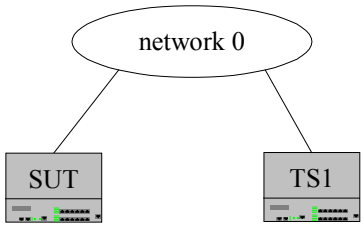
References: [ISO 10589] – Sections 9.5 and 9.6

Last Modification: April 22, 2004

Discussion: Reserved/Circuit Type – Most significant 6 bits reserved (Transmitted as zero, ignored on receipt). Low order bits (bits1 and 2) indicate:

- . 0 – reserved value (if specified the entire PDU shall be ignored)

Test Setup: Configure the systems as shown below. TS1 is a packet generator simulating a system. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: Receipt of reserved circuit type to Level 1 IS

1. Configure the SUT as a Level 1 IS-IS system in area 49.0001.
2. Enable IS-IS on the SUT.
3. TS1 transmits Level 1 IIH PDUs on network 0 in area 49.0001, with the reserved bit specified.
4. Observe the packets transmitted on network 0.

Part B: Receipt of reserved circuit type to Level 2 IS

5. Configure the SUT as a Level 2 IS-IS system.
6. Re-start IS-IS on the SUT.
7. TS1 transmits Level 2 IIH PDUs on network 0 in area 49.0001, with the reserved bit specified.
8. Observe the packets transmitted on network 0.

Observable Results:

- In Parts A and B, the SUT should ignore the IIH PDU from TS1 and should not list TS1 as its adjacent neighbor.

Possible Problems: None.

2. TIMERS

Overview

The following tests verify that an intermediate system properly sets timers defined in the ISO/IEC 10589.

Discussion

These tests are designed to verify that the SUT behaves properly when a specific timer is set.

Test Implementation:

In each test in this section, a test tool is used to transmit IS-IS packets. This simulates all test systems involved in the test procedure.

References:

- ISO/IEC 10589 – Sections 7, 8, 10 and 12

Test IS-IS.2.1: ZeroAgeLifetime

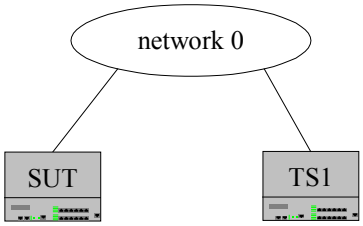
Purpose: To verify that a system properly sets its ZeroAgeLifetime.

References: [ISO 10589] – Section 7.3.21

Last Modification: February 23, 2004

Discussion: ZeroAgeLifetime – This is the minimum amount of time for which the header of an expired LSP shall be retained after it has been flooded with zero Remaining Lifetime. A very safe value for this would be 2 × MaxAge. However all that is required is that the header be retained until the zero Remaining Lifetime LSP has been safely propagated to all the neighbors.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: Expired header

1. Configure the SUT to be a Level 1 system with priority of 1.
2. Enable IS-IS on the SUT.
3. TS1 transmits Level 1PDUs with a priority of 100, to become neighbors with the SUT and DIS on network 0. TS1 then sends an LSP with remaining lifetime set to 49 seconds.
4. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, 1 minute after the LSP transmitted by TS1 has expired (49 seconds after it was sent), the SUT should delete the expired LSP from its database.

Possible Problems: Some implementations may not allow for the configuration of ZeroAgeLifetime. In such a case the default setting should be 1 minute.

Test IS-IS.2.2: Minimum and MaximumLSPGenerationInterval

Purpose: To verify that a system properly sets and executes its MinimumLSPGenerationInterval and MaximumLSPGenerationInterval.

References: [ISO 10589] – Section 7.3.5, 7.3.21

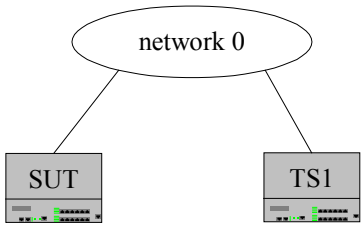
Last Modification: April 23, 2004

Discussion: MinimumLSPGenerationInterval – This is the minimum time interval between generation of Link State PDUs. A source Intermediate system shall wait at least this long before re-generating one of its own Link State PDUs. Setting the interval too slow causes a delay in reporting new information. Setting the interval too fast allows too much overhead.

A reasonable setting is 30 seconds.

The Update Process shall periodically re-generate and propagate on every circuit with an IS adjacency of the appropriate Level (by setting SRMflag on each circuit), all the LSPs (Level 1 and /or Level 2) for the local system and any pseudonodes for which it is responsible. The Intermediate system shall regenerate each LSP at intervals of at most maximumLSPGenerationInterval, with jitter applied.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: MinimumLSPGenerationInterval set to 30 seconds

1. Configure the SUT as a Level 1 system with a minimumLSPGenerationInterval of 30 seconds and a maximumLSPGenerationInterval of 2 minutes.
2. Enable IS-IS on the SUT
3. TS1 transmits Level 1 PDUs to become adjacent with the SUT.
4. Observe the packets transmitted on network 0.

Part B: MinimumLSPGenerationInterval set to 25 seconds

5. Configure the SUT as a Level 2 system with a minimumLSPGenerationInterval of 25 seconds and a maximumLSPGenerationInterval of 1 minute.
6. Re-start IS-IS on the SUT.
7. TS1 transmits Level 2 PDUs to become adjacent with the SUT.
8. Observe the packets transmitted on network 0.

Part C: MaximumLSPGenerationInterval greater than MaxAge

9. Configure the SUT with a maximumLSPGenerationInterval of 25 minutes and a MaxAge of 20 minutes.
10. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should transmit Link State PDUs at a rate of no less than 30 seconds and no more than 2 minutes.
- In Part B, the SUT should transmit Link State PDUs at a rate of no less than 25 seconds and no more than 1 minute.
- In Part C. the SUT should not allow the MaximumGenerationInterval to be greater than MaxAge.

Possible Problems: The SUT may not support the configuration of maximumLSPGenerationInterval. If this is the case, only the results for minimumLSPGenerationInterval should be checked, and part C shall not be tested. The SUT may not allow for the configuration of MaxAge, in which case the value of MaxAge should be 20 minutes.

Test IS-IS.2.3: MinimumLSPTransmissionInterval

Purpose: To verify that a system properly sets its MinimumLSPTransmissionInterval.

References: [ISO 10589] – Sections 7.3.15.5 and 7.3.21

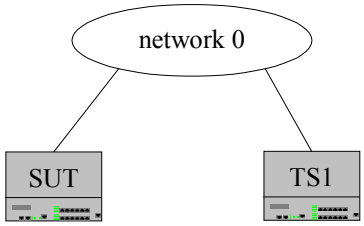
Last Modification: April 23, 2004

Discussion: Parameters:
MinimumLSPTransmissionInterval – This is the amount of time an Intermediate system shall wait before further propagating another Link State PDU from the same source system. Setting the interval too slow causes a delay in propagation of routing information and stabilization of routing algorithm. Setting the interval too fast allows the possibility that the routing algorithm, under low probability circumstances, will use too many resources (CPU and bandwidth). Setting minimumLSPTransmissionInterval greater than minimumLSPGenerationInterval makes no sense, because the source would be allowed to generate LSPs more quickly than they would be allowed to be broadcast. Setting minimumLSPTransmissionInterval smaller than the minimumLSPGenerationInterval is desirable to recover from lost LSPs.

The interval between two consecutive transmissions of the same LSP shall be at least minimumLSPTransmissionInterval. Clearly, this can only be achieved precisely by keeping a separate timer for each LSP. This would be an unwarranted overhead. Any technique which ensures the interval will be between minimumLSPTransmissionInterval and 2x minimumLSPTransmissionInterval is acceptable.

A reasonable value for minimumLSPTransmissionInterval is 5 seconds.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:
Part A: MinimumLSPTransmissionInterval less than minimumLSPGenerationInterval

1. Configure the SUT as the Level 1 DIS on network 0.
2. Configure the SUT to have a minimumLSPTransmissionInterval of 5 seconds and a maximumLSPGenerationInterval of 30 seconds.
3. Enable IS-IS on the SUT.
4. TS1 transmits Level 1 PDUs to become adjacent with the SUT.
5. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should transmit Link State PDUs at an interval of no less than 5 seconds.

Possible Problems: None.

Test IS-IS.2.4: CompleteSNPInterval

Purpose: To verify that a system properly sets its CompleteSNPInterval.

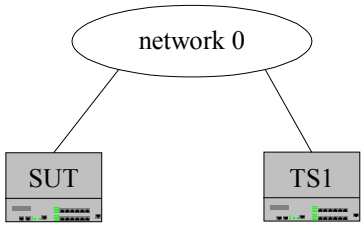
References: [ISO 10589] – Section 7.3.21

Last Modification: January 12, 2009

Discussion: Parameters:
CompleteSNPInterval – This is the amount of time between periodic transmissions of a complete set of Sequence number PDUs by the Designated Intermediate system on a broadcast link. Setting the interval too slow delays convergence of the routing algorithm when Link State PDUs are lost due to the datagram environment of the Data Link layer on the broadcast link. Setting the interval too fast results in extra control traffic overhead.

A reasonable value is 10 seconds.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:
Part A: CompleteSNPInterval of 10 seconds

1. Configure the SUT as the Level 1 DIS on network 0.
2. Configure the SUT to have a CompleteSNPInterval of 10 seconds.
3. Enable IS-IS on the SUT.
4. TS1 transmits Level 1 PDUs to become adjacent with the SUT.
5. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should transmit periodic transmissions of a complete set of Sequence number PDUs every 10 seconds, allowing for jitter.

Possible Problems: None.

Test IS-IS.2.5: Level n Intermediate System HoldingTime

Purpose: To verify that a system properly purges a neighbor from its database and generates an adjacencyStateChange event when it does not hear from its neighbor within holding time.

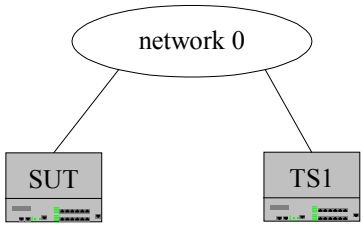
References: [ISO 10589] Section 8.4.2.5.2

Last Modification: April 23, 2004

Discussion: The IS shall keep a separate holding time (adjacency holdingTimer) for each "*Ln* Intermediate System" adjacency. The value of holdingTimer shall be set to the holding time as reported in the Holding Time field of the Level n LAN IIH PDUs. If a neighbor is not heard from in that time, the IS shall

a) purge it from the database; and
b) generate an adjacencyStateChange (Down) event.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: Level 1 Intermediate System adjacency holdingTimer

1. Configure the SUT with an ISISHelloTimer interval of 10 seconds, ISISHoldingMultiplier of 10 and priority of 1.
2. Configure the SUT as a Level 1 IS-IS system in area 49.0001.
3. Enable IS-IS on the SUT.
4. TS1 transmits level 1 IIH PDUs with a holding time of 100 seconds and priority of 100, and level 1 LSPs to become DIS on network 0 and adjacent with the SUT.
5. Observe the packets transmitted on network 0.

Part B: Neighbor down.

6. TS1 is disabled.
7. Observe the packets transmitted on network 0.

Part C: Level 2 Intermediate System adjacency holdingTimer

8. Configure the SUT as a Level 2 IS-IS system in area 49.0002, with an ISISHelloTimer interval of 10 seconds, ISISHoldingMultiplier of 10 and priority of 1.
9. Enable IS-IS on the SUT.
10. TS1 transmits level 2 IIH PDUs with a holding time of 100 seconds and priority of 100 and level 1 LSPs to become DIS on network 0 and adjacent with the SUT.
11. Observe the packets transmitted on network 0.
12. TS1 is disabled.
13. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should transmit a Level 1 LAN IIH PDU with a Hold Time of 100 seconds.
- In Part B, Approximately 100 seconds after the SUT does not hear from TS1, the SUT should purge TS1 from its database.
- In Part C, the SUT should transmit a Level 2 LAN IIH PDU with a Hold Time of 100 seconds. Approximately 100 seconds after the SUT does not hear from TS1, the SUT should purge TS1 from its database.

Possible Problems: None.

Test IS-IS.2.6: Change in topology on the LAN

Purpose: To verify that a system correctly acquires proper information when a system is disabled on a LAN.

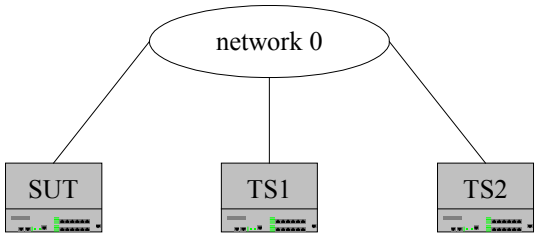
References: [ISO 10589] – Section 8.4.6

Last Modification: April 23, 2004

Discussion: When there is a change in the topology or configuration of the LAN (for example the partitioning of a LAN into two segments by the failure of a repeater or bridge), it is desirable for the (new) Designated Intermediate System to acquire the new End system configuration of the LAN as quickly as possible in order that it may generate Link State PDUs which accurately reflect the actual configuration. This is achieved as follows.
When the circuit is enabled, or the Intermediate system detects a change in the set of Intermediate systems on the LAN, or a change in the Designated Intermediate System ID, the IS shall initiate a poll of the ES configuration by performing the following actions.

a) Delay a random interval between 0 and ISISHelloTimer. (This is to avoid synchronization with other Intermediate systems that have detected change.)
b) If (and only if) an Intermediate System had been removed from the set of Intermediate systems on the LAN, reset the entryRemainingTime field in the neighbor-SystemIDs adjacency database record of all adjacencies on this circuit to the value (ISISHelloTimer + pollESHelloRate) x ISISHoldingMultiplier or the existing value whichever is the lower. (This causes any End systems that are no longer present on the LAN to be rapidly timed out, but not before they have a chance to respond to the poll.)
c) Transmit ISISHoldingMultiplier iSH PDUs for each NET possessed by the Intermediate system with a Suggested ES Configuration Timer value of pollESHelloRate at an interval between them of ISISHelloTimer and a holding time of iSConfigurationTimer x ISISHoldingMultiplier.
d) Resume sending ISH PDUs at intervals of iSConfiguration-Timer with a Suggested ES Configuration Timer value of defaultESHelloTimer.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: The SUT becomes the DIS

1. Configure the SUT as a Level 1 IS-IS system in area 49.0001. The SUT should be DIS on network 0.
2. Configure the SUT with a Hello Timer set to 10 seconds.
3. Enable IS-IS on the SUT.

4. TS1 and TS2 transmit level 1 IIH PDUs at 10 second intervals, and level 1 LSPs to become adjacent with the SUT.
5. Wait for systems to see each other as neighbors
6. TS2 is disabled on network 0.
7. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, after TS2 is disabled, the SUT should transmit a LSP with a suggested LAN topology, which does not include TS2 as a neighbor.

Possible Problems: None.

3. PROTOCOL DATA UNIT

Overview

The following tests verify that a given system properly handles the receiving and transmitting of IS-IS Protocol Data Units (PDUs).

Discussion

These tests are designed to test a system's conformance behaviors upon receiving and transmitting PDUs, set forth in ISO/IEC 10859.

Test Implementation:

In each test in this section, a test tool is used to transmit IS-IS packets. This simulates all test systems involved in the test procedure.

References:

- ISO/IEC 10859 – Sections 2, 7, 12 and 14
- RFC 5302

Test IS-IS.3.1 L1LSPBufferSize Mismatch

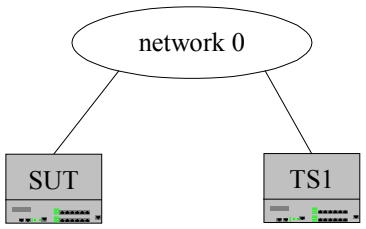
Purpose: To verify that a system properly sets the ReceivedLSPBufferSize for its own interfaces, allows for the proper setting of the originatingL1LSPBufferSize and drops any incoming packets with originatingL1LSPBufferSize greater than ReceiveLSPBufferSize.

References: [ISO 10589] – Sections 7.3.4.2, 7.3.14.2 and 7.3.15.1

Last Modification: April 16, 2004

Discussion: The maximum sized Level 1 or Level 2 LSP that may be generated by a system is determined by the values of the management parameters originatingL1LSPBufferSize and originatingL2LSPBufferSize (512…1492). When a Link State PDU (LSP) is received a system shall perform the following functions: If this is a Level 1 LSP and the originatingLSPBufferSize field is present and the value in the PDU does not match the local value of originatingL1LSPBufferSize or this is a Level 2 LSP and the originatingLSPBufferSize field is present and the value in the PDU does not match the local value of originatingL2LSPBufferSize then an originatingLSP-BufferSizeMismatch alarm shall be generated and the PDU shall be accepted for further processing. The maximum size control PDU (Link State PDU or Sequence Numbers PDU) that a system expects to receive is ReceiveLSPBufferSize octets (1492). (i.e. the Update process must provide buffers of at least this size for the reception, storage and forwarding of received Link State PDUs and Sequence Numbers PDUs.) If a control PDU larger than this size is received, it shall be treated as if it had an invalid checksum (i.e. ignored by the Update Process and a corruptedLSPReceived event generated).

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: The SUT receives an LSP with length less than ReceiveLSPBufferSize

1. Configure the SUT as a Level 1 IS-IS system with a ReceiveLSPBufferSize set to 1492 and originatingL1LSPBufferSize set to at least 1492.
2. Enable IS-IS on the SUT.
3. TS1 transmits PDUs to become adjacent with the SUT.
4. TS1 transmits an LSP smaller in length than 1492.
5. Observe the packets transmitted on network 0.

Part B: The SUT receives an LSP with length equal to ReceiveLSPBufferSize

6. TS1 transmits an LSP with length equal to 1492.
7. Observe the packets transmitted on network 0.

Part C: The SUT receives an LSP with length greater than ReceiveLSPBufferSize

8. TS1 transmits an LSP with length greater than 1492.
9. Observe the packets transmitted on network 0.

Observable Results:

- In Parts A and B, the SUT should accept the LSP from TS1.
- In Part C, the SUT should discard the LSP from TS1.

Possible Problems: Some implementations may allow ReceivedLSPBuffersize to be configured. In such a case, the value of ReceivedLSPBuffersize should be 1492. In accordance with RFC 3719 sections 5(4)-(6) and 6, some routers may not discard large PDUs by default.

Test IS-IS.3.2: Acknowledging LSPs

Purpose: To verify that an Intermediate System properly acknowledges an incoming LSP.

References: [ISO 10589] – Sections 7.3.4.5, 7.3.14.2 and 7.3.17

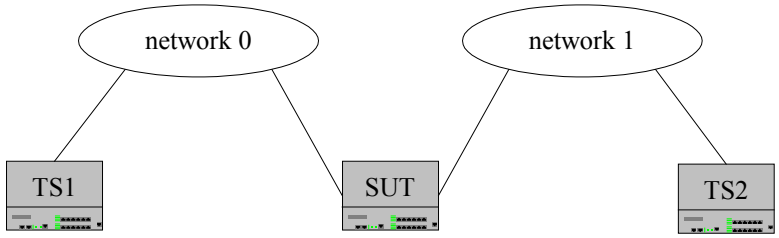
Last Modification: April 12, 2004

Discussion: When some event requires changing the LSP information for a system, the system shall reissue that (or those) LSP(s) that would have different contents. It is not required to reissue the unchanged LSPs. Thus a single End system adjacency change only requires the reissuing of the LSP containing the End System Neighbors option referring to that adjacency.

Level 2 Link State PDUs shall be propagated on circuits that have at least one Level 2 adjacency.

On broadcast links, instead of explicit acknowledgements for each link state PDU by each Intermediate system, a special PDU known as a Complete Sequence Numbers PDU (CSNP), shall be multicast periodically by the Designated Intermediate System. The PDU shall contain a list of all LSPs in the database, together with enough information so that Intermediate systems receiving the CSNP can compare with their LSP database to determine whether they and the CSNP transmitter have synchronized LSP databases. If an Intermediate system, upon receipt of a Complete Sequence Numbers PDU, detects that the transmitter was out of date, the receiver shall multicast the missing information. If an Intermediate system detects that the transmitter had more up to date information, the receiving Intermediate system shall multicast a Partial Sequence Numbers PDU (PSNP), containing information about LSPs for which it has older information.

Test Setup: Configure the Systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used. The Backbone should be assigned an area ID of 49.0002.



Procedure:

Part A: The SUT is the Level 1 DIS

1. Configure the SUT as a Level 1 IS-IS system with a priority of 3 on both networks.
2. Enable IS-IS on the SUT.
3. TS1 and TS2 transmit Level 1 PDUs to become adjacent with the SUT. They advertise a priority of 2 in their IIH PDUs so that the SUT should be elected Level 1 DIS on both networks.
4. TS2 transmits a Level 1 LSP with a route to an external network.
5. Observe the packets transmitted on networks 0 and 1.

Part B: The SUT is a non-DIS on Level 1

6. TS1 and TS2 transmit Level 1 PDUs to become adjacent with the SUT. They advertise a priority of 4 in their IIH PDUs so that they become the DIS on their respective networks. TS2 transmits an LSP with a route to the external network.
7. TS2 transmits a new LSP without the Level 1 path to the external network.
8. Observe the packets transmitted on networks 0 and 1.

Part C: The SUT is the Level 2 DIS

9. Configure the SUT as a Level 2 IS-IS system with a priority of 3 on both networks.
10. TS1 and TS2 transmit Level 2 PDUs to become adjacent with the SUT. They advertise a priority of 2 in their IIH PDUs so that the SUT should be elected Level 2 DIS on both networks.
11. TS2 transmits a new Level 2 LSP with a route to the external network.
12. Observe the packets transmitted on networks 0 and 1.

Part D: The SUT is a non-DIS on Level 2

13. TS1 and TS2 transmit Level 2 PDUs to become adjacent with the SUT. They advertise a priority of 4 in their IIH PDUs so that they become the DIS on their respective networks. TS2 transmits a Level 2 LSP with a route to the external network.
14. TS2 transmits a new Level 2 LSP without the path to the external network.
15. Observe the packets transmitted on networks 0 and 1.

Observable Results:

- In Part A, the SUT should generate a Level 1 CSNP on both networks listing TS2's new LSP.
- In Part B, the SUT should not generate a CSNP advertising TS2's new LSP.
- In Part C, the SUT should generate a Level 2 CSNP on both networks listing TS2's new LSP.
- In Part D, the SUT should not generate a CSNP advertising TS2's new LSP.

Possible Problems: None.

Test IS-IS.3.3: Election of LAN Level 1 Level 2 Designated Intermediate System

Purpose: To verify that a system properly elects Level 1 and Level 2 systems.

References: [ISO 10589] – Sections 7.2.3, 8.4.1 and 8.4.5

Last Modification: January 12, 2009

Discussion: A LAN Designated Intermediate System is the Intermediate system in a particular set on the LAN with the highest priority. In case of a tie the numerically highest MAC source SNPAAddresses are compared. Designated Intermediate systems are determined separately for Level 1 and Level 2. They are known as the LAN Level 1Designated IS and the LAN Level 2 Designated IS respectively.

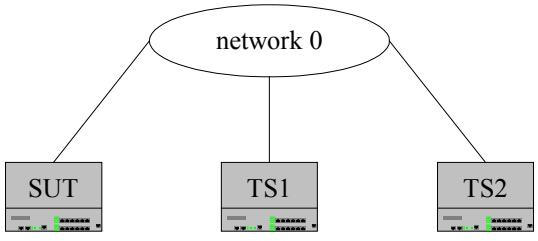
Level 2 Intermediate systems (with manualL2OnlyMode "False") elect both the LAN Level 1 and LAN Level 2 Designated Intermediate Systems.

The designated Intermediate system, on behalf of the pseudonode, shall construct Link State PDUs reporting the links to all the systems on the broadcast subnetwork with a zero value for each supported routing metric).

An Intermediate system may resign as Designated Intermediate System on a broadcast circuit either because it (or its SNPA on the broadcast subnetwork) is being shut down or because some other Intermediate system of higher priority has taken over that function. When an Intermediate system resigns as Designated Intermediate System, it shall initiate a network wide purge of its pseudonode Link State PDU(s) by setting their Remaining Lifetime to zero. A LAN Level 1 Designated Intermediate System purges Level 1 Link State PDUs and a LAN Level 2 Designated Intermediate System purges Level 2 Link State PDUs. An Intermediate system that has resigned as both Level 1 and Level 2 Designated Intermediate System shall purge both sets of LSPs.

An Intermediate system shall not declare itself to be a LAN Designated Intermediate system of any type until it has at least one "Up" End system (not including manual adjacencies) or Intermediate system adjacency on the circuit.

Test Setup: Configure the systems shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: The SUT with no adjacencies

1. Configure the SUT as a Level 1-2 IS-IS system.
2. Enable IS-IS on the SUT.
3. Observe the packets transmitted on network 0.

Part B: The SUT with higher priority

5. Configure the SUT to have a priority of 3 and a helloTimer of 5 seconds.
6. TS1 transmits Level 1 IIH PDUs with a priority of 2. TS2 transmits Level 2 IIH PDUs with a priority of 2.
7. Observe the packets transmitted on network 0.

Part C: The SUT disabled

10. Disable the SUT.
11. Observe the packets transmitted on network 0.

Part D: Level 2 Preemptive election

12. TS1 stops sending Level 1 IIH PDUs and begins sending Level 2 IIH PDUs with a priority of 1. TS1 and TS2 list TS2 as the DIS in their IIH PDUs.
13. Restart IS-IS on the SUT (still with a priority of 3).
14. Observe the packets transmitted on network 0.

Part E: Level 1 Preemptive selection

15. Disable the SUT.
16. TS1 and TS2 begin sending Level 1 IIH PDUs. TS1 lists a priority of 1 and TS2 lists a priority of 2. Both list TS2 as the DIS.
17. Restart IS-IS on the SUT.
18. Observe the packets transmitted on network 0.

Part F: The SUT with lower priority

19. Configure the SUT to have priority1.
20. Restart IS-IS on the SUT.
21. TS2 begins sending Level 2 IIH PDUs, both with priorities of 2.
22. Observe the packets transmitted on network 0.

Part G: The SUT with higher MAC source SNPA address

23. Configure the SUT to have a priority of 3.
24. Restart IS-IS on the SUT.
25. TS1 and TS2 begin transmitting Level 1 and Level 2 IIH PDUs respectively with priorities of 3 and a MAC source SNPA addresses lower than the SUT.
26. Observe the packets transmitted on network 0.

Part H: The SUT with lower MAC source SNPA address on Level 1

27. Restart IS-IS on the SUT.
28. TS1 begins transmitting Level 1 IIH PDUs with a priority of 3 and MAC source SNPA addresses lower than the SUT.
29. TS2 begins transmitting Level 1 IIH PDUs with a priority of 3 and MAC source SNPA addresses higher than the SUT.
30. Observe the packets transmitted on network 0.

Part I: The SUT with lower MAC source SNPA address on Level 2

31. Restart IS-IS on the SUT.
32. TS1 begins transmitting Level 2 IIH PDUs with a priority of 3 and MAC source SNPA addresses lower than the SUT.
33. TS2 begins transmitting Level 2 IIH PDUs with a priority of 3 and MAC source SNPA addresses higher than the SUT.
34. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should not generate a Pseudonode LSP to proclaim itself to be LAN Level 1 or Level 2 Designated Intermediate System.
- In Part B, the SUT should become the Level 1 and Level 2 DIS after waiting for HelloTimer x 2 seconds. The SUT should generate Level 1 and a Level 2 pseudonode LSPs containing neighbor adjacency information. A value of zero shall be used for all supported routing metrics.
- In Part C, the SUT should purge both its Level 1 and Level 2 pseudonode LSPs with the Remaining Lifetime set to zero.
- In Part D, the SUT should be elected Level 2 DIS. The SUT should generate Level 2 pseudonode LSPs containing neighbor adjacency information. A value of zero shall be used for all supported routing metrics.
- In Part E, the SUT should be elected Level 1 DIS. The SUT should generate a Level 1 pseudonode LSP containing neighbor adjacency information. A value of zero shall be used for all supported routing metrics.
- In Part F, TS1 should be elected Level 1 DIS and TS2 should be elected Level 2 DIS.
- In Part G, the SUT should be elected Level 1 and Level 2 DIS. The SUT should generate Level 1 and Level 2 pseudonode LSPs containing neighbor adjacency information. A value of zero shall be used for all supported routing metrics.
- In Part H, TS2 should be elected Level 1 DIS. The SUT should purge its Level 1 pseudonode LSPs with the Remaining Lifetime set to zero.
- In Part I, TS2 should be elected Level 2 DIS. The SUT should purge its Level 2 pseudonode LSPs with the Remaining Lifetime set to zero.

Possible Problems: None.

Test IS-IS.3.4: Multiple LSPs and LSPBufferSize

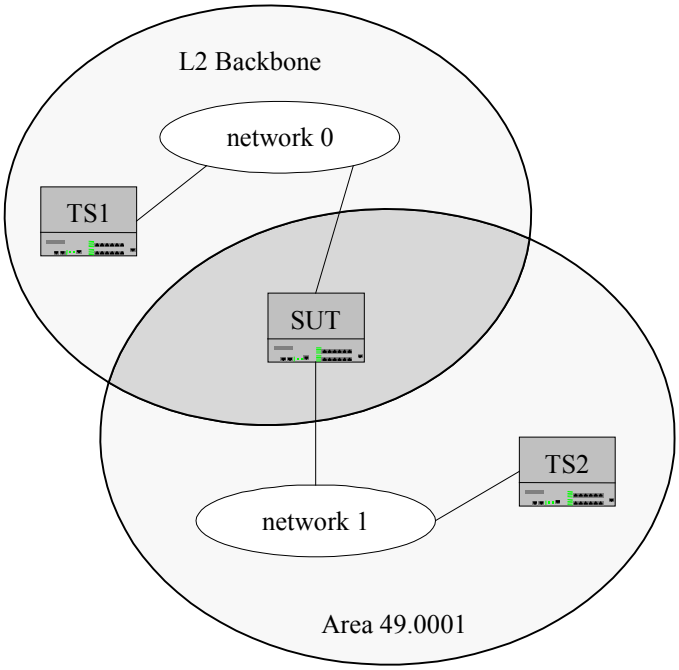
Purpose: To verify that a system properly generates packets in accordance with the value of it's originating buffer size.

References: [ISO 10589] – Sections 7.3.4.1 and 7.3.14.2

Last Modification: April 16, 2004

Discussion: The maximum size control PDU (Link State PDU or Sequence Numbers PDU) that a system expects to receive is ReceiveLSPBufferSize octets. (i.e. the Update process must provide buffers of at least this size for the reception, storage and forwarding of received Link State PDUs and Sequence Numbers PDUs.)Because a Link State PDU is limited in size to ReceiveLSPBufferSize, it may not be possible to include information about all of a system's neighbors in a single LSP. In such cases, a system may use multiple LSPs to convey this information. Each LSP in the set carries the same sourceID field, but sets its own LSP Number field individually. Each of the several LSPs is handled independently by the Update Process, thus allowing distribution of topology updates to be pipelined. However, the Decision Process recognizes that they all pertain to a common originating system because they all use the same sourceID.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: The SUT must transmit more information than ReceivedLSPBufferSize will allow

1. Configure the SUT as a Level 1-2 IS-IS system, having an originatingL2LSPBufferSize set to 512 and advertising Level 2 routes into Level 1.
2. IS-IS is enabled on the SUT.

3. TS1 transmits Level 2 PDUs to become adjacent with the SUT on Network 0. TS2 transmits Level 1 PDUs to become adjacent with the SUT on Network 1.
4. TS1 transmits an LSP with a length greater than 512.
5. Observe the Level 2 packets transmitted on network 1.

Observable Results:

- In Part A, the SUT should send two LSPs smaller in length than 512 to TS2 containing the routes advertised by TS1.

Possible Problems: The SUT may not choose to split the neighbor information into multiple LSPs, but may truncate one single LSP instead, to accommodate ReceivedLSPBufferSize.

Test IS-IS.3.5: Neighbor not yet Adjacent

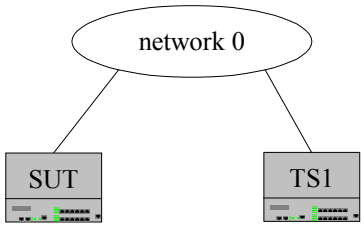
Purpose: To verify that a system discards an LSP or SNP from a neighbor with which it has not exchanged hello packets and formed an adjacency.

References: [ISO 10589] – Sections 8.4.1 and 8.4.5

Last Modification: November 11, 2003

Discussion: An Intermediate system shall not declare itself to be a LAN Designated Intermediate system of any type until it has at least one "Up" End system (not including manual adjacencies) or Intermediate system adjacency on the circuit. Additionally Level 1 and 2 Link State PDUS should only be propagated when a given system has at least one Level 1 or 2 adjacency, respectively.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: Level 1 LSP sent declaring DIS prior to adjacency forming

1. Configure the SUT as a Level 1 IS-IS system.
2. Enable IS-IS on the SUT.
3. TS1 transmits a Level 1 LSP to the network declaring it self as DIS and listing the SUT as an adjacent neighbor.
4. Observe the packets transmitted on network 0.

Part B: Level 1 PSNP sent prior to adjacency forming

5. TS1 transmits a Level 1 PSNP.
6. Observe the packets transmitted on network 0.

Part C: Level 2 LSP sent declaring DIS prior to adjacency forming

7. Configure the SUT as a Level 2 only IS-IS system.
8. TS1 is a Level 2 only IS-IS system.
9. Enable IS-IS on the SUT.
10. TS1 transmits an LSP declaring itself as DIS and listing the SUT as an adjacent neighbor.
11. Observe the packets transmitted on network 0.

Part D: Level 2 PSNP sent prior to adjacency forming

12. Configure the SUT as a Level 1-2 IS-IS system.
13. Enable IS-IS on the SUT.
14. TS1 transmits a Level 2 PSNP.
15. Observe the packets transmitted on network 0.

Observable Results:

- In Parts A and C, the SUT should not acknowledge the LSP and should not list TS1 as an adjacent neighbor.
- In Parts B and D, the SUT should not respond to the PSNP transmitted by TS1.

Possible Problems: None.

Test IS-IS.3.6: Basic LSP Propagation

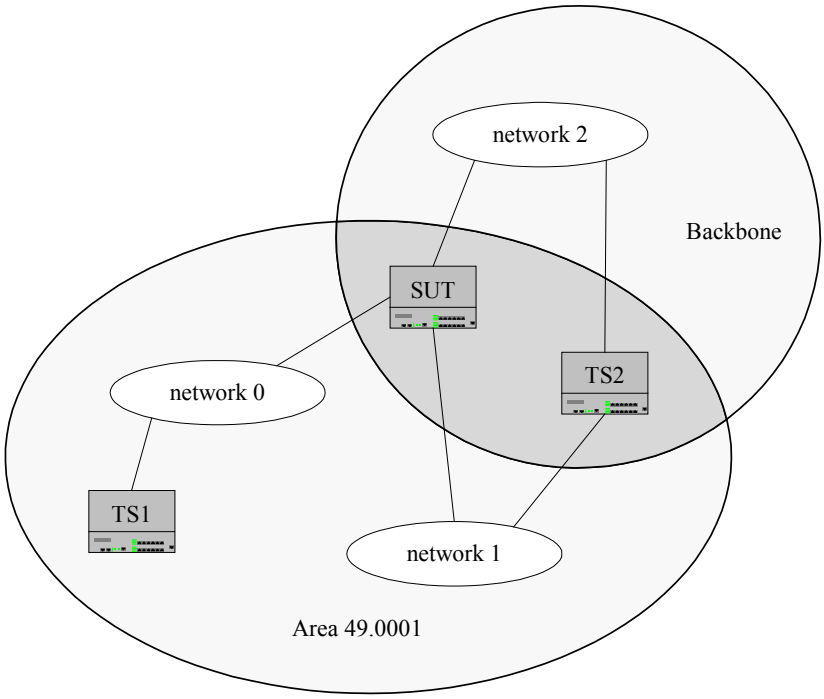
Purpose: To verify that a system properly propagates Link State PDUs (LSPs) from within its Level 1 area.

References: [ISO 10589] – Sections 7.3.2 and 7.3.15.1

Last Modification: April 13, 2004

Discussion: The Update Process is responsible for constructing a set of Link State PDUs. The purpose of these Link State PDUs is to inform all the other Intermediate systems (in the area, in the case of Level 1, or in the Level 2 subdomain, in the case of Level 2), of the state of the links between the Intermediate system that generated the PDUs and its neighbors. The Update Process in an Intermediate system shall generate one or more new Link State PDUs when notified by the Subnetwork Dependent Functions of an Adjacency Database Change.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: The SUT is a Level 1-2 system

1. Configure the SUT as a Level 1-2 system, with priority 3 on network 2, priority 2 on network 1 and priority 2 on network 0.
2. Configure the SUT's interfaces on networks 0 and 1 as level 1 circuits and it's interface to network 2 as a level 2 only circuit.
3. IS-IS is enabled on the SUT.

4. TS2 transmits Level 1 PDUs on Network 1 and Level 2 PDUs on Network 2 to become adjacent with the SUT. TS2 has a priority of 1 in its IIH PDUs on Network 1 a priority of 2 on Network 2.
5. Once the SUT has become adjacent with TS2, TS1 sends Level 1 PDUs to become adjacent with the SUT on Network 0. TS2 has a priority of 3 in its IIH PDUs.
6. Observe the packets transmitted on all networks.

Part B: The SUT is Level 1-2 DIS

6. Restart IS-IS on the SUT.
7. TS1 now has a priority of 1 in its IIH PDUs.
8. After the SUT becomes adjacent with TS1 and TS2, TS1 stops sending IIH PDUs.
9. Observe the packets transmitted on all networks.

Observable Results:

- In Part A, the SUT should transmit TS1's new LSP to network 1 but not to network 2.
- In Part B, the SUT should transmit a new pseudonode LSP no longer listing TS1 as a neighbor on network 0 to network 1, but not network 2.

Possible Problems: None.

Test IS-IS.3.7: Propagating Reachable Addresses

Purpose: To verify that a system properly generates LSPs containing Reachable Address prefixes throughout the IS-IS domain.

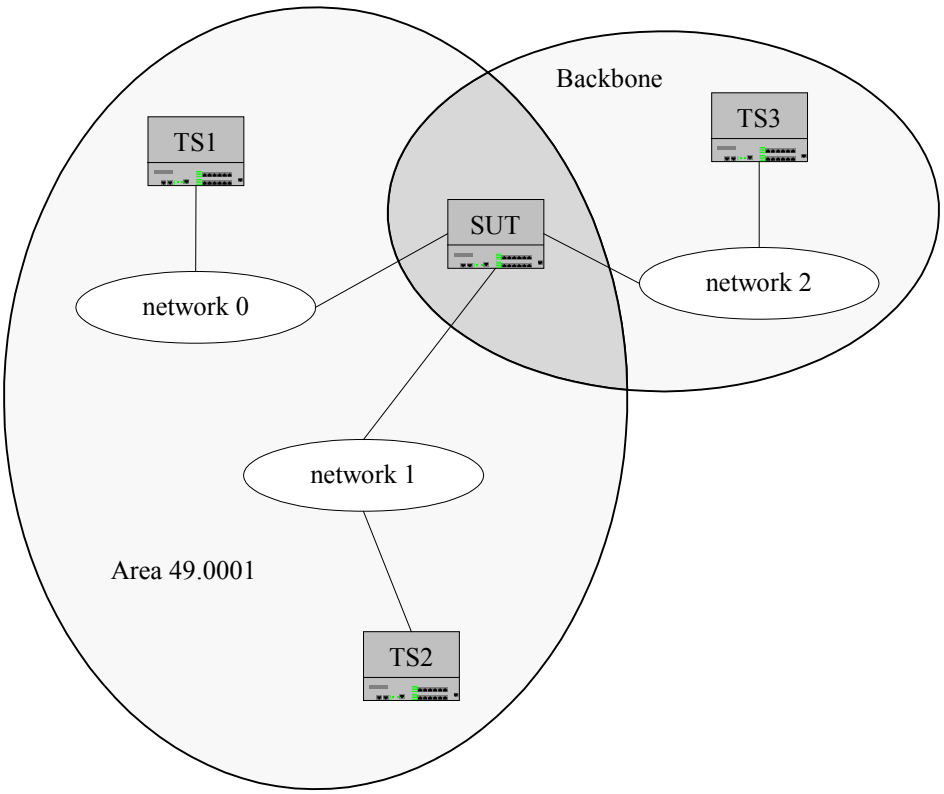
References: [ISO 10589] – Sections 7.3.3.2 and 7.3.6
[RFC 5302] – Sections 2.2 and 3.3

Last Modification: January 12, 2009

Discussion: A Level 2 Intermediate system may have a number of reachable Address managed objects created by System management. When a reachable Address managed object is in operational-State "Enabled" and the linkage managed object associated with its parent Circuit is also in operationalState "Enabled", the name and each of its defined routing metrics shall be included in Level 2 LSPs generated by this system.

In addition to the periodic generation of LSPs, an Intermediate system shall generate an LSP when an event occurs which would cause the information content to change; such as a change in Reachable Address metric

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used. The Backbone should be assigned an area ID of 49.0002.



Procedure:

Part A: TS1 is a Level 1-2 DIS

1. Configure the SUT as a Level 1-2 IS-IS system with a priority of 3 on all links.
2. Enable IS-IS on the SUT.
3. TS1 advertises a priority of 4 in both its Level 1 and Level 2 IIH PDUs. TS1 forms an adjacency with the SUT and becomes the Level 1 and Level 2 DIS on Network 0.
4. TS2 advertises a priority of 4 in its Level 1 IIH PDUs. TS2 forms an adjacency with the SUT and becomes the Level 1 DIS on Network 1.
5. TS3 advertises a priority of 2 in its Level 2 IIH PDUs. The SUT forms an adjacency with TS3 and becomes the Level 2 DIS on Network 2.
6. TS1 advertises two external routes, one in a Level 1 LSP and another in a Level 2 LSP.
7. Later, TS1 transmits additional Level 1 and Level 2 LSPs advertising the same external routes with a different cost.
8. Observe the packets transmitted on all networks.

Part B: SUT is a Level 1-2 DIS

9. Restart IS-IS on the SUT.
10. TS1 advertises a priority of 1 in its Level 1 IIH PDUs. The SUT forms an adjacency with TS1 and becomes the Level 1 DIS on Network 0.
11. TS2 advertises a priority of 4 in its Level 1 IIH PDUs. TS2 forms an adjacency with the SUT and becomes the Level 1 DIS on Network 1.
12. TS3 advertises a priority of 2 in its Level 2 IIH PDUs. The SUT forms an adjacency with TS3 and becomes the Level 2 DIS on Network 2.
13. TS1 advertises two external routes, one in a Level 1 LSP and another in a Level 2 LSP.
14. Later, TS1 transmits additional Level 1 and Level 2 LSPs advertising the same external routes with a different cost.
15. Observe the packets transmitted on all networks.

Observable Results:

- In Parts A and B the SUT should advertise the external route learned from TS1's Level 1 LSP to Network 1, and the external route learned from TS1's Level 2 LSP to Network 2. After TS1 transmits the updated LSPs, the SUT should propagate the updated external route costs in LSPs to their respective networks. There should be no route leaking of IP External Reachability information from one Level to another.

Possible Problems: None.

Test IS-IS.3.8: Level 1 Designated Intermediate System

Purpose: To verify that a system properly behaves when declaring or resigning itself as Designated Intermediate System.

References: [ISO 10589] – Sections 7.2.3, 7.3.8 and 8.4.5

Last Modification: January 12, 2009

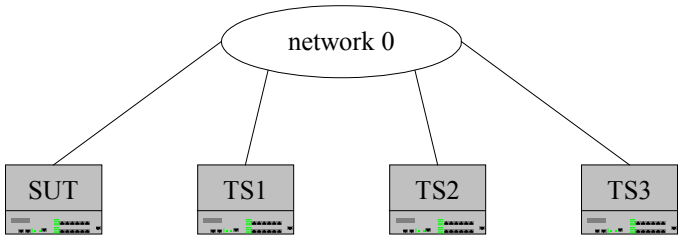
Discussion: Instead of treating a broadcast subnetwork as a fully connected topology, the broadcast subnetwork is treated as a pseudonode, with links to each attached system. Attached systems shall only report their link to the pseudonode. The designated Intermediate system, on behalf of the pseudonode, shall construct Link State PDUs reporting the links to all the systems on the broadcast subnetwork with a zero value for each supported routing metric).

The pseudonode shall be identified by the sourceID of the Designated Intermediate system, followed by a non-zero pseudonodeID assigned by the Designated Intermediate system. The pseudonodeID is locally unique to the Designated Intermediate system.

An Intermediate system may resign as Designated Intermediate System on a broadcast circuit either because it (or its SNPA on the broadcast subnetwork) is being shut down or because some other Intermediate system of higher priority has taken over that function. When an Intermediate system resigns as Designated Intermediate System, it shall initiate a network wide purge of its pseudonode Link State PDU(s) by setting their Remaining Lifetime to zero and performing the actions described in 7.3.16.4. A LAN Level 1 Designated Intermediate System purges Level 1 Link State PDUs and a LAN Level 2 Designated Intermediate System purges Level 2 Link State PDUs. An Intermediate system which has resigned as both Level 1 and Level 2 Designated Intermediate System shall purge both sets of LSPs.

When an Intermediate system declares itself as designated Intermediate system and it is in possession of a Link State PDU of the same level issued by the previous Designated Intermediate System for that circuit (if any), it shall initiate a network wide purge of that (or those) Link State PDU(s) as above.

Test Setup: Configure the systems as shown below. All of the systems are Level 1 IS-IS systems in the same area address. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: Level 1 Intermediate System becomes DIS

1. Configure the SUT as a Level 1 IS-IS system with a priority of 5 and a Hello Interval of 10 seconds on Network 0.
2. Enable IS-IS on the SUT.
3. TS1, TS2 and TS3 transmit Level 1 PDUs to become adjacent with the SUT. TS1, TS2, and TS3 advertise priorities of 4, 3, and 2 respectively in their IIH PDUs.
4. Observe the packets transmitted on network 0.

Part B: Level 1 Intermediate System resigns as DIS due to Shutdown

5. Shutdown the SUT.
6. Observe the packets transmitted on network 0.

Part C: Level 1 Intermediate System resigns as DIS due to change in priority

7. Restart IS-IS on the SUT. It should become the DIS on the network.
8. Configure the SUT's priority to be 1.
9. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should become the Level 1 DIS after waiting HelloTimer x 2 seconds. The SUT should generate Level 1 pseudonode LSPs for the link to TS1, TS2 and TS3. A value of zero shall be used for all supported routing metrics.
- In Parts B and C, the SUT should withdraw Level 1 pseudonode LSPs with the Remaining Lifetime set to zero.

Possible Problems: None.

Test IS-IS.3.9: Level 2 Only Designated Intermediate System

Purpose: To verify that a system properly behaves when declaring or resigning itself as Designated Intermediate System.

References: [ISO 10589] – Sections 7.2.3, 7.3.10 and 8.4.5

Last Modification: January 12, 2009

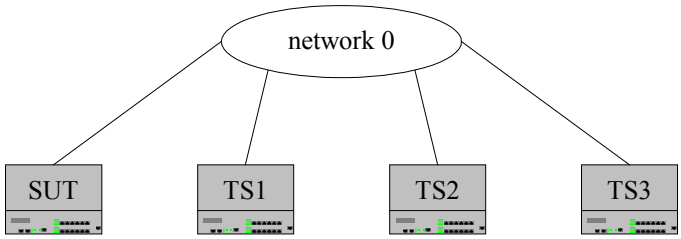
Discussion: Instead of treating a broadcast subnetwork as a fully connected topology, the broadcast subnetwork is treated as a pseudonode, with links to each attached system. Attached systems shall only report their link to the pseudonode. The designated Intermediate system, on behalf of the pseudonode, shall construct Link State PDUs reporting the links to all the systems on the broadcast subnetwork with a zero value for each supported routing metric).

The pseudonode shall be identified by the sourceID of the Designated Intermediate system, followed by a non-zero pseudonodeID assigned by the Designated Intermediate system. The pseudonodeID is locally unique to the Designated Intermediate system.

An Intermediate system may resign as Designated Intermediate System on a broadcast circuit either because it (or its SNPA on the broadcast subnetwork) is being shut down or because some other Intermediate system of higher priority has taken over that function. When an Intermediate system resigns as Designated Intermediate System, it shall initiate a network wide purge of its pseudonode Link State PDU(s) by setting their Remaining Lifetime to zero and performing the actions described in 7.3.16.4. A LAN Level 1 Designated Intermediate System purges Level 1 Link State PDUs and a LAN Level 2 Designated Intermediate System purges Level 2 Link State PDUs. An Intermediate system that has resigned as both Level 1 and Level 2 Designated Intermediate System shall purge both sets of LSPs.

When an Intermediate system declares itself as designated Intermediate system and it is in possession of a Link State PDU of the same level issued by the previous Designated Intermediate System for that circuit (if any), it shall initiate a network wide purge of that (or those) Link State PDU(s) as above.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: Level 2 Only Intermediate System becomes DIS

1. Configure the SUT as a Level 2 only IS-IS system, with the Hello Timer set to 20 seconds, and a priority of 5.
2. Enable IS-IS on the SUT.
3. TS1, TS2 and TS3 transmit Level 2 PDUs to become adjacent with the SUT. TS1, TS2, and TS3 advertise priorities of 4, 3, and 2 respectively in their IIH PDUs.
4. Observe the packets transmitted on network 0.

Part B: Level 2 Only Intermediate System resigns as DIS due to Shutdown

5. Shutdown the SUT.
6. Observe the packets transmitted on network 0.

Part C: Level 2 Intermediate System resigns as DIS due to change in priority

7. Restart IS-IS on the SUT. It should become the DIS on the network.
8. Configure the SUT's priority to be 1.
9. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should become the Level 2 DIS after waiting for HelloTimer x 2 seconds. The SUT should generate Level 2 pseudonode LSPs for the link to TS1, TS2 and TS3. A value of zero shall be used for all supported routing metrics.
- In Parts B and C, the SUT should withdraw Level 2 pseudonode LSPs with the Remaining Lifetime set to zero.

Possible Problems: Some implementations may not support the purging of LSAs, which were not locally originated.

Test IS-IS.3.10: Link Failure on Level 1 Broadcast Subnetwork

Purpose: Level 1 Designated Intermediate System detects a link failure.

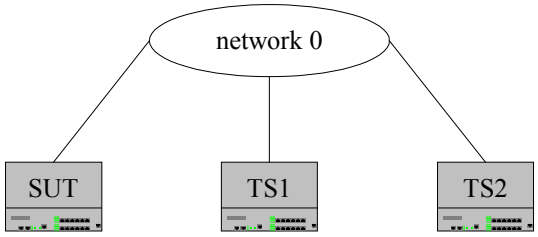
References: [ISO 10589] – Section 7.2.4

Last Modification: November 11, 2003

Discussion: Two Intermediate systems are not considered neighbors unless each reports the other as directly reachable over one of their SNPAs. A malfunctioning IS might, however, report another IS to be a neighbor when in fact it is not.

On broadcast subnetworks, this class of failure shall be detected by the designated IS, which has the responsibility to ascertain the set of Intermediate systems that can all communicate on the subnetwork. The designated IS shall include these Intermediate systems (and no others) in the Link State PDU it generates for the pseudonode representing the broadcast subnetwork.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 is used for Level 2.



Procedure:

Part A: The SUT is not a neighbor with TS2

1. Configure the SUT as a Level 1 IS-IS system, with a higher priority than TS1 and TS2.
2. Enable IS-IS on the SUT.
3. TS1 transmits Level 1 PDUs to become adjacent with the SUT.
4. TS2 transmits Level 1 PDUs listing the SUT as a neighbor, but with in area 49.0003.
5. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should not list TS2 as a neighbor and should list only TS1 as its neighbor in its pseudonode LSP.

Possible Problems: None.

Test IS-IS.3.11: Link Failure on Level 2 Only Broadcast subnetwork

Purpose: Level 2 Designated Intermediate System detects a link failure.

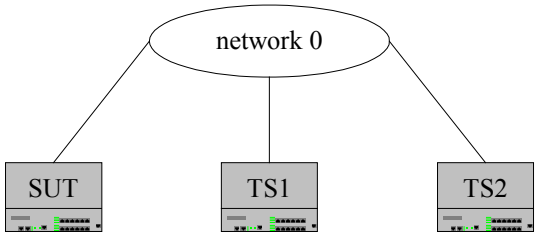
References: [ISO 10589] – Section 7.2.4

Last Modification: November 11, 2003

Discussion: Two Intermediate systems are not considered neighbors unless each reports the other as directly reachable over one of their SNPAs. A malfunctioning IS might, however, report another IS to be a neighbor when in fact it is not.

On broadcast subnetworks, this class of failure shall be detected by the designated IS, which has the responsibility to ascertain the set of Intermediate systems that can all communicate on the subnetwork. The designated IS shall include these Intermediate systems (and no others) in the Link State PDU it generates for the pseudonode representing the broadcast subnetwork.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 is used for Level 2.



Procedure:

Part A: The SUT is not a neighbor with TS2

1. Configure the SUT as a Level 2 only IS-IS system.
2. Enable IS-IS on the SUT.
3. TS1 transmits PDUs to become adjacent with the SUT. TS1 has a lower priority than the SUT in its Level 2 IIH PDUs.
4. TS2 transmits Level 1 PDUs listing the SUT as a neighbor.
5. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should not list TS2 as a neighbor and should list only TS1 as the IS neighbor in the pseudonode LSP it generates.

Possible Problems: None.

Test IS-IS.3.12: Multiple LSPs for the System

Purpose: To verify that a system does not process any LSPs in absence of LSPs with LSP Number zero and remaining lifetime >0.

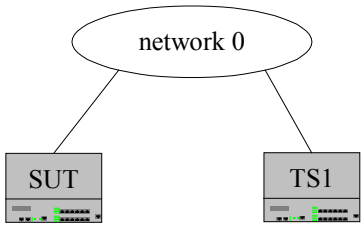
References: [ISO 10589] – Section 7.2.5

Last Modification: October 20, 2004

Discussion: The Update process is capable of dividing a single logical LSP into a number of separate PDUs for the purpose of conserving link bandwidth and processing (see 7.3.4). The Decision Process, on the other hand, shall regard the LSP with LSP Number zero in a special way. If the LSP with LSP Number zero and remaining lifetime > 0 is not present for a particular system then the Decision Process shall not process any LSPs with non-zero LSP Number which may be stored for that system. The following information shall be taken only from the LSP with LSP Number zero. Any values, which may be present in other LSPs for that system, shall be disregarded by the Decision Process.

a) The setting of the LSP Database Overload bit.
b) The value of the IS Type field.
c) The Area Addresses option field.
d) The setting of the AttachedFlag bit

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: Propagation of LSPs without LSP number zero and remaining lifetime > 0

1. Configure the SUT as a Level 1 IS-IS system in area 49.0001.
2. Enable IS-IS on the SUT.
3. TS1 transmits Level 1 PDUs to become adjacent with SUT.
4. After the SUT and TS1 are neighbors, TS1 transmits multiple Level 1 LSPs, none of which have a LSP number of 0. One of these LSPs contains a route to an external network.
5. Observe the packets transmitted on network 0.

Part B: Propagation of LSPs with LSP number zero but remaining lifetime zero

6. Restart IS-IS on the SUT.
7. After the SUT and TS1 become neighbors, TS1 transmits multiple Level 1 LSPs, one of which with an LSP number of 0 but with the remaining lifetime set to zero. One of these LSPs contains a route to an external network.
8. Observe the packets transmitted on network 0.

Observable Results:

- In Parts A and B, the SUT should not install the route to the external network in its routing table.

Possible Problems: None.

4. ROUTE SELECTION, DOMAIN WIDE PREFIX DISTRIBUTION AND ECMP

Overview:

The following tests verify that a system properly calculates and selects routes internal and external to the IS-IS domain.

Discussion:

These tests are designed to test a system's ability to properly calculate and select routes, in compliance with the references listed below.

Test Implementation:

In each test in this section, a test tool is used to transmit IS-IS packets. This simulates all test systems involved in the test procedure.

References:

- ISO/IEC 10589
- RFC 5304
- RFC 1195

Test IS-IS.4.1: Internal and External Metrics

Purpose: To verify that an Intermediate System correctly chooses between multiple routes to one network based on internal and external metrics.

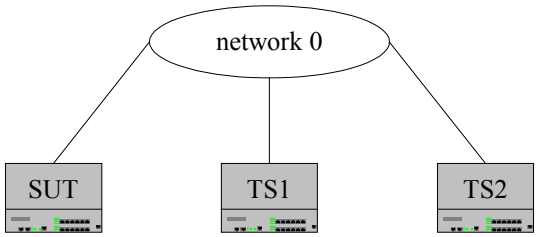
References: [ISO 10589] – Section 7.2.2

Last Modification: January 28, 2004

Discussion: The Default metric is understood by every Intermediate system in the domain. Each circuit shall have a positive integral value assigned for this metric. The value may be associated with any objective function of the circuit, but by convention is intended to measure the *capacity* of the circuit for handling traffic, for example, its throughput in bits-per-second. Higher values indicate a lower capacity.

The Default metric may be of two types: an *Internal metric* or an *External metr*ic. Internal metrics are used to describe links/routes to destinations internal to the routeing domain. External metrics are used to describe links/routes to destinations outside of the routeing domain. These two types of metrics are not directly comparable, except the internal routes are always preferred over external routes. In other words an internal route will always be selected even if an external route with lower total cost exists.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: Internal Metric vs. External Metric

1. Configure the SUT as a Level 1 IS-IS system in area 49.0001.
2. Start IS-IS on the SUT.
3. TS1 and TS2 transmit Level 1PDUs to become adjacent with the SUT.
4. TS1 transmits a Level 1 LSP with a path to an external network with an internal metric of 10. TS2 transmits a Level 1 LSP with a path to the same external network with an external metric of 10.
5. Observe the SUT's routing table.

Part B: External Metric with Lower Cost

6. TS2 transmits a Level 1 LSP with a path to the external network with an external metric of 0.
7. Observe the SUT's routing table.

Part C: Multiple Paths with Internal Metrics

8. TS2 transmits a Level 1 LSP with a path to the external network with an internal metric of 0.
9. Observe the SUT's routing table.

Observable Results:

- In Part A, the SUT should have a path to the external network with TS1 as the next hop.

- In Part B, the SUT should have a path to the external network with TS1 as the next hop.
- In Part C, the SUT should have a path to the external network with TS2 as the next hop.

Possible Problems: None.

Test IS-IS.4.2: Intra-Area Level 1 Routing

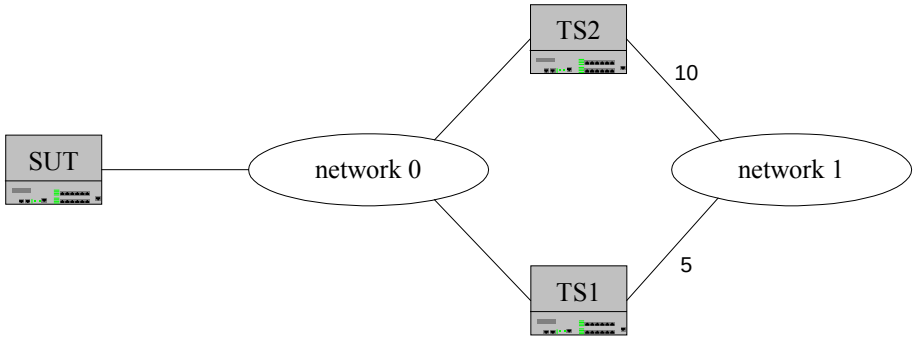
Purpose: To verify that an Intermediate System taking part in level 1 routing, correctly chooses between multiple paths to a network within its area.

References: [ISO 10589] – Section 7.2.12.1

Last Modification: January 28, 2004

Discussion: If an Intermediate system takes part in level 1 routeing, and determines (by looking at the area address) that a given destination is reachable within its area, then that destination will be reached exclusively by use of level 1 routeing.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: Two Intra-area Level 1 Paths

1. Configure the SUT as a Level 1 IS-IS system in area 49.0001.
2. Start IS-IS on the SUT.
3. TS1 and TS2 transmit Level 1 PDUs to become adjacent with the SUT. TS1 and TS2 both transmit Level 1 LSPs advertising an internal path to Network 1 with metrics of 5 and 10 respectively.
4. Observe the SUT's routing table.

Part B: New Best Cost Path

5. TS1 transmits a Level 1 LSP advertising its path to Network 1 with a metric of 15.
6. Observe the SUT's routing table.

Observable Results:

- In Part A, the SUT should have a path to network 1 with TS1 as the next hop.
- In Part B, the SUT should have a path to network 1 with TS2 as the next hop.

Possible Problems: None.

Test IS-IS.4.3: Intra-Area Level 2 Routing

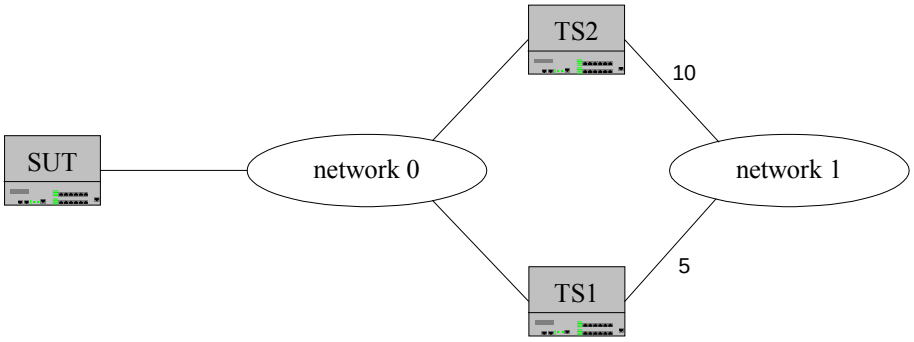
Purpose: To verify that an Intermediate System taking part in level 2 routing correctly chooses between multiple paths to a network within its area.

References: [ISO 10589] – Section 7.2.12.3

Last Modification: December 15, 2003

Discussion: If an Intermediate system takes part in level 2 routeing and the IS determines (by looking at the area address) that the destination is reachable within its area, then the destination will be reached either by level 1 or level 2 routeing. If a level 2 route exists, it shall be preferred over a level 1 route that traverses a virtual link. Otherwise, the level 1 route shall be preferred.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: Two Intra-area Level 2 Paths

1. Configure the SUT as a Level 1-2 IS-IS system.
2. Start IS-IS on the SUT.
3. TS1 transmits PDUs to become adjacent with the SUT on Level 1. TS1 transmits a Level 1 LSP with advertising an internal path to Network 1 with a metric of 5.
4. TS2 transmits PDUs to become adjacent with the SUT on Level 2. TS2 transmits a Level 2 LSP with advertising an internal path to Network 1 with a metric of 10.
5. Observe the SUT's routing table.

Part B: L2 Path has Lower Metric

6. TS1 transmits a Level 1 LSP advertising its path to Network 1 with a metric of 15.
7. Observe the SUT's routing table.

Part C: Level 2 calculation.

8. Restart IS-IS on the SUT.
9. TS1 stops sending Level 1 PDUs and transmits Level 2 PDUs to become adjacent with the SUT. TS1 transmits a Level 2 LSP advertising its path to Network 1 with a metric of 15.
10. Observe the SUT's routing table.

Observable Results:

- In Part A, the SUT should have a path to network 1 with TS1 as the next hop.
- In Part B, the SUT should have a path to network 1 with TS1 as the next hop.
- In Part C, the SUT should have a path to network 1 with TS2 as the next hop.

Possible Problems: None.

Test IS-IS.4.4: Equal Cost Routes

Purpose: To verify that a system properly handles equal cost paths to an external network.

References: [ISO 10589] – Appendix C.2

Last Modification: February 25, 2004

Discussion: An algorithm invented by Dijkstra (see references) known as *shortest path first (SPF*), is used as the basis for the route calculation. It has a computational complexity of the square of the number of nodes, which can be decreased to the number of links in the domain times the log of the number of nodes for sparse networks (networks which are not highly connected).

A number of additional optimizations are possible:

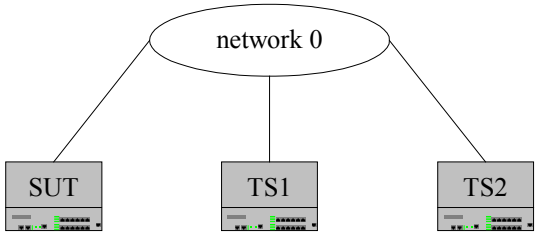
a) If the routeing metric is defined over a small finite field (as in this International Standard), the factor of log *n* may be removed by using data structures which maintain a separate list of systems for each value of the metric rather than sorting the systems by logical distance.

b) Updates can be performed incrementally without requiring a complete recalculation. However, a full update must be done periodically to recover from data corruption, and studies suggest that with a very small number of link changes (perhaps two) the expected computation complexity of the incremental update exceeds the complete recalculation. Thus, this International Standard specifies the algorithm only for the full update.

c) If only End system LSP information has changed, it is not necessary to recompute the entire Dijkstra tree for the IS. If the proper data structures exist, End Systems may be attached and detached as leaves of the tree and their forwarding information base entries altered as appropriate.

The original SPF algorithm does not support load splitting over multiple paths. The algorithm in this International Standard does permit load splitting by identifying a set of equal cost paths to each destination rather than a single least cost path.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used for Level 1 and 49.0002 for Level 2.



Procedure:

Part A: ECMP with Internal Metrics

1. Configure the SUT as a Level 1 IS-IS system.
2. Start IS-IS on the SUT.

3. TS1 and TS2 transmit Level 1 PDUs to become adjacent with the SUT. TS1 and TS2 transmit Level 1 LSPs advertising an external network with an internal metric of 10.
4. Observe the SUT's routing table.

Part B: ECMP with External Metrics

5. TS1 and TS2 transmit Level 1 LSPs with a path to the external network with an external metric set to 10.
6. Observe the SUT's routing table.

Part C: Equal Cost Intra-area Routes

7. TS1 and TS2 transmit Level 1 LSPs advertising an internal path to network 1 with a cost of 10.
8. Observe the SUT's routing table.

Observable Results:

- In Parts A and B, the SUT should have two paths to the external network with TS1 and TS2 as the next hops.
- In Part C, the SUT should have two paths to network 1 with TS1 and TS2 as the next hops

Possible Problems: None.

Test IS-IS.4.5: Level 1 to Level 2 PDU Transmission

Purpose: To verify that a system properly transmits internal and external Level 1 PDUs into the Level 2 area.

References: [RFC 5302] – Sections 2 and 3.1

Last Modification: January 12, 2009

Discussion: To some extent, in IS-IS the level 2 backbone can be seen as a separate area itself. RFC 1195 defines that L1L2 routers can advertise IP routes that were learned via L1 routing into L2. These routes can be regarded as inter-area routes. RFC 1195 defines that these L1->L2 inter-area routes must be advertised in L2 LSPs in the "IP Internal Reachability Information" TLV (TLV 128). Intra-area L2 routes are also advertised in L2 LSPs in an "IP Internal Reachability Information" TLV. Therefore, L1->L2 inter-area routes are indistinguishable from L2 intra-area routes.

This document redefines this high-order bit in the default metric field in TLVs 128 and 130 to be the up/down bit. L1L2 routers must set this bit to one for prefixes that are derived from L2 routing and are advertised into L1 LSPs. The bit must be set to zero for all other IP prefixes in L1 or L2 LSPs

Test Setup: Configure the Systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used. The Backbone should be assigned an area ID of 49.0002

Procedure:

Part A: Level 1 to Level 2 Distribution

1. Configure the SUT as a Level 1-2 system.
2. Start IS-IS on the SUT.
3. TS1 transmits Level 2 PDUs, indicating a metric of 2 on network 1, to become adjacent with the SUT on Network 0. TS2 transmits Level 1 PDUs to become adjacent with the SUT on Network 1. TS2 transmits a Level 2 LSP advertising a path to Network 2 with a metric of 1.
4. Observe the packets transmitted on network 0.

Part B: Level 1 Interface Down

5. TS2 stops transmitting PDUs on Network 1.
6. Observe the packets transmitted on network 0.

Part C: Level 1 External Route

7. TS2 transmits Level 1 PDUs to become adjacent with the SUT on Network 1 once again. TS2 transmits a Level 1 LSP advertising a path to an external network (2.2.2.0/24).
8. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should transmit an LSP to network 0, with the up/down bit set to 0 (up) for all routes, advertising routes to network 1 and network 2, with metrics of 2 and 3 respectively. These should be advertised in Internal Reachability (TLV 128).
- In Part B, the SUT should transmit an LSP to network 0 with the up/down bit set to 0 (up) for its route to network 1 but with out a route to network 2.
- In Part C, the SUT should transmit an LSP to network 0, advertising an external route to network 2.2.2.0 with the up/down bit set to 0 (up). This should be advertised in External Reachability (TLV130).

Possible Problems: None.

Procedure:

Part A: Level 2 to Level 1 Route Distribution

1. Configure the SUT to be a Level 1-2 system with a metric of 2 on network 1 for both levels.
2. Configure the SUT to distribute routing information from Level 2 to Level 1.
3. Start IS-IS on the SUT.
4. TS1 transmits Level 1 PDUs to become adjacent with the SUT on Network 0. TS2 transmits Level 2 PDUs to become adjacent with the SUT on Network 1. TS2 transmits a Level 2 LSP advertising a path to Network 2 with a metric of 1.
5. Observe the packets transmitted on network 0.

Part B: Level 2 interface down

6. TS2 stops transmitting PDUs on Network 1.
7. Observe the packets transmitted on network 0.

Part C: Level 2 External Route

9. TS2 transmits Level 2 PDUs to become adjacent with the SUT on Network 1. TS2 transmits a Level 2 LSP advertising a path to an external network (2.2.2.0/24).
10. Observe the packets transmitted on network 0.

Observable Results:

- In Part A, the SUT should send a LSP(s) to network 0, with the up/down bit set to 1 (down), advertising routes to network 1 and network 2, with metrics of 2 and 3 respectively. These should be advertised in Internal Reachability.
- In Part B, the SUT should send a LSP(s) to network 0 with the up/down bit set to 1 (down), with a route to network 1, but not network 2; unless the SUT originated a separate LSP for network 2. In which case, that LSP should be reissued with remaining lifetime set to 0.
- In Part C, the SUT should send an LSP to network 0 with the up/down bit set to 1 (down), advertising an external route to network 2.2.2.0. This should be advertised in External Reachability.

Possible Problems: None.

Test IS-IS.4.7: Level 2 to Level 1 Route Calculation

Purpose: To verify that a system properly transmits Level 2 PDUs into the Level 1 area, and calculates the shortest path through the IS-IS domain.

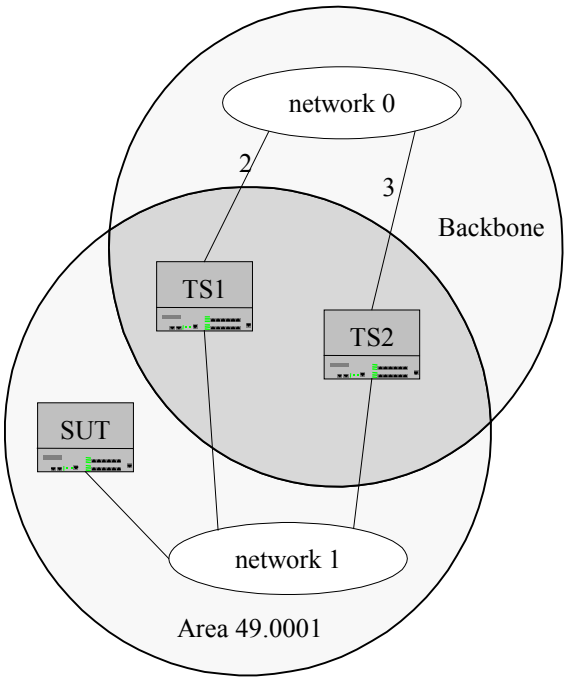
References: [RFC 5302] – Section 3.1 (5)
[RFC 1195] – Section 3.10.1
[ISO 10589] – Section 7.2.12.2

Last Modification: January 12, 2009

Discussion: Level 1 to Level 2 inter-area routes are advertised in L1 LSPs, in TLV 128. The up/down bit is set to one, metric-type is internal metric. These IP prefixes are learned via L2 routing, and were derived during the L2 SPF computation from prefixes advertised in TLV 128

Amongst routes in the area of the same TOS to equally specific address matches, the shortest routes are preferred. For determination of the shortest path, if a route on which the specified TOS is supported is available, then the specified TOS metric is used, otherwise the default metric is used.

Test Setup: Configure the Systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used. The Backbone should be assigned an area ID of 49.0002. The SUT should not have a route to network 0.



Procedure:
Part A: Route calculation through Level 2

1. Configure the SUT to be a Level 1 system with metric 1 on network 1.
2. Start IS-IS on the SUT.

3. TS1 and TS2 transmit Level 1 PDUs to become adjacent with the SUT on Network 1. TS1 and TS2 transmit Level 1 LSPs advertising a path to Network 0 with the up/down bit set to 1(down) and metrics of 2 and 3 respectively.
4. Check the SUT's routing table.

Part B: Level 2 path cost change

5. TS1 transmits a Level 1 LSP with a path to Network 0 with the up/down bit set to 1(down) and a metric of 6.
6. Check the SUT's routing table.

Observable Results:

- In Part A, the SUT should have a route to network 0 through TS1.
- In Part B, the SUT should have a route to network 0 through TS2.

Possible Problems: None.

Test IS-IS.4.8: External vs. Internal Route Preference

Purpose: To verify that a system properly chooses between external and internal route types to the same destination.

References: [RFC 5302]- Section 3.2

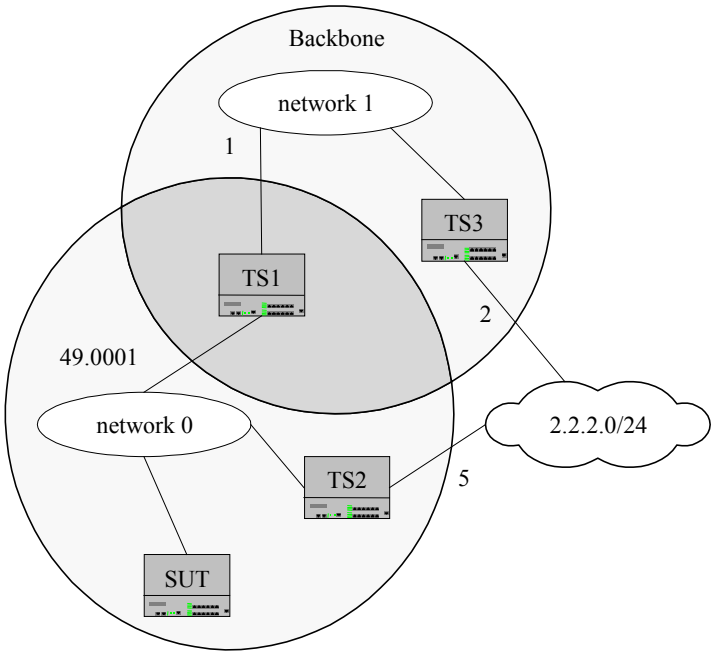
Last Modification: January 12, 2009

Discussion: Unfortunately IS-IS cannot depend on metrics alone for route selection. Some types of routes must always be preferred over others, regardless of the costs that were computed in the Dijkstra calculation.

The order of preference of IP routes in IS-IS is based on a few assumptions.
RFC 1195 defines that routes derived from L1 routing are preferred over routes derived from L2 routing. Based on these assumptions, this document defines the following route preferences.

1) L1 intra-area routes with internal metric
   L1 external routes with internal metric
2) L2 intra-area routes with internal metric
   L2 external routes with internal metric
   L1->L2 inter-area routes with internal metric
   L1->L2 inter-area external routes with internal metric
3) L2->L1 inter-area routes with internal metric
   L2->L1 inter-area external routes with internal metric

Test Setup: Configure the Systems as shown below. If a router is not assigned to a particular area, the default area of 49.0001 is used. The Backbone should be assigned an area ID of 49.0002.



Procedure:

Part A: Level 1 vs. Level 2 External Networks

1. Configure the SUT to be a Level 1 system.
2. Start IS-IS on the SUT.
3. TS1 and TS2 transmit Level 1 PDUs to the SUT to become adjacent on Network 0. TS1 transmits a Level 1 LSP with a path to external network 2.2.2.0/24 with an internal metric of 3 and the up/down bit set to down. TS2 transmits a Level 1 LSP with a path to external network 2.2.2.0/24 with an internal metric of 5 and the up/down bit set to up.
4. Check the SUT's routing table.

Part B: Multiple Level 2 External Networks

5. Configure the SUT as a Level 2 system.
6. Restart IS-IS on the SUT.
7. TS1 and TS2 transmit Level 2 PDUs to become adjacent with the SUT on Network 0. TS1 transmits a Level 2 LSP with a path to external network 2.2.2.0/24 with an internal metric of 3 and the up/down bit set to up. TS2 advertises a path to transmits a Level 2 LSP with a path to external network 2.2.2.0/24 with an internal metric of 5 and the up/down bit set to up.
8. Check the SUT's routing table.

Observable Results:

- In Part A, the SUT should have a route to the external network through TS2.
- In Part B, the SUT should have a route to the external network through TS1.

Possible Problems: None.

Test IS-IS.4.9: Up/Down Bit

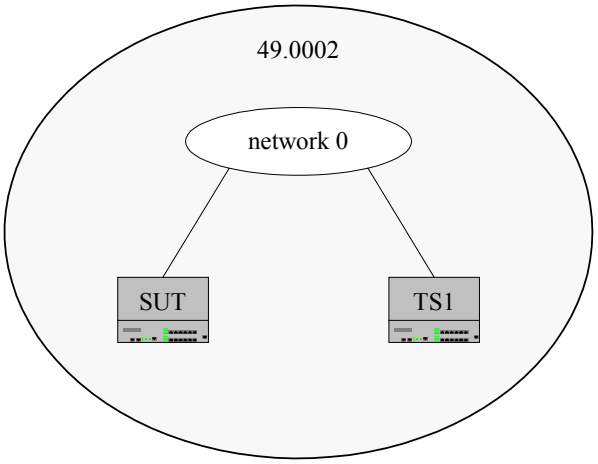
Purpose: To verify that Level 2 system properly handles LSPs advertising routes with the up/down bit set to down.

References: [RFC 5302] – Sections 3.1and 3.3

Last Modification: January 12, 2009

Discussion: It is recommended that implementations ignore the up/down bit in L2 LSPs, and accept the prefixes in L2 LSPs regardless whether the up/down bit is set.

Test Setup: Configure the Systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used. The Backbone should be assigned an area ID of 49.0002.



Procedure:

Part A: Received L2 LSP with up/down bit set

1. Configure the SUT as a Level 2 system in area 49.0002.
2. Start IS-IS on the SUT.
3. TS1 transmits and Level 2 PDUs to become adjacent with the SUT. TS1 transmits a Level 2 LSP advertising a route with the up/down bit set to down.
4. Observe the traffic transmitted on network 0 and the SUT's database.

Observable Results:

- In Part A, the SUT should accept the prefixes advertised in the Level 2 LSP but ignore the up/down bit.

Possible Problems: The SUT may not ignore the up/down bit.

5. AUTHENTICATION, CONFIGURATION AND FORMATTING

Overview

The following tests verify that a system properly implements HMAC-MD5 authentication and allows for the proper configuration of administrative values.

Discussion

This section is designed to serve as a checklist for compliance with those values indicated as configurable in ISO/IEC 10589, as to test a systems compliance with the rules regarding authentication as set forth in RFC 3567.

Test Implementation:

In each test in this section, a test tool is used to transmit IS-IS packets. This simulates all test systems involved in the test procedure.

References:

- ISO/IEC 10589
- RFC 5304

Test IS-IS.5.1: HMAC-MD5 Authentication

Purpose: To verify that a system properly implements HMAC-MD5 authentication.

References: [RFC 3567] – Section 2

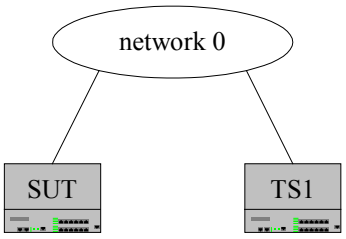
Last Modification: January 12, 2009

Discussion: The authentication type used for Hashed Message Authentication Codes - Message Digest 5 (HMAC-MD5) is 54 (0x36). The length of the Authentication Value for HMAC-MD5 is 16, and the length field in the TLV is 17.

The HMAC-MD5 algorithm requires a key K and text T as input [RFC 2104]. The key K is the password for the PDU type, as specified in ISO 10589. The text T is the IS-IS PDU to be authenticated with the Authentication Value field inside of the Authentication Information TLV set to zero. Note that the Authentication Type is set to 54 and the length of the TLV is set to 17 before authentication is computed. When LSPs are authenticated, the Checksum and Remaining Lifetime fields are set to zero (0) before authentication is computed. The result of the algorithm is placed in the Authentication Value field.

An implementation that implements HMAC-MD5 authentication and receives HMAC-MD5 Authentication Information MUST discard the PDU if the Authentication Value is incorrect.

Test Setup: Configure the systems as shown below. SUT, and TS1 are Level 1-2 systems. If a system is not assigned to a particular area, the default area of 49.0001 is used.



Procedure:

Part A: HMAC-MD5 Authentication enabled on the SUT

1. TS1 is a Level 1-2 system.
2. Configure the SUT as a Level 1-2 system using HMAC-MD5 authentication.
3. IS-IS is enabled on the SUT.
4. Observe the traffic transmitted on network 0.

Part B: HMAC-MD5 Authentication match

5. TS1 is enabled and using HMAC-MD5 with the same key and text password as the SUT.
6. Observe the traffic transmitted on network 0.

Part C: HMAC-MD5 Authentication mismatch

7. Configure the SUT with a different HMAC-MD5 key and text than those for TS1.
8. Restart IS-IS on the systems.
9. Observe the traffic on network 0.

Observable Results:

- In Part A, the SUT should send a LSP with the TLV set to 10 and length field in the TLV set to 17, authentication type set to 54 and the length set to 16.
- In Part B, the SUT and TS1 should become neighbors.
- In Part C, the SUT and TS1 should not become neighbors.

Possible Problems: None.

Test IS-IS.5.2: Cleartext Authentication

Purpose: To verify that a system properly implements cleartext authentication.

References: [ISO 10589] – Section 8.4.2.1

Last Modification: January 11, 2005

Discussion:
On receipt of a Broadcast IIH PDU, perform the following PDU acceptance tests:

a) If the IIH PDU was received over a circuit whose externalDomain attribute is "True", the IS shall discard the PDU.

b) If the ID Length field of the PDU is not equal to the value of the IS's routeingDomainIDLength, the PDU shall be discarded and an iDFieldLengthMismatch event generated.

c) If the value of circuitTransmitPassword or the set of circuitReceivePasswords for this circuit is non-null, then perform the following tests:

1) If the PDU does not contain the Authentication Information field then the PDU shall be discarded and an authenticationFailure event generated.

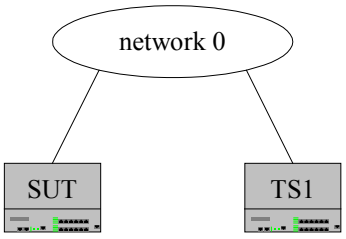
2) If the PDU contains the Authentication Information field, but the Authentication Type is not equal to "Password", then

i. If the IS implements the authentication procedure indicated by the Authentication Type whether the IS accepts or ignores the PDU is outside the scope of this International Standard.

ii. If the IS does not implement the authentication procedure indicated by the Authentication Type then the IS shall ignore the PDU and generate an authenticationFailure event."

3) Otherwise, the IS shall compare the password in the received PDU with the passwords in the set of circuitReceivePasswords for the circuit on which the PDU was received. If the value in the PDU matches any of these passwords, the IS shall accept the PDU for further processing. If the value in the PDU does not match any of the circuitReceivePasswords, then the IS shall ignore the PDU and generate an authenticationFailure event.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used.



Procedure:

Part A: Cleartext Authentication match

1. TS1 is a Level 1-2 system using cleartext authentication.
2. Configure the SUT as a Level 1-2 system using cleartext authentication with the same key as TS1.
3. Enable IS-IS on the systems.
4. Observe the traffic transmitted on network 0.

Part B: Cleartext Authentication mismatch

5. Configure the SUT with a different key than TS1.
6. Restart IS-IS on the systems.
7. Observe the traffic on network 0.

Part C: No Authentication on TS1

8. Disable authentication on TS1.
9. Restart IS-IS on the systems.
10. Observe the traffic on network 0.

Observable Results:

- In Part A, the SUT and TS1 should become neighbors.
- In Parts B and C, the SUT and TS1 should not become neighbors.

Possible Problems: None.

Test IS-IS.5.3: Area-wide Authentication

Purpose: To verify that a system properly implements area-wide authentication.

References: [ISO 10589] – Section 7.3.15.1

Last Modification: February 18, 2004

Discussion: If a system receives a level 1 LSP, and the value of areaTransmitPassword or the set of areaReceive-Passwords is non-null, then perform the following tests:

i. If the PDU does not contain the Authentication Information field then the PDU shall be discarded and an authenticationFailure event generated.

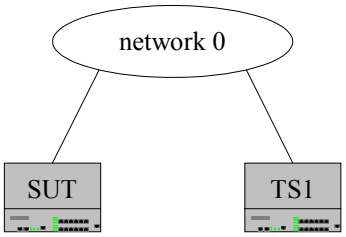
ii. If the PDU contains the Authentication Information field, but the Authentication Type is not equal to "Password", then:

   a. If the IS implements the authentication procedure indicated by the Authentication Type whether the IS accepts or ignores the PDU is outside the scope of this International Standard.

   b. If the IS does not implement the authentication procedure indicated by the Authentication Type then the IS shall ignore the PDU and generate an authenticationFailure event."

iii. Otherwise, the IS shall compare the password in the received PDU with the passwords in the set of areaReceivePasswords, augmented by the value of the areaTransmitPassword. If the value in the PDU matches any of these passwords, the IS shall accept the PDU for further processing. If the value in the PDU does not match any of the above values, then the IS shall ignore the PDU and generate an authenticationFailure event.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used.



Procedure:

Part A: No Authentication on TS1

1. Configure the SUT as a Level 1 system with area-wide authentication.
2. TS1 is a Level 1 system without area-wide authentication enabled.
3. Start IS-IS on the systems.
4. TS1 advertises a route to an external network.
5. Observe the SUT's routing table.

Part B: Authentication Match

6. Area-wide authentication is enabled on TS1 with the same authentication type and key as the SUT.
7. Restart IS-IS on the systems.
8. TS1 re-advertises its route to the external network.
9. Observe the SUT's routing table.

Part C: Authentication Mismatch

10. TS1 has a different authentication key than the SUT.
11. Restart IS-IS on the systems.
12. TS1 re-advertises its route to the external network.
13. Observe the SUT's routing table.

Observable Results:

- In Parts A and C, the SUT should not install the route from TS1.
- In Part B, the SUT should install the route from TS1.

Possible Problems: None.

Test IS-IS.5.4: Domain-wide Authentication

Purpose: To verify that a system properly implements domain-wide authentication.

References: [ISO 10589] – Section 7.3.15.1

Last Modification: February 18, 2004

Discussion: If a system receives a level 2 LSP, and the value of domain-TransmitPassword or the set of domainReceive-Passwords is non-null, then perform the following tests:

i. If the PDU does not contain the Authentication Information field then the PDU shall be discarded and an authenticationFailure event generated.

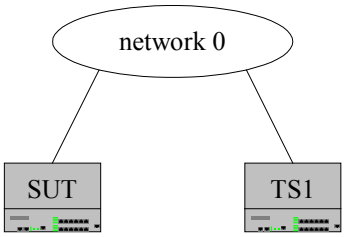
ii. If the PDU contains the Authentication Information field, but the Authentication Type is not equal to "Password", then:

   a. If the IS implements the authentication procedure indicated by the Authentication Type whether the IS accepts or ignores the PDU is outside the scope of this International Standard.

   b. If the IS does not implement the authentication procedure indicated by the Authentication Type then the IS shall ignore the PDU and generate an authenticationFailure event."

iii. Otherwise, the IS shall compare the password in the received PDU with the passwords in the set of domainReceivePasswords, augmented by the value of the domainTransmitPassword. If the value in the PDU matches any of these passwords, the IS shall accept the PDU for further processing. If the value in the PDU does not match any of the above values, then the IS shall ignore the PDU and generate an authenticationFailure event.

Test Setup: Configure the systems as shown below. If a system is not assigned to a particular area, the default area of 49.0001 is used.



Procedure:

Part A: No Authentication on TS1

1. Configure the SUT as a Level 2 system with domain-wide authentication.
2. TS1 is a Level 2 system without domain-wide authentication enabled.
3. Start IS-IS on the systems.
4. TS1 advertises a route to an external network.
5. Observe the SUT's routing table.

Part B: Authentication Match

6. Domain-wide authentication is enabled on TS1 with the same authentication type and key as the SUT.
7. Restart IS-IS on the systems.
8. TS1 re-advertises its route to the external network.
9. Observe the SUT's routing table.

Part C: Authentication Mismatch

10. TS1 has a different authentication key than the SUT.
11. Restart IS-IS on the systems.
12. TS1 re-advertises its route to the external network.
13. Observe the SUT's routing table.

Observable Results:

- In Parts A and C, the SUT should not install the route from TS1.
- In Part B, the SUT should install the route from TS1.

Possible Problems: None.

Test IS-IS.5.5: Global Parameters

Purpose: To verify that the global parameters listed below are configurable.

References: [ISO 10589] – Sections 7.2.10 and 7.2.10.1

Last Modification:

Discussion: The following area parameters must be configurable:

- Area(s)
- IS-Type
- LSP Buffer Size
- Maximum Area Addresses

All tests in this section are implicitly tested by other tests. They are here only as a checklist.

Possible Problems: Some routers may support RFC 3719, which states in section 3.2 that Maximum Area Address is a constant and no longer a variable.

Test IS-IS.5.6: Interface Parameters

Purpose: To verify that the interface parameters listed below are configurable.

References: [ISO 10589] – Sections 7.2.10 and 7.2.10.1

Last Modification:

Discussion: The following interface parameters must be configurable:

- Interface output cost
- Priority
- Hello Time
- Hello Multiplier
- Circuit Type

All tests in this section are implicitly tested by other tests. They are here only as a checklist.

Possible Problems: None.