

Bridge Functions Consortium

**Spanning Tree Protocol
Operations Test Suite**
Version 2.4



Last Updated: 2008-06-23

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MODIFICATION RECORD

Version	Date	Editor(s)	Comments
Initial Version	1999-08-01		
1.0	1999-09-01		
1.1	1999-10-31		
1.2	1999-12-16		
1.3	2000-02-02		
1.4	2000-03-15		
2.0	2003-08-29		
2.1	2004-11-08		
2.2	2005-01-27	Tyler Marcotte	Format Modification
2.3	2005-05-25	Curtis Simonson	Format Modification
2.4	2008-06-23	Timothy Davis	Modified Test 1.4

ACKNOWLEDGEMENTS

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

Micah Abbott	University of New Hampshire
Brandon Barry	University of New Hampshire
Calvin Bascom	University of New Hampshire
Gerard Goubert	University of New Hampshire
Fred Mansfield Jr	University of New Hampshire
Tyler Marcotte	University of New Hampshire
Mike Mason	University of New Hampshire
Daniel Riss	University of New Hampshire
Garth Russ	University of New Hampshire
Benjamin Schultz	University of New Hampshire
Curtis Simonson	University of New Hampshire
Robert Wolff	University of New Hampshire

INTRODUCTION

The University of New Hampshire's InterOperability Laboratory (IOL) is an institution designed to improve the interoperability of standards based products by providing an environment where a product can be tested against other implementations of a standard. This suite of tests has been developed to help implementers evaluate the functionality of their Spanning Tree capable products.

The operation of Spanning Tree Protocol provides for the recovery of networks in the event of link failure. Spanning Tree Protocol also helps guard against the creation (either accidental or intentional) of data loops in the active topology.

This test suite has been designed based on the set of clauses described in IEEE Std.802.1D™-1998 and IEEE Std.802.1t™-2001 that pertain to the Spanning Tree Algorithm and Protocol. The test suite is designed to help determine whether or not the DUT will behave in accordance with the standard during normal operation.

These tests do not determine whether the DUT conforms to either of these standards, nor are they designed as interoperability tests. Rather, they provide one method to isolate problems within a Spanning Tree capable device that will affect interoperability. Successful completion of all tests contained in this suite does not guarantee that the tested device will operate with other Spanning Tree capable devices. However, combined with satisfactory completion of interoperability testing, these tests provide a reasonable level of confidence that the DUT will function well in most Spanning Tree capable environments.

REFERENCES

The following documents are referenced in this text:

- IEEE Std.802.1D™-1998
- IEEE Std.802.1t™-2001

DEFINITION OF TERMS:

BPDU	Bridge Protocol Data Unit
DUT	Device Under Test
FDB	Filtering Database
ID	Identifier
MAC	Media Access Control
PVID	Port VLAN Identifier
STP	Spanning Tree Protocol
TS	A Test Station capable of transmitting and receiving arbitrary MAC frames
TCN	Topology Change Notification
VLAN	Virtual Local Area Network

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 the concatenation of the short test suite name, 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 STP.op.1.2 refers to the second test of the first test group in the STP Operation 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.
- Resource Requirements:** The Resource Requirements section specifies the software, hardware, and test equipment that will be needed to perform the test.
- 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 Layout:** This diagram shows how the Test Systems, DUT, and any other Devices used should be connected for this test. Elements of the Procedure may change the Layout.
- 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, disconnecting links between devices, and sending MAC frames from a Test Station. The test procedure also cues the tester to make observations, which are interpreted in accordance with the observable results given for that test part.
- Observable Results:** This section lists observable results that can be examined by the tester to verify that the DUT is operating properly. When multiple observable results are possible, this section provides a short discussion on how to interpret them. The determination of a PASS or FAIL for each test is usually based on how the behavior of the DUT 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.

TEST SETUP:

Default Values for DUT Settings:

Unless otherwise stated, the DUT shall be configured as follows before every Part of every Test.

Elements of Test Procedure may cause these settings to change. This is expected. These setting simply help ensure that the DUT is in a known state prior to running each Part of each test.

- The Spanning Tree Protocol shall be enabled on the DUT and each Port used for testing.
- The DUT shall be connected to the specified number of Test Stations and no other devices.
- Ports on the DUT that are connected to Test Stations shall be members of the Untagged Set for the Default VLAN. These Ports shall not be members of any other VLAN. The PVID for these Ports shall be that of the Default VLAN.
- All Ports on the DUT connected to Test Stations shall be in the Forwarding Port State.
- The DUT shall consider itself to be the Root Bridge.
- The Topology Change and Topology Change Acknowledgement Flags shall not be set in Configuration BPDUs transmitted by the DUT.
- Bridge Forward Delay, Bridge Max Age, and Bridge Hello Time shall be set to their recommended default values (Bridge Forward Delay = 15 seconds, Bridge Max Age = 20 seconds, Bridge Hello Time = 2 seconds.)
- It may be that Ports used for testing operate at different speeds. In order to simplify the testing process, select one of the speeds (whichever is most common), and set the Path Cost for each Port used for testing to the recommended default value for Ports operating at that speed. That is, if 3 Ports used for testing operate at 100Mb/s, and 1 operates at 1000Mb/s, set the Path Cost of all 4 Ports to 200,000 (the recommended path cost for 100Mb/s).
- The ageing time for the filtering database(s) shall be set to the recommended default value (300 seconds).

Default Values for Configuration BPDUs:

Unless otherwise stated, Configuration BPDUs transmitted by Test Stations shall be properly formatted, and shall contain the following values for settable Configuration BPDU parameters:

Topology Change Acknowledgement Flag	False
Topology Change Flag	False
Root ID Priority	0x8000 (32,768)
Root ID MAC address	Worse than the Bridge MAC address of the DUT
Root Path Cost	0x00000000 (0)
Bridge ID Priority	0x8000 (32,768)
Bridge ID MAC address	Equal to Root Bridge MAC address
Port ID	0x8 + port number [Port 1 would be 0x8001]
Message Age	0x0000 (0)
Max Age	0x1400 (20 seconds)
Hello Time	0x0200 (2 seconds)
Forward Delay	0x0F00 (15 seconds)

NOTE: A Root ID, A, is considered better than another Root ID, B, if it is a numerically lower value. That is, A is “better” than B if $A < B$. If $A > B$, A is considered to be “worse” than B.

GROUP 1: Initialization

Scope:

The following tests cover the Spanning Tree algorithm's initialization function

Overview:

These tests are designed to verify that the DUT properly initializes all Ports and Spanning Tree Algorithm parameters. It will verify that all Configuration BPDU values (with the exception of Message Age) are properly initialized, that all Ports initialize to Designated Ports, and that Configuration BPDUs are transmitted on all Designated Ports.

Test STP.op.1.1 – Root ID Initialized to Bridge ID

Purpose: To verify that the DUT sets the Root ID to its Bridge ID upon initialization.

References:

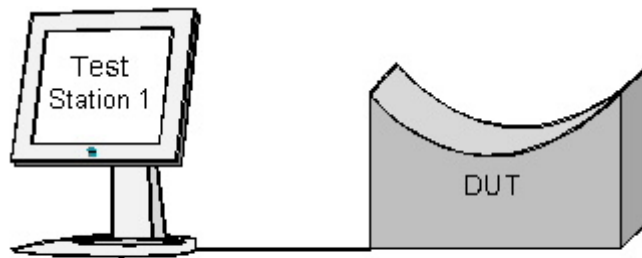
- IEEE Std. 802.1D-1998: sub-clause 8.8.1
- IEEE Std. 802.1D-1998: sub-clause 8.9.1

Resource Requirements:

- 1 Test Station

Discussion: When a Spanning Tree capable Bridge is first powered on and/or Spanning Tree is enabled, it runs through an initialization procedure that prepares it to participate in the Spanning Tree Protocol. Part of this procedure involves setting the DUT's Root ID equal to its own Bridge ID.

Test Layout:



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Procedure:

Part A: Root ID Initialized to Bridge ID

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Test Station 1 to capture.
3. Wait until Test Station 1 has received 2 Configuration BPDUs.
4. Record the value of the Root ID contained in the captured Configuration BPDUs.

Observable Results:

- The value of the Root ID contained in Configuration BPDUs captured by Test Station 1 should be equal to the Bridge ID of the DUT.

Possible problems:

- None

Test STP.op.1.2 – Root Path Cost Initialized to Zero

Purpose: To verify that the DUT sets the Root Path Cost to zero upon initialization.

References:

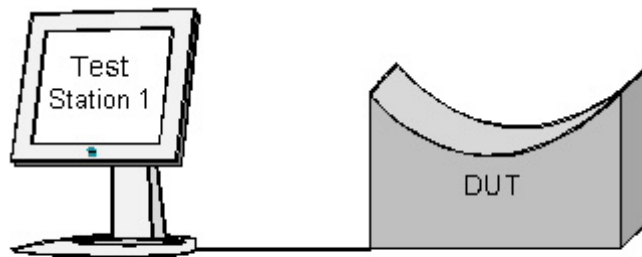
- IEEE Std. 802.1D-1998: sub-clause 8.8.1
- IEEE Std. 802.1D-1998: sub-clause 8.9.1

Resource Requirements:

- 1 Test Station

Discussion: When a Spanning Tree capable Bridge is first powered on and/or Spanning Tree is enabled, it runs through an initialization procedure that prepares it to participate in the Spanning Tree Protocol. Part of this procedure involves setting the DUT's Root Path Cost equal to zero.

Test Layout:



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Procedure:

Part A: Root Path Cost Initialized to Zero

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Test Station 1 to capture.
3. Wait until Test Station 1 has received 2 Configuration BPDUs.
4. Record the value of the Root Path Cost contained in the captured Configuration BPDUs.

Observable Results:

- The Root Path Cost value contained in Configuration BPDUs captured by Test Station 1 should be equal to zero.

Possible Problems:

- None.

Test STP.op.1.3 – Topology Change and Topology Change Acknowledgement Flags

Purpose: To verify that upon initialization, after the Topology Change timer has expired and in the absence of a Topology Change, the DUT does not set the Topology Change flag or the Topology Change Acknowledgement flag.

References:

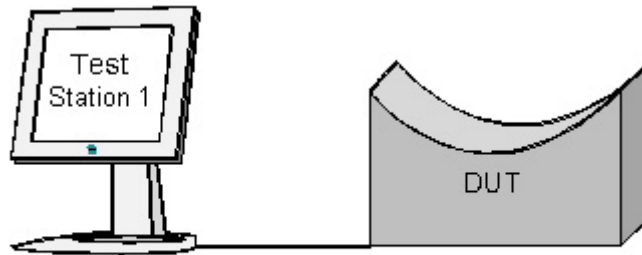
- IEEE Std. 802.1D-1998: sub-clause 8.8.1
- IEEE Std. 802.1D-1998: sub-clause 8.9.1

Resource Requirements:

- 1 Test Station

Discussion: When a Spanning Tree capable Bridge is first powered on and/or Spanning Tree is enabled, it runs through an initialization procedure that prepares it to participate in the Spanning Tree Protocol. Once this procedure is complete, after the Topology Change timer has expired (a Topology Change will be detected when the Ports on the DUT enter the Forwarding Port State), neither the Topology Change flag nor the Topology Change Acknowledgement flag should be set.

Test Layout:



Procedure:

Part A: Topology Change Flag Not Set Upon Initialization

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Test Station 1 to capture.
3. Wait until Test Station 1 has received 2 Configuration BPDUs.
4. Record the value of the Topology Change flag contained in the captured Configuration BPDUs.

Part B: Topology Change Acknowledgement Flag Not Set Upon Initialization

5. Ensure that the [default](#) values are configured on the DUT.
6. Set Test Station 1 to capture.
7. Wait until Test Station 1 has received 2 Configuration BPDUs.
8. Record the value of the Topology Change Acknowledgement flag contained in the captured Configuration BPDUs.

Observable Results:

- In each case, the value of the BPDU flags field contained in Configuration BPDUs captured by Test Station 1 should be 0x00.

Possible Problems:

- None.

Test STP.op.1.4 – All Ports Initialized to Designated Ports

Purpose: To verify that the DUT sets all of its Ports to Designated Ports upon initialization.

References:

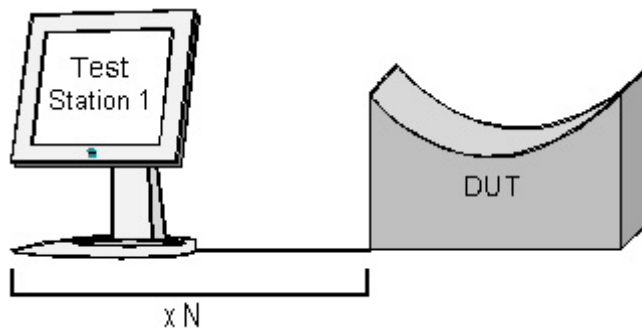
- IEEE Std. 802.1D-1998: sub-clause 8.8.1
- IEEE Std. 802.1D-1998: sub-clause 8.9.1

Resource Requirements:

- N Test Stations

Discussion: When a Spanning Tree capable Bridge is first powered on and/or Spanning Tree is enabled, it runs through an initialization procedure that prepares it to participate in the Spanning Tree Protocol. Upon initialization, once this procedure is complete, all Ports on the Bridge that are to be enabled should become Designated Ports and begin transmitting Configuration BPDUs. Once the Ports have entered the Forwarding Port State, they will be able to send and receive traffic normally.

Test Layout:



Procedure:

Part A: All Ports Initialized to Designated Ports

1. Ensure that the [default](#) values are configured on the DUT.
2. Set all Test Stations to capture.
3. Disable Spanning Tree Protocol.
4. Enable Spanning Tree Protocol.
5. Transmit unicast, multicast, and broadcast traffic from Test Station 1.
6. Examine the frames captured by each Test Station.
7. Repeat Steps 1-6 with each Test Station.

Observable Results:

- In each case, the Test Station that transmitted unicast, multicast, and broadcast traffic should not receive any of the traffic it transmitted.
- In each case, all Test Stations other than the transmitting Test Station should capture all of the transmitted traffic.
- In each case, all Test Stations should capture Configuration BPDUs containing a Root ID equal to the Bridge ID of the DUT.

Possible Problems:

- Insufficient resources (e.g. time and Test Stations) may dictate that a subset of the total number of Ports on the DUT be tested. In this case, use as wide a distribution of Ports on the DUT as possible.

Test STP.op.1.5 – Static fields within Configuration BPDUs

Purpose: To verify that Configuration BPDUs transmitted by the DUT contain the proper values for the following fields: length/type, Logical Link Control, Protocol ID, Protocol Version ID, and BPDU Type.

References:

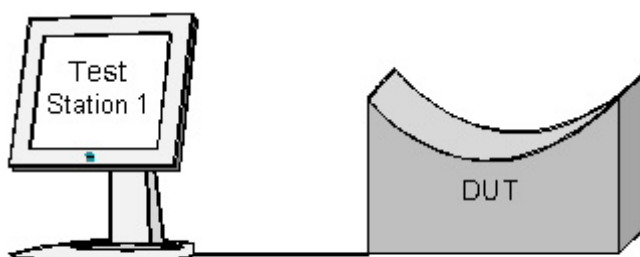
- IEEE Std. 802.1D-1998: Table 7-8
- IEEE Std. 802.1D-1998: sub-clause 9.3.1
- IEEE Std. 802.1D-1998: sub-clause 9.3.2
- IEEE Std. 802.3-2000: sub-clause 3.2.6

Resource Requirements:

- 1 Test Station

Discussion: When a Spanning Tree capable Bridge is first powered on and/or Spanning Tree is enabled, it runs through an initialization procedure that prepares it to participate in the Spanning Tree Protocol. Upon initialization, the Bridge should transmit Configuration BPDUs with the constant values defined in IEEE Std. 802.1D-1998 and IEEE Std. 802.3-2000 for the following fields: length/type, LLC, Protocol ID, Protocol Version ID, and BPDU Type.

Test Layout:



Procedure:

Part A: Static Field Verification

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Test Station 1 to capture.
3. Wait until Test Station 1 has received 2 Configuration BPDUs.
4. Record the value of the length/type field contained in the captured Configuration BPDUs.
5. Record the value of the LLC fields contained in the captured Configuration BPDUs.
6. Record the value of the Protocol ID field contained in the captured Configuration BPDUs.
7. Record the value of the Protocol Version ID field contained in the captured Configuration BPDUs.
8. Record the value of the BPDU Type field contained in the captured Configuration BPDUs.

Observable Results:

- The length/type field should be 0x0026
- The LLC fields should be 0x42 42 03
- The Protocol ID field should be 0x0000
- The Protocol Version ID field should be 0x00
- The BPDU Type field should be of 0x00

Possible Problems:

- None.

Test STP.op.1.6 – Dynamic fields within Configuration BPDUs

Purpose: To verify that Configuration BPDUs transmitted by the DUT contain the proper values for the following fields: Bridge ID, Port ID, Bridge Max Age, Bridge Hello Time, and Bridge Forward Delay.

References:

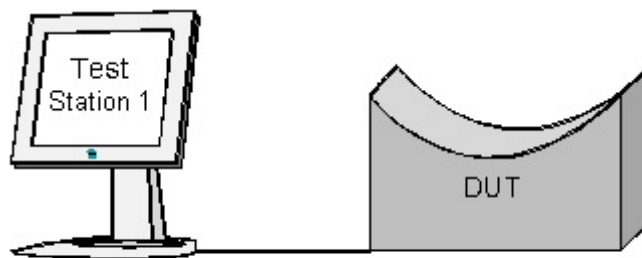
- IEEE Std. 802.1D-1998: sub-clause 8.5.1
- IEEE Std. 802.1D-1998: sub-clause 9.2.8
- IEEE Std. 802.1D-1998: sub-clause 9.3
- IEEE Std. 802.1t-2001: sub-clause 8.10.2
- IEEE Std. 802.1t-2001: sub-clause 9.2.5
- IEEE Std. 802.1t-2001: sub-clause 9.2.7

Resource Requirements:

- 1 Test Station

Discussion: When a Spanning Tree capable Bridge is first powered on and/or Spanning Tree is enabled, it runs through an initialization procedure that prepares it to participate in the Spanning Tree Protocol. Upon initialization, the Bridge should transmit Configuration BPDUs with the values defined in management for the following fields: Bridge ID, Port ID, Max Age, Hello Time, and Forward Delay. The Bridge ID is the concatenation of the Bridge Priority and the Bridge MAC address. The Port ID is the concatenation of the Port Priority and the Port Number. IEEE Std. 802.1t-2001 states that only the most significant 4 bits in the 16 bit Bridge Priority may be set (all other bits in the Bridge Priority must be set to zero); this standard also states that only the most significant four bits of the Port ID may be set (all other bits in the Port ID are used for the Port Number). While the DUT remains the Root Bridge, Max Age, Hello Time, and Forward Delay are set to the current values for Bridge Max Age, Bridge Hello Time, and Bridge Forward Delay, respectively. IEEE Std. 802.1t-2001 defines the recommended default value and allowable range for each of these parameters.

Test Layout:



Procedure:

Part A: Bridge ID Propagation

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Test Station 1 to capture.
3. Wait until Test Station 1 has received 2 Configuration BPDUs.
4. Record the Bridge ID value contained in captured Configuration BPDUs
5. If the DUT allows the Bridge Priority to be changed, repeat steps 1-3 using a different value for Bridge Priority.

Part B: Port ID Propagation

6. Ensure that the [default](#) values are configured on the DUT.
7. Set Test Station 1 to capture.
8. Wait until Test Station 1 has received 2 Configuration BPDUs.
9. Record the Port ID value contained in captured Configuration BPDUs
10. If the DUT allows the Port Priority to be changed, repeat steps 6-9 using a different value for Port Priority.

Part C: Max Age Propagation

11. Ensure that the [default](#) values are configured on the DUT.
12. Set Test Station 1 to capture.
13. Wait until Test Station 1 has received 2 Configuration BPDUs.
14. Record the Max Age value contained in captured Configuration BPDUs
15. If the DUT allows Bridge Max Age to be changed, repeat steps 11-14 using a different value for Bridge Max Age. Adjust the values of Bridge Hello Time and Bridge Forward Delay if necessary.

Part D: Hello Time Propagation

16. Ensure that the [default](#) values are configured on the DUT.
17. Set Test Station 1 to capture.
18. Wait until Test Station 1 has received 2 Configuration BPDUs.
19. Record the Hello Time value contained in captured Configuration BPDUs
20. If the DUT allows Bridge Hello Time to be changed, repeat steps 16-19 using a different value for Bridge Hello Time. Adjust the values of Bridge Max Age and Bridge Forward Delay if necessary.

Part E: Forward Delay Propagation

21. Ensure that the [default](#) values are configured on the DUT.
22. Set Test Station 1 to capture.
23. Wait until Test Station 1 has received 2 Configuration BPDUs.
24. Record the Forward Delay value contained in captured Configuration BPDUs
25. If the DUT allows Bridge Forward Delay to be changed, repeat steps 21-24 using a different value for Bridge Forward Delay. Adjust the values of Bridge Hello Time and Bridge Max Age if necessary.

Observable Results:

- In each case, Test Station 1 should capture Configuration BPDUs containing the value that had been set for the parameter being tested.
- In Part A, the Bridge ID contained in captured Configuration BPDUs should be the concatenation of the Bridge Priority and the Bridge MAC address. Only the first 4 bits of the Bridge Priority should be set.
- In Part B, the Port ID contained in captured Configuration BPDUs should be the concatenation of the Port Priority and the Port Number. The Port Priority should not comprise more than the first four bits of the Port ID. A Port number of zero is not allowed.
- In Parts C, D, and E, the Bridge Times (Max Age, Hello Time, and Forward Delay) contained in captured Configuration BPDUs should be equal to the values of Bridge Max Age, Bridge Hello Time, and Bridge Forward Delay, respectively.

Possible Problems:

- The DUT may not permit these values to be changed or displayed. This does not mean the device is non-conformant. A failure would result in the DUT not transmitting the value displayed in management.

GROUP 2: Configuration BPDU Reception and Frame Format

Scope:

The following tests cover the processing and transmission of Configuration BPDUs containing a wide range of values.

Overview:

These tests help verify that the DUT does not accept invalid Configuration BPDUs. The tests also help verify that the DUT properly processes received Configuration BPDUs, and that Configuration BPDUs transmitted by the DUT are well formed and contain the proper set of values.

Test STP.op.2.1 – Protocol ID Verification

Purpose: To verify that the DUT only processes Configuration BPDUs with a Protocol ID equal to 0x0000.

References:

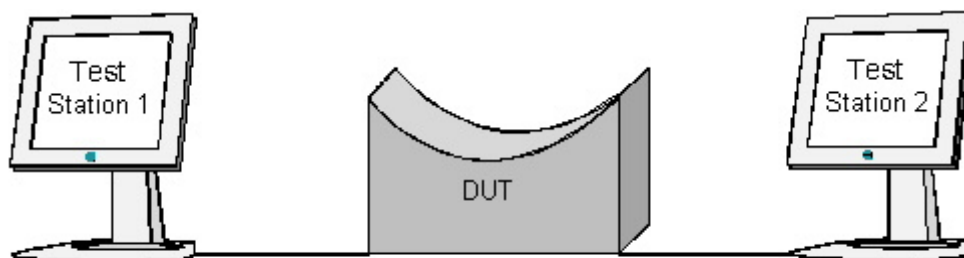
- IEEE Std. 802.1D-1998: sub-clause 9.3.1
- IEEE Std. 802.1D-1998: sub-clause 9.3.3
- IEEE Std. 802.1D-1998: Figure 9.1

Resource Requirements:

- 2 Test Stations

Discussion: The Protocol ID is encoded in the first and second octet of a Configuration BPDU. A Protocol ID of 0x0000 identifies the frame as an STP Configuration BPDU. Frames containing any other Protocol ID are not STP Configuration BPDUs and shall not be processed as such by a Bridge.

Test Layout:



Procedure:

Part A: Valid Protocol ID

1. Ensure that the [default](#) values are configured on the DUT.
2. Continuously transmit Configuration BPDUs with a Protocol ID of 0x0000 and a Root ID better than that of the DUT from Test Station 1.
3. Set Test Stations 1 and 2 to capture.
4. Wait for Test Station 2 to receive 2 Configuration BPDUs.
5. Record the Protocol ID contained in Configuration BPDUs captured by Test Station 2.
6. Observe the frames (if any) captured by Test Station 1.

Part B: Invalid Protocol ID

7. Ensure that the [default](#) values are configured on the DUT.
8. Ensure the DUT is the Root Bridge.
9. Set Test Stations 1 and 2 to capture.
10. Continuously transmit a Configuration BPDU with a Protocol ID of 0x0001 and a Root ID better than that of the DUT from Test Station 1.
11. Wait more than one second.
12. Repeat Steps 10 and 11, incrementing the Protocol ID used until all nonzero Protocol ID values have been used.
13. Observe the frames captured by Test Stations 1 and 2.

Observable results:

- In Part A, Test Station 1 should not capture any Configuration BPDUs.
- In Part A, Test Station 2 should capture Configuration BPDUs containing a Root ID equal to the one used by Test Station 1.
- In Part B, regardless of the invalid Protocol ID value being tested, Test Stations 1 and 2 should capture Configuration BPDUs containing a Root ID equal to the Bridge ID of the DUT and a Protocol ID of 0x0000. Neither Test Station should capture any other BPDUs.

Possible Problems:

- Insufficient resources (e.g. time) may dictate that a subset of the total number of invalid Protocol IDs be tested in Part B. In this case, use as wide a distribution of invalid Protocol IDs as possible.

Test STP.op.2.2 – Protocol Version ID Verification

Purpose: To verify that the DUT accepts Configuration BPDUs with varying Protocol Version IDs.

References:

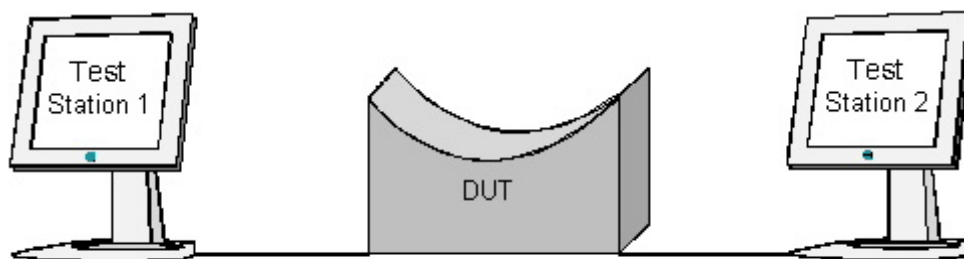
- IEEE Std. 802.1D-1998: sub-clause 9.3.1
- IEEE Std. 802.1D-1998: sub-clause 9.3.3
- IEEE Std. 802.1D-1998: Figure 9.1

Resource Requirements:

- 2 Test Stations

Discussion: The Protocol Version ID is encoded in the third octet of a BPDU. A compliant device must not check the Protocol Version ID upon the receipt of a BPDU. This allows future versions of the Spanning Tree Protocol to use this field while providing legacy support for STP.

Test Layout:



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Procedure:

Part A: Valid Protocol Version ID

1. Ensure that the [default](#) values are configured on the DUT.
2. Continuously transmit properly formatted Configuration BPDUs with a Protocol Version ID of 0x00 and a Root ID better than that of the DUT from Test Station 1.
3. Set both Test Stations to capture.
4. Wait until Test Station 2 has received 2 Configuration BPDUs.
5. Record the value of the Protocol Version ID contained in Configuration BPDUs captured by Test Station 2.
6. Observe the frames (if any) captured by Test Station 1.

Part B: Future Protocol Version ID

7. Ensure that the [default](#) values are configured on the DUT.
8. Continuously transmit properly formatted Configuration BPDUs with a Protocol Version ID of 0x01 and a Root ID better than that of the DUT from Test Station 1.
9. Set both Test Stations to capture.
10. Wait until Test Station 2 has received 2 Configuration BPDUs.
11. Record the value of the Protocol Version ID contained in Configuration BPDUs captured by Test Station 2.
12. Observe the frames (if any) captured by Test Station 1.
13. Repeat Steps 8-12, incrementing the Protocol ID used until all nonzero Protocol ID values have been used. In each case, decrement the value of the Root ID used in Step 8.

Observable results:

- In Parts A and B, Test Station 1 should not receive any Configuration BPDUs.
- In Parts A and B, Test Station 2 should receive Configuration BPDUs containing a Protocol Version ID of 0x00 and a Root ID equal to the one used by Test Station 1.
- In Part B, Test Station 2 should receive Configuration BPDUs containing each of the successively better Root ID values used by Test Station 1.

Possible Problems:

- None.

Test STP.op.2.3 – BPDU Type Field Verification

Purpose: To verify that the DUT properly accepts or rejects Configuration BPDUs based on their BPDU Type field.

References:

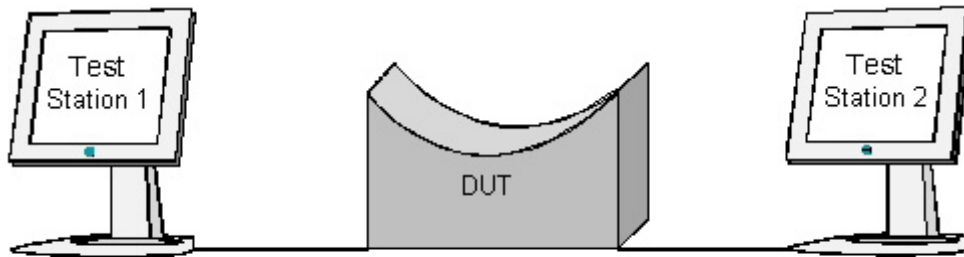
- IEEE Std. 802.1D-1998: sub-clause 9.3
- IEEE Std. 802.1D-1998: Figure 9.1

Resource Requirements:

- 2 Test Stations

Discussion: Each version of STP defines one or more valid BPDU types. For version 0x00 of STP, the BPDU Type field allows a device to distinguish between a Configuration BPDU and a Topology Change Notification BPDU. A BPDU Type Field value of 0x00 denotes a Configuration BPDU and a BPDU Type field value of 0x80 denotes a Topology Change Notification BPDU. Any other value in the BPDU Type field denotes an invalid BPDU Type (for version 0x00 of STP) and shall not be processed. The BPDU Type field is encoded in the fourth octet of a BPDU.

Test Layout:



Procedure:

Part A: Receiving BPDU Type in Topology Change Notification BPDUs

1. Ensure that the [default](#) values are configured on the DUT.
2. Continuously transmit properly formatted Configuration BPDUs with a Root ID better than that of the DUT from Test Station 1.
3. Set Test Station 1 to capture.
4. Transmit a properly formatted Topology Change Notification BPDU from Test Station 2.
5. Wait until Test Station 1 has received 2 Topology Change Notification BPDUs.
6. Record the BPDU Type contained in Topology Change Notification BPDUs transmitted by Test Station 1.

Part B: Nonzero BPDU Types

7. Ensure that the [default](#) values are configured on the DUT.
8. Ensure the DUT is the Root Bridge.
9. Set Test Stations 1 and 2 to capture.
10. Transmit from Test Station 1 a Configuration BPDU with a BPDU Type of 0x01 and a Root ID better than that of the DUT.
11. Wait more than one second.
12. Repeat Steps 10-11, incrementing the BPDU Type used in Step 10 by one, until BPDU Type values up to and including 0xFF have been used.
13. Observe the frames captured by Test Stations 1 and 2.

Observable results:

- In Part A, the BPDU Type contained in captured Topology Change Notification BPDUs should be equal to 0x80.
- In Part B, regardless of the BPDU Type value being tested, Test Stations 1 and 2 should capture Configuration BPDUs containing a Root ID equal to the Bridge ID of the DUT and a BPDU Type of 0x00. Neither Test Station should capture any other BPDUs.

Possible Problems:

- Insufficient resources (e.g. time) may dictate that a subset of the total number of invalid BPDU Types be tested in Part C. In this case, use as wide a distribution of invalid BPDU Types as possible.

Test STP.op.2.4 – BPDU Flags Field Verification

Purpose: To verify that the DUT accepts Configuration BPDUs with varying values in the BPDU Flags field of a Configuration BPDU.

References:

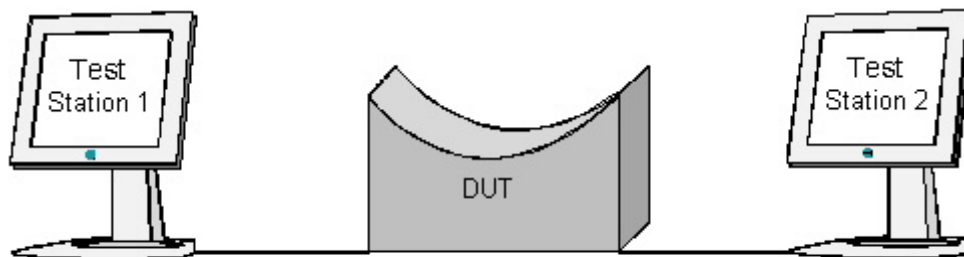
- IEEE Std. 802.1D-1998: sub-clauses 8.5.1.9 and 8.5.1.10
- IEEE Std. 802.1D-1998: sub-clauses 8.5.3.12
- IEEE Std. 802.1D-1998: sub-clauses 9.2.4 and 9.3
- IEEE Std. 802.1D-1998: Figure 9.1

Resource Requirements:

- 2 Test Stations

Discussion: Each version of Spanning Tree defines one or more flags, encoded using one or more bits within the BPDU Flags field. Version 0x00 defines 2 flags, each encoded in a single bit. The least significant bit in the BPDU flags field is the Topology Change Flag. The most significant bit in the BPDU flags field is the Topology Change Acknowledgement flag. The Topology Change Flag notifies Bridges throughout the LAN that there has been a change in the topology of the LAN. Each Bridge that receives such a notification sets the ageing time for its Filtering Database equal to Forward Delay. As a result, all dynamic filtering entries that are not updated during the next Forward Delay interval are flushed. Bridges respond to Topology Change Notification BPDUs by setting the Topology Change Acknowledgement Flag in the next Configuration BPDU transmitted on the Port that received a TCN BPDU. This will cause the Bridge that was transmitting TCN BPDUs to stop transmitting TCN BPDUs (until it detects another Topology Change). Bits 2-7 of the Flags field are reserved for future use and are not checked upon reception of a Configuration BPDU.

Test Layout:



Procedure:

Part A: Topology Change and Topology Change Acknowledgement Flags

1. Ensure that the [default](#) values are configured on the DUT.
2. Continuously transmit properly formatted Configuration BPDUs with a Root ID better than that of the DUT from Test Station 1.
3. Set Test Stations 1 and 2 to capture.
4. Wait until Test Station 2 has received 2 Configuration BPDUs.
5. Transmit a properly formatted TCN BPDU from Test Station 2.
6. Wait until Test Station 1 has received a TCN BPDU.
7. Set the Topology Change and Topology Change Acknowledgement Flags in the next Configuration BPDU transmitted by Test Station 1.
8. Continue to set the Topology Change Flag in Configuration BPDUs transmitted by Test Station 1.
9. Wait until Test Station 2 has received 4 more Configuration BPDUs.
10. Observe the frames captured by Test Stations 1 and 2.

Part B: BPDU Flags Field of 0xFF

11. Ensure that the [default](#) values are configured on the DUT.
12. Continuously transmit properly formatted Configuration BPDUs with a Root ID better than the Bridge ID of the DUT from Test Station 1.
13. Set Test Stations 1 and 2 to capture.
14. Wait until Test Station 2 has received 2 Configuration BPDUs.
15. Transmit a properly formatted TCN BPDU from Test Station 2.
16. Wait until Test Station 1 has received a TCN BPDU.
17. Transmit a Configuration BPDU containing a BPDU Flags Field of 0xFF from Test Station 1.
18. Wait until Test Station 2 has received 4 more Configuration BPDUs.
19. Observe the frames captured by Test Stations 1 and 2.

Observable results:

- In Parts A and B, Test Station 1 should not capture any Configuration BPDUs.
- In Parts A and B, Test Station 2 should capture Configuration BPDUs containing a Root ID equal to the one used by Test Station 1.
- In Part A, once Test Station 1 has transmitted a Configuration BPDU with the Topology Change Acknowledgement Flag set, Test Station 1 should not capture additional TCN BPDUs.
- In Part A, once Test Station 1 has transmitted a Configuration BPDU with the Topology Change Flag set, the Configuration BPDUs captured by Test Station 2 should have the Topology Change Flag set.
- In Part B, once Test Station 1 has transmitted a Configuration BPDU with the BPDU Flags Field set, Test Station 1 should not capture additional TCN BPDUs.
- In Part B, once Test Station 1 has transmitted a Configuration BPDU with the BPDU Flags Field set, the Configuration BPDUs captured by Test Station 2 should have the Topology Change Flag set.

Possible Problems:

- None.

Test STP.op.2.5 – Root ID Field Verification

Purpose: To verify that the DUT accepts Configuration BPDUs with varying values in the Root ID field.

References:

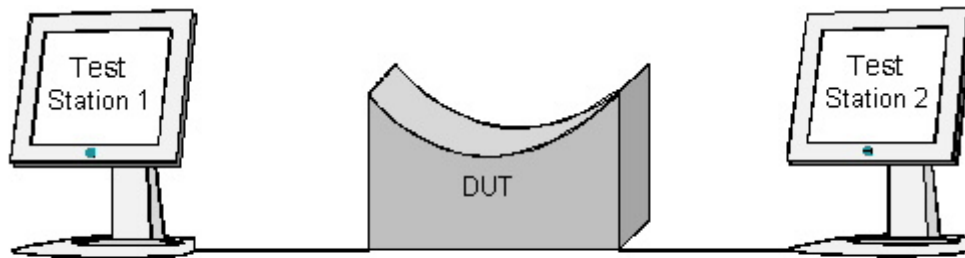
- IEEE Std. 802.1D-1998: sub-clause 8.5.1.1
- IEEE Std. 802.1D-1998: sub-clause 8.6.1.3.2
- IEEE Std. 802.1D-1998: Figure 9.1
- IEEE Std. 802.1t-2001: sub-clause 9.2.5

Resource Requirements:

- 2 Test Stations

Discussion: The Root ID contained in Configuration BPDUs transmitted by a Bridge is a result of the Root Bridge Selection process. If a Bridge has not received a Configuration BPDU containing a Root ID better than its own Bridge ID, the Bridge considers itself the Root Bridge, and transmits Configuration BPDUs containing a Root ID equal to its own Bridge ID on all Ports. Otherwise, the Bridge makes the Port on which it received the best Root ID the Root Port, and transmits Configuration BPDUs containing that value on all of its Designated Ports. The Root ID is the concatenation of a 2-byte Bridge Priority and a 6-byte Bridge MAC address. Only the 4 most significant bits of the Root Bridge Priority may be set.

Test Layout:



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Procedure:

Part A: Priority portion of the Root ID

1. Ensure that the [default](#) values are configured on the DUT.
2. Continuously transmit properly formatted Configuration BPDUs with a Root ID of 0xF00000FFFFFFFF from Test Station 1.
3. Set Test Stations 1 and 2 to capture.
4. Wait until Test Station 2 has received 2 Configuration BPDUs.
5. Observe the frames (if any) captured by Test Station 1.
6. Record the value of the Root ID contained in Configuration BPDUs captured by Test Station 2.
7. Repeat Steps 2-6 using successively better values for the Priority portion of the Root ID contained in the Configuration BPDUs transmitted by Test Station 1 (0xE000 – 0x0000).

Part B: MAC address portion of the Root ID

8. Ensure that the [default](#) values are configured on the DUT.
9. Continuously transmit properly formatted Configuration BPDUs with a Root ID of 0x800000FFFFFFFF from Test Station 1.
10. Set Test Stations 1 and 2 to capture.
11. Wait until Test Station 2 has received 2 Configuration BPDUs.
12. Observe the frames (if any) captured by Test Station 1.
13. Record the value of the Root ID contained in Configuration BPDUs captured by Test Station 2.
14. Repeat Steps 9-13 using the following values for the MAC address portion of the Root ID contained in Configuration BPDUs transmitted by Test Station 1: Bridge MAC address of the DUT + 1, Bridge MAC address of the DUT – 1, MAC address of 0x000000000000.

Observable results:

- When the Configuration BPDUs transmitted by Test Station 1 contain a Root ID worse than the Bridge ID of the DUT, Test Stations 1 and 2 should capture Configuration BPDUs with a Root ID equal to the Bridge ID of the DUT.
- When the Configuration BPDUs transmitted by Test Station 1 contain a Root ID better than the Bridge ID of the DUT, Test Station 1 should not capture any Configuration BPDUs.
- When the Configuration BPDUs transmitted by Test Station 1 contain a Root ID better than the Bridge ID of the DUT, Test Station 2 should capture Configuration BPDUs with a Root ID equal to the one used by Test Station 1.

Possible Problems:

- As with any properly formatted Configuration BPDUs, ensure the Bridge MAC address portion of the Root ID (the least significant 6 bytes) is a valid unicast MAC address.

Test STP.op.2.6 – Root Path Cost Field Verification

Purpose: To verify that the DUT accepts Configuration BPDUs with varying values in the Root Path Cost field.

References:

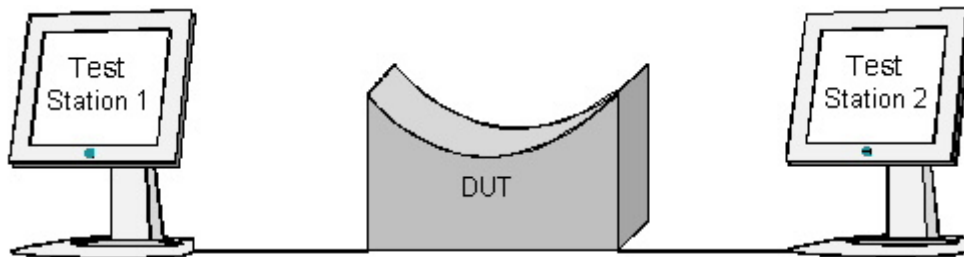
- IEEE Std. 802.1D-1998: sub-clause 8.5.1.2
- IEEE Std. 802.1D-1998: sub-clause 8.5.3.2
- IEEE Std. 802.1D-1998: sub-clause 9.3.1
- IEEE Std. 802.1D-1998: Figure 9.1
- IEEE Std. 802.1t -2001: sub-clause 8.10.2
- IEEE Std. 802.1t -2001: Table 8-5

Resource Requirements:

- 2 Test Stations

Discussion: The Root Path Cost for a Bridge is the cost of the path from the Root to the Bridge. When the Bridge is Root this cost is zero. Otherwise this cost is the sum of the Designated Cost and Path Cost parameters held for the Root Port.

Test Layout:



Procedure:

Part A: Root Path Cost of 0x00000000

1. Ensure that the [default](#) values are configured on the DUT.
2. Continuously transmit properly formatted Configuration BPDUs with a Root Path Cost of 0x00000000 and a Root ID better than that of the DUT from Test Station 1.
3. Set Test Stations 1 and 2 to capture.
4. Wait until Test Station 2 has received 2 Configuration BPDUs.
5. Observe the frames (if any) captured by Test Station 1.
6. Record the Root Path Cost value contained in Configuration BPDUs captured by Test Station 2.

Part B: Root Path Cost of 0x00000002

7. Ensure that the [default](#) values are configured on the DUT.
8. Continuously transmit properly formatted Configuration BPDUs with a Root Path Cost of 0x00000002 and a Root ID better than that of the DUT from Test Station 1.
9. Set Test Stations 1 and 2 to capture.
10. Wait until Test Station 2 has received 2 Configuration BPDUs.
11. Observe the frames (if any) captured by Test Station 1.
12. Record the Root Path Cost value contained in Configuration BPDUs captured by Test Station 2.

Part C: Root Path Cost of 0x00030D40

13. Ensure that the [default](#) values are configured on the DUT.
14. Continuously transmit properly formatted Configuration BPDUs with a Root Path Cost of 0x00030D40 and a Root ID better than that of the DUT from Test Station 1.
15. Set Test Stations 1 and 2 to capture.
16. Wait until Test Station 2 has received 2 Configuration BPDUs.
17. Observe the frames (if any) captured by Test Station 1.
18. Record the Root Path Cost value contained in Configuration BPDUs captured by Test Station 2.

Part D: Root Path Cost of 0xFFFFFFFF – Informational

19. Ensure that the [default](#) values are configured on the DUT.
20. Continuously transmit properly formatted Configuration BPDUs with a Root Path Cost of 0xFFFFFFFF and a Root ID better than that of the DUT from Test Station 1.
21. Set Test Stations 1 and 2 to capture.
22. Wait until Test Station 2 has received 2 Configuration BPDUs.
23. Observe the frames (if any) captured by Test Station 1.
24. Record the Root Path Cost value contained in Configuration BPDUs captured by Test Station 2.

Observable results:

- In Parts A, B, and C, Test Station 1 should not capture any Configuration BPDUs.
- In Parts A, B, and C, Configuration BPDUs captured by Test Station 2 should contain a Root ID equal to the one used by Test Station 1.
- In Part A, the Root Path Cost contained in Configuration BPDUs captured by Test Station 2 should be equal to the Path Cost of the Port on the DUT connected to Test Station 1.
- In Parts B and C, the Root Path Cost contained in Configuration BPDUs captured by Test Station 2 should be equal to the sum of the Root Path Cost contained in Configuration BPDUs transmitted by Test Station 1 and the Path Cost of the Port on the DUT connected to Test Station 1.
- Part D is conducted for informational purposes only. Examine the test data and be sure to note any behavior that may prevent interoperability.

Possible Problems:

- None

Test STP.op.2.7 – Bridge ID Field Verification

Purpose: To verify that the DUT accepts Configuration BPDUs with varying values in the Bridge ID field.

References:

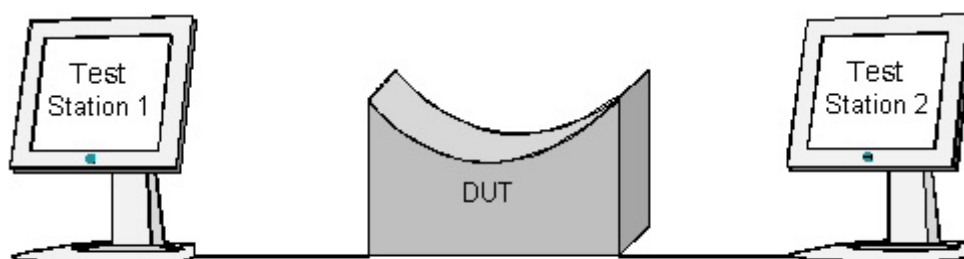
- IEEE Std. 802.1D-1998: sub-clause 8.5.1.3
- IEEE Std. 802.1D-1998: sub-clause 8.6.1.3.2
- IEEE Std. 802.1D-1998: Figure 9.1
- IEEE Std. 802.1t-2001: sub-clause 9.2.5

Resource Requirements:

- 2 Test Stations

Discussion: The Bridge ID is the concatenation of a 2-byte Bridge Priority and a 6-byte Bridge MAC address. Only the 4 most significant bits of the Bridge Priority may be set. The MAC address component of the Bridge ID ensures that the Bridge will be distinguished from all other Bridges on the LAN. The Bridge ID contained in a Configuration BPDU is always that of the Bridge from which it was transmitted.

Test Layout:



Procedure:

Part A: MAC address portion of the Bridge ID

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Test Stations 1 and 2 to capture.
3. Wait until Test Station 2 has received 2 Configuration BPDUs.
4. Record the value of the Bridge ID contained in Configuration BPDUs captured by Test Stations 1 and 2.

Part B: Priority portion of the Bridge ID

5. Ensure that the [default](#) values are configured on the DUT.
6. Set Bridge Priority on the DUT to 0xF000.
7. Set Test Stations 1 and 2 to capture.
8. Wait until Test Station 2 has received 2 Configuration BPDUs.
9. Record the value of the Bridge ID contained in Configuration BPDUs captured by Test Stations 1 and 2.
10. Repeat Steps 6-9, using progressively better Bridge Priority values in each case (0xE000, 0xD000, etc.), until all valid Bridge Priority values have been used.

Part C: Attempt to configure invalid Bridge Priority values

11. Ensure that the [default](#) values are configured on the DUT.
12. Set Test Stations 1 and 2 to capture.
13. Attempt to set the Bridge Priority on the DUT to 0x0001.
14. Wait until Test Station 2 has received 2 Configuration BPDUs.
15. Record the value of the Bridge ID contained in Configuration BPDUs captured by Test Stations 1 and 2.
16. Repeat Steps 13-15 using Bridge Priority values of 0x7999, 0x8100, and 0xFFFF.

Observable results:

- In each case, the Bridge ID contained in Configuration BPDUs captured by Test Station 1 should be equal to the Bridge ID contained in Configuration BPDUs captured by Test Station 2.
- In Parts A and C, the Bridge ID contained in Configuration BPDUs captured by Test Stations 1 and 2 should be the concatenation of the recommended default Bridge Priority value, 0x8000 (configured during the Test Setup), and the Bridge MAC address of the DUT.
- In Part B, the Bridge ID contained in Configuration BPDUs captured by Test Stations 1 and 2 should be the concatenation of the Bridge Priority value used and the Bridge MAC address of the DUT.
- In Part C, it should not be possible to configure any invalid values.

Possible Problems:

- Legacy equipment (i.e. devices which comply with the requirements of IEEE 802.1D-1998, but have not been updated to reflect the changes made in IEEE 802.1t-2001) may allow the Bridge Priority values specified in Part C to be set.

Test STP.op.2.8 – Port ID Field Verification

Purpose: To verify that the DUT accepts Configuration BPDUs with varying values in the Port ID field.

References:

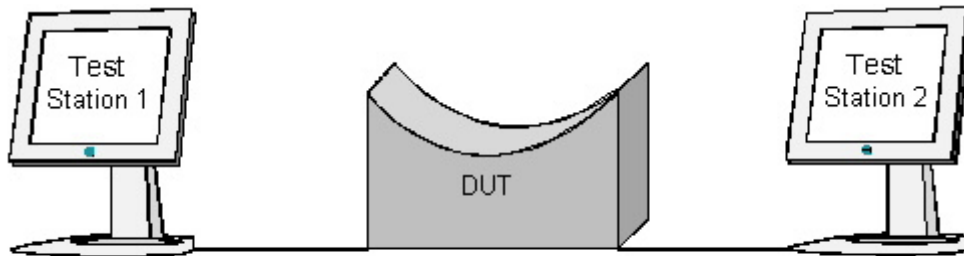
- IEEE Std. 802.1D-1998: sub-clause 8.5.1.4
- IEEE Std. 802.1D-1998: sub-clause 8.6.1.3.2
- IEEE Std. 802.1D-1998: Figure 9.1
- IEEE Std. 802.1t-2001: sub-clause 9.2.7

Resource Requirements:

- 2 Test Stations

Discussion: The Port ID is the concatenation of a 4-bit Port Priority value and the 12-bit Port Number. This ID distinguishes the Port from all other Ports on the Bridge. The Port ID may be needed as a tiebreaker when two Bridges are directly connected with more than one link, and when a Bridge is directly connected to itself. The Port ID contained in a Configuration BPDU is always that of the Port from which it was transmitted.

Test Layout:



Procedure:

Part A: Port Number portion of the Port ID

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Test Stations 1 and 2 to capture.
3. Wait until Test Station 2 has received 2 Configuration BPDUs.
4. Record the value of the Port ID contained in Configuration BPDUs captured by Test Stations 1 and 2.

Part B: Priority portion of the Port ID

5. Ensure that the [default](#) values are configured on the DUT.
6. Set Port Priority for the Ports on the DUT connected to Test Stations 1 and 2 to 0xF0.
7. Set Test Stations 1 and 2 to capture.
8. Wait until Test Station 2 has received 2 Configuration BPDUs.
9. Record the value of the Port ID contained in Configuration BPDUs captured by Test Stations 1 and 2.
10. Repeat Steps 6-9, using progressively better Port Priority values in each case (0xE0, 0xD0, etc.), until all valid Port Priority values have been used.

Part C: Attempt to configure invalid Port Priority values

11. Ensure that the [default](#) values are configured on the DUT.
12. Set Test Stations 1 and 2 to capture.
13. Attempt to set the Port Priority on the DUT to 0x01.
14. Wait until Test Station 2 has received 2 Configuration BPDUs.
15. Record the value of the Port ID contained in Configuration BPDUs captured by Test Stations 1 and 2.
16. Repeat Steps 13-15 using Port Priority values of 0x79, 0x81, and 0xFF.

Observable results:

- In each case, the Port ID contained in Configuration BPDUs captured by Test Station 1 should be equal to the Port ID assigned to the Port on the DUT connected to Test Station 1. The Port ID contained in Configuration BPDUs captured by Test Station 2 should be equal to the Port ID assigned to the Port on the DUT connected to Test Station 2.
- In Part A, the Port Number portion of the Port IDs contained in Configuration BPDUs captured by Test Stations 1 and 2 should be equal to the unique number assigned to the transmitting Port.
- In Part B, the Port Priority portion of the Port ID contained in Configuration BPDUs captured by Test Stations 1 and 2 should be equal to the Port Priority value that had been set in Step 6.
- In Part C, the Port Priority portion of the Port ID contained in Configuration BPDUs captured by Test Stations 1 and 2 should be equal to the recommended default Port Priority value, 0x80, configured during the Test Setup.

Possible Problems:

- The Port Number assigned to a Port is defined to be a small integer in the range from 1 upwards. A Bridge may not, therefore, assign a Port Number less than one to any of its Ports.
- Legacy equipment (i.e. devices which comply with the requirements of IEEE 802.1D-1998, but have not been updated to reflect the changes made in IEEE 802.1t-2001) may allow the Port Priority values specified in Part C to be set

Test STP.op.2.9 – Message Age Field Verification

Purpose: To verify that the DUT accepts only Configuration BPDUs containing a Message Age less than their Max Age, and that the Message Age value contained in Configuration BPDUs transmitted by the DUT (when it is not the Root Bridge) is incremented properly.

References:

- IEEE Std. 802.1D-1998: sub-clause 8.5.1.5
- IEEE Std. 802.1D-1998: sub-clause 9.2.8
- IEEE Std. 802.1D-1998: sub-clause 9.3.3
- IEEE Std. 802.1D-1998: Figure 9.1

Resource Requirements:

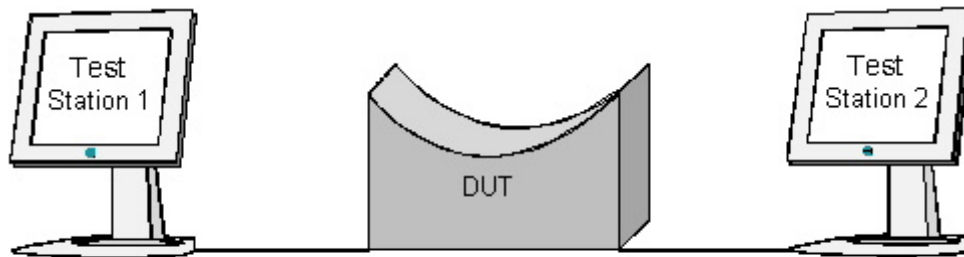
- 2 Test Stations

Discussion: The Message Age field marks the age of information contained in a Configuration BPDU relative to its origination at the Root Bridge. When a Port receives a Configuration BPDU containing better information than that which is currently held for the Port, the information contained in the received Configuration BPDU is recorded, and the Port's Message Age Timer is set to the Message Age contained in the received Configuration BPDU. The Message Age Timer is started – it will increment at regular intervals until new information is received or Message Age Timer Expiry occurs.

When a Bridge is the Root, it transmits Configuration BPDUs containing a Message Age of zero. Otherwise, when a Bridge transmits a Configuration BPDU, the Message Age is equal to the current value of the Message Age Timer for the Root Port on the Bridge incremented by a value greater than zero plus any transmission delay, but less than the maximum allowed Message Age Increment Overestimate.

Configuration BPDUs containing a Message Age that is greater than or equal to their Max Age are not valid BPDUs, and the information they contain shall not be processed.

Test Layout:



Procedure:

Part A: DUT is the Root Bridge

1. Ensure that the [default](#) values are configured on the DUT.
2. Ensure the DUT is the Root Bridge.
3. Set Test Stations 1 and 2 to capture.
4. Wait until Test Station 1 has received 2 Configuration BPDUs.
5. Record the Message Age value contained in Configuration BPDUs captured by Test Stations 1 and 2.

Part B: DUT is not the Root Bridge – received Message Age is less than received Max Age

6. Ensure that the [default](#) values are configured on the DUT.
7. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT from Test Station 1. These BPDUs should contain a Root Path Cost of zero, a Designated Bridge ID equal to their Root ID, a Message Age of zero, a Forward Delay of 30 seconds, and a Max Age of 40 seconds.
8. Wait for the Spanning Tree to converge.
9. Set Test Stations 1 and 2 to capture.
10. Wait until Test Station 2 has received 2 Configuration BPDUs.
11. Change the values contained in the Configuration BPDUs being transmitted by Test Station 1 such that the Root ID is better, the Root Path Cost is nonzero, and the Message Age is one second.
12. Wait until Test Station 2 has received 2 Configuration BPDUs.
13. Repeat Steps 11-12 18 times. In each case, the Root ID should be better than the previous value, the Root Path Cost should remain nonzero, and the Message Age should be 1 second greater than the previous value.
14. Observe the frames captured by Test Station 2.

Part C: DUT is not the Root Bridge – received Message Age is equal to received Max Age

15. Ensure that the [default](#) values are configured on the DUT.
16. Set Test Stations 1 and 2 to capture.
17. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT and a Max Age value equal to the Message Age value from Test Station 1.
18. Wait until Test Station 2 has received 2 Configuration BPDUs.
19. Observe the frames captured by Test Station 2.

Part D: DUT is not the Root Bridge – received Message Age is greater than received Max Age

20. Ensure that the [default](#) values are configured on the DUT.
21. Set Test Stations 1 and 2 to capture.
22. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT from Test Station 1. The Message Age value in the Configuration BPDUs should be one second greater than the Max Age value.
23. Observe the frames captured by Test Station 2.
24. Repeat steps 21-23, using a Message Age of 0xFFFF in Step 22.

Observable results:

- In Part A, Test Stations 1 and 2 should both capture Configuration BPDUs containing a Root ID equal to the Bridge ID of the DUT and a Message Age of 0x0000. Test Stations 1 and 2 should not capture any other Configuration BPDUs.
- In Part B, Test Station 1 should not capture any Configuration BPDUs.
- In Part B, Test Station 2 should capture Configuration BPDUs containing each of the successively better Root ID values used by Test Station 1. The Message Age in each of these Configuration BPDUs should be the Message Age contained in Configuration BPDUs (containing the same Root ID) transmitted by Test Station 1, plus a valid Message Age Increment.
- In Parts C and D, Test Stations 1 and 2 should both capture Configuration BPDUs containing a Root ID equal to the Bridge ID of the DUT and a Message Age of 0x0000. Test Stations 1 and 2 should not capture any other Configuration BPDUs.

Possible Problems:

- None.

Test STP.op.2.10 – Max Age Field Verification

Purpose: To verify that the DUT propagates the Max Age properly.

References:

- IEEE Std. 802.1D-1998: sub-clause 8.5.1.6
- IEEE Std. 802.1D-1998: sub-clause 9.2.8
- IEEE Std. 802.1D-1998: sub-clause 9.3.3
- IEEE Std. 802.1D-1998: Figure 9.1

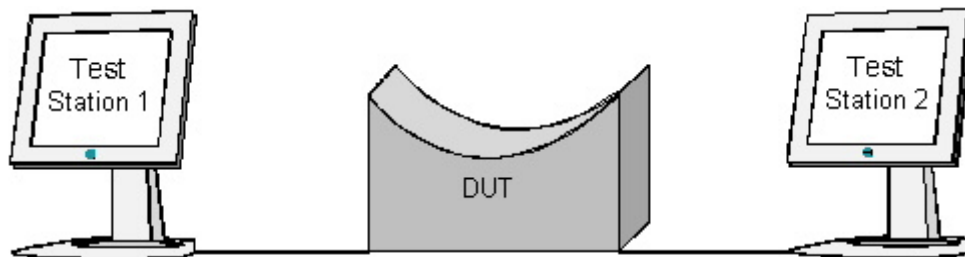
Resource Requirements:

- 2 Test Stations

Discussion: This Max Age parameter is conveyed to ensure that each Bridge in a Bridged LAN has a consistent value against which to test the age of stored configuration information. During a Topology Change, the Topology Change timer is set to the sum of Max Age and Forward Delay.

Configuration BPDUs containing a Message Age that is greater than or equal to their Max Age are not valid BPDUs, and the information they contain shall not be processed.

Test Layout:



Procedure:

Part A: Max Age when DUT is the Root Bridge

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Bridge Forward Delay on the DUT to 30 seconds.
3. Set Bridge Hello Time on the DUT to 1 second.
4. Set Bridge Max Age on the DUT to 6 seconds.
5. Set Test Stations 1 and 2 to capture.
6. Wait until Test Station 2 has received 2 Configuration BPDUs.
7. Increase the DUT's Bridge Max Age value by one second.
8. Wait until Test Station 1 has received 2 Configuration BPDUs.
9. Repeat Steps 7-8 for Bridge Max Age values up to and including 40 seconds.
10. Observe the frames captured by Test Stations 1 and 2.

Part B: Max Age when the DUT is not the Root Bridge

11. Ensure that the [default](#) values are configured on the DUT.
12. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT, a Hello Time of 0x0100, a Max Age of 0x0600, and a Forward Delay of 0x1E00 from Test Station 1.
13. Wait for the Spanning Tree to converge.
14. Set Test Stations 1 and 2 to capture.
15. Wait until Test Station 2 has received 2 Configuration BPDUs.
16. Increase the Max Age contained in Configuration BPDUs transmitted by Test Station 1 by one second.
17. Wait until Test Station 2 has received 2 Configuration BPDUs.
18. Repeat Steps 16-17 for Max Age values up to and including 40 seconds.
19. Observe the frames captured by Test Stations 1 and 2.

Observable results:

- In Part A, Test Stations 1 and 2 should both capture Configuration BPDUs containing a Root ID equal to the Bridge ID of the DUT and no other Configuration BPDUs. The varying Max Age values contained in these Configuration BPDUs should reflect each of the different Bridge Max Age values that were configured on the DUT.
- In Part B, Test Station 1 should not capture any Configuration BPDUs.
- In Part B, Test Station 2 should have captured Configuration BPDUs containing a Root ID equal to the one used by Test Station 1 and no other Configuration BPDUs. The varying Max Age values contained in these Configuration BPDUs should reflect each of the different Max Age values contained in Configuration BPDUs transmitted by Test Station 1.

Possible Problems:

- The DUT may not support configuration of Bridge Times. If this is the case, Part A cannot be performed.

Test STP.op.2.11 – Hello Time Field Verification

Purpose: To verify that the DUT propagates the Hello Time properly.

References:

- IEEE Std. 802.1D-1998: sub-clause 8.5.1.7
- IEEE Std. 802.1D-1998: sub-clause 9.2.8
- IEEE Std. 802.1D-1998: Figure 9.1

Resource Requirements:

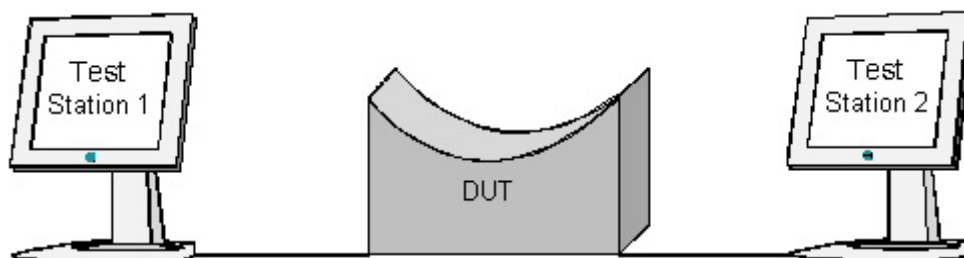
- 2 Test Stations

Discussion: The Hello Time field conveyed in Configuration BPDUs is not directly used by the Spanning Tree Algorithm but is conveyed to facilitate the monitoring of protocol performance by management functions.

A Bridge that is Root sets its Hello Timer to the value of Bridge Hello Time. This insures the periodic transmission of Configuration BPDUs.

A Bridge that is not Root uses its own Bridge Hello Time value to determine the rate at which TCN BPDUs should be transmitted (rather than the value conveyed in Configuration BPDUs).

Test Layout:



Procedure:

Part A: Hello Time when DUT is the Root Bridge

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Bridge Forward Delay on the DUT to 15 seconds.
3. Set Bridge Hello Time on the DUT to 1 second.
4. Set Bridge Max Age on the DUT to 22 seconds.
5. Set Test Stations 1 and 2 to capture.
6. Wait until Test Station 2 has received 2 Configuration BPDUs.
7. Increase the DUT's Bridge Hello Time value by one second.
8. Wait until Test Station 1 has received 2 Configuration BPDUs.
9. Repeat Steps 7-8 for Bridge Hello Time values up to and including 10 seconds.
10. Observe the frames captured by Test Stations 1 and 2.

Part B: Hello Time when the DUT is not the Root Bridge

11. Ensure that the [default](#) values are configured on the DUT.
12. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT, a Hello Time of 0x0100, a Max Age of 0x2800, and a Forward Delay of 0x1E00 from Test Station 1.
13. Wait for the Spanning Tree to converge.
14. Set Test Stations 1 and 2 to capture.
15. Wait until Test Station 2 has received 2 Configuration BPDUs.
16. Increase the Hello Time contained in Configuration BPDUs transmitted by Test Station 1 by one second.
17. Wait until Test Station 2 has received 2 Configuration BPDUs.
18. Repeat Steps 16-17 for Hello Time values up to and including 10 seconds.
19. Observe the frames captured by Test Stations 1 and 2.

Observable results:

- In Part A, Test Stations 1 and 2 should both capture Configuration BPDUs containing a Root ID equal to the Bridge ID of the DUT and no other Configuration BPDUs. The varying Hello Time values contained in these Configuration BPDUs should reflect each of the different Bridge Hello Time values that were configured on the DUT.
- In Part B, Test Station 1 should not capture any Configuration BPDUs.
- In Part B, Test Station 2 should have captured Configuration BPDUs containing a Root ID equal to the one used by Test Station 1 and no other Configuration BPDUs. The varying Hello Time values contained in these Configuration BPDUs should reflect each of the different Hello Time values contained in Configuration BPDUs transmitted by Test Station 1.

Possible Problems:

- The DUT may not support configuration of Bridge Times. If this is the case, Part A cannot be performed.

Test STP.op.2.12 – Forward Delay Field Verification

Purpose: To verify that the DUT propagates the Forward Delay properly.

References:

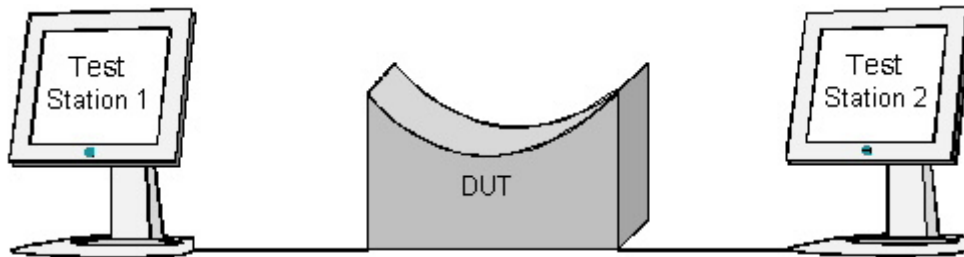
- IEEE Std. 802.1D-1998: sub-clause 8.5.1.8
- IEEE Std. 802.1D-1998: Figure 9.1
- IEEE Std. 802.1D-1998: sub-clause 9.2.8

Resource Requirements:

- 2 Test Stations

Discussion: The forward delay parameter is conveyed to ensure that each Bridge in a Bridged LAN uses a consistent value for the Forward Delay Timer when transferring the state of a Port to the Forwarding State. This parameter is also used as the timeout value for ageing Filtering Database dynamic entries following changes in active topology.

Test Layout:



Procedure:

Part A: Forward Delay when DUT is the Root Bridge

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Bridge Hello Time on the DUT to 1 second.
3. Set Bridge Max Age on the DUT to 6 seconds.
4. Set Bridge Forward Delay on the DUT to 4 seconds.
5. Set Test Stations 1 and 2 to capture.
6. Wait until Test Station 2 has received 2 Configuration BPDUs.
7. Increase the DUT's Bridge Forward Delay value by one second.
8. Wait until Test Station 1 has received 2 Configuration BPDUs.
9. Repeat Steps 7-8 for Bridge Forward Delay values up to and including 30 seconds.
10. Observe the frames captured by Test Stations 1 and 2.

Part B: Forward Delay when the DUT is not the Root Bridge

11. Ensure that the [default](#) values are configured on the DUT.
12. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT, a Hello Time of 0x0100, a Max Age of 0x0600, and a Forward Delay of 0x0400 from Test Station 1.
13. Wait for the Spanning Tree to converge.
14. Set Test Stations 1 and 2 to capture.
15. Wait until Test Station 2 has received 2 Configuration BPDUs.
16. Increase the Forward Delay contained in Configuration BPDUs transmitted by Test Station 1 by one second.
17. Wait until Test Station 2 has received 2 Configuration BPDUs.
18. Repeat Steps 16-17 for Forward Delay values up to and including 30 seconds.
19. Observe the frames captured by Test Stations 1 and 2.

Observable results:

- In Part A, Test Stations 1 and 2 should both capture Configuration BPDUs containing a Root ID equal to the Bridge ID of the DUT and no other Configuration BPDUs. The varying Forward Delay values contained in these Configuration BPDUs should reflect each of the different Bridge Forward Delay values that were configured on the DUT.
- In Part B, Test Station 1 should not capture any Configuration BPDUs.
- In Part B, Test Station 2 should have captured Configuration BPDUs containing a Root ID equal to the one used by Test Station 1 and no other Configuration BPDUs. The varying Forward Delay values contained in these Configuration BPDUs should reflect each of the different Forward Delay values contained in Configuration BPDUs transmitted by Test Station 1.

Possible Problems:

- The DUT may not support configuration of Bridge Times. If this is the case, Part A cannot be performed.

GROUP 3: Root Port Selection Process

Scope:

The following tests cover the Spanning Tree algorithm's root_selection function.

Overview:

These tests are designed to verify that the DUT, upon determining that it is not the Root Bridge, properly selects a Root Port based on information stored on each of its Ports. A Root Port is chosen after comparing received Root ID, Bridge ID, Root Path Cost, and Port ID values.

Test STP.op.3.1 – Root Bridge Selection: Root ID Values

Purpose: To verify that the DUT properly identifies the Root Bridge and selects the proper Root Port when comparing Root IDs.

References:

- IEEE Std. 802.1D-1998: sub-clause 8.6.8.3
- IEEE Std. 802.1D-1998: sub-clause 8.6.9.3

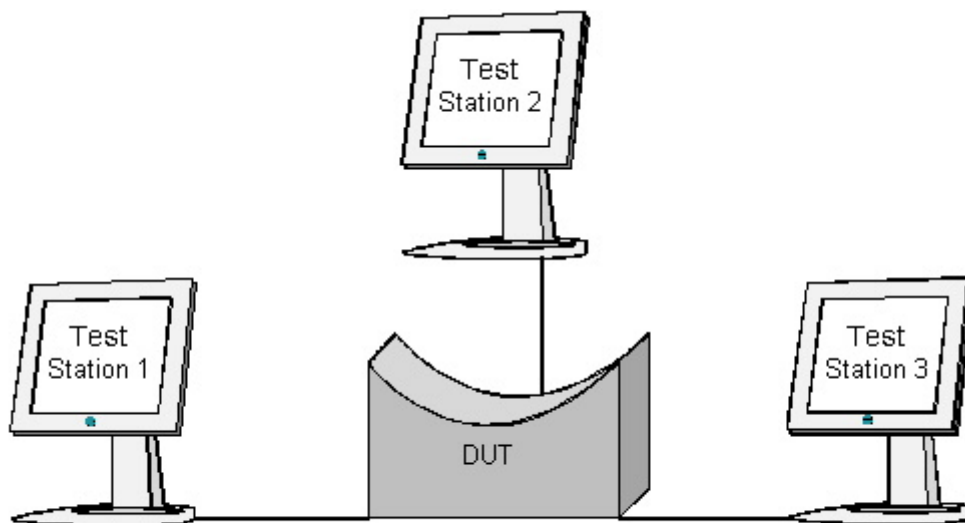
Resource Requirements:

- 3 Test Stations

Discussion: When Spanning Tree is operational, the Root Bridge is selected by comparing information from received Configuration BPDUs to the information stored for the current Root Port. All Bridges participating in Spanning Tree exchange the best stored value for Root ID in order to reach agreement upon which Bridge should become Root.

The first parameter that is compared during the Root Selection process is the Root ID. This test verifies that the DUT properly selects the Root Bridge when comparing Root IDs.

Test Layout:



Procedure:

Part A: Root Port Selection Based on Root ID

1. Ensure that the [default](#) values are configured on the DUT.
2. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT from Test Station 1.
3. Continuously transmit Configuration BPDUs containing a Root ID better than the one used by Test Station 1 from Test Station 2.
4. Wait for the Spanning Tree to converge.
5. Set Test Stations 1, 2, and 3 to capture.
6. Wait until Test Station 3 has received at least 2 Configuration BPDUs.
7. Record the Root ID value reported by management on the DUT.
8. Observe the Configuration BPDUs (if any) captured by each Test Station.

Observable Results:

- Test Stations 1 and 3 should capture Configuration BPDUs containing a Root ID equal to the one used by Test Station 2.
- Test Station 2 should not capture any Configuration BPDUs.
- The Root ID reported by management on the DUT should be the one used by Test Station 2.

Possible problems:

- Management may not report the Root ID.

Test STP.op.3.2 – Root Bridge Selection: Root Path Cost Values

Purpose: To verify that the DUT properly identifies the Root Bridge and selects the proper Root Port when comparing Root Path Costs.

References:

- IEEE Std. 802.1D-1998: sub-clause 8.6.8.3
- IEEE Std. 802.1D-1998: sub-clause 8.6.9.3

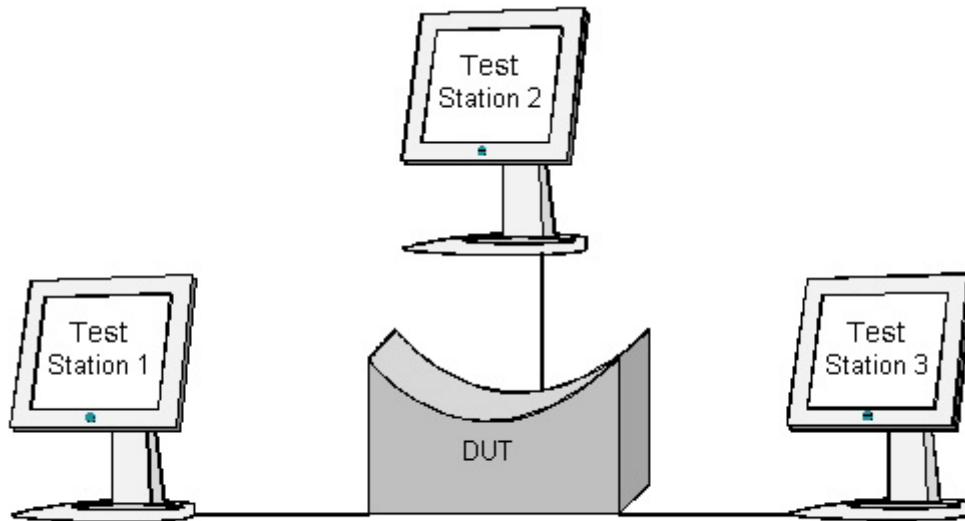
Resource Requirements:

- 3 Test Stations

Discussion: When Spanning Tree is operational, the Root Bridge is selected by comparing information from received Configuration BPDUs to the information stored for the current Root Port. All Bridges participating in Spanning Tree exchange the best stored value for Root ID in order to reach agreement upon which Bridge should become Root.

The second parameter compared, if necessary, during the Root Selection process is the Root Path Cost. This test verifies that the DUT properly selects the Root Bridge when comparing Root Path Costs.

Test Layout:



Procedure:

Part A: Root Bridge Selection Based on Root Path Cost

1. Ensure that the [default](#) values are configured on the DUT.
2. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT and a Root Path Cost of 0x00000001 from Test Station 1.
3. Transmit Configuration BPDUs containing a Root ID equal to the one used by Test Station 1 and a Root Path Cost of 0x00000000 from Test Station 2.
4. Wait for the Spanning Tree to converge.
5. Set Test Stations 1, 2, and 3 to capture.
6. Wait until Test Station 3 has received at least 2 Configuration BPDUs.
7. Record the Root Path Cost value reported by management on the DUT.
8. Observe the Configuration BPDUs (if any) captured by each Test Station.

Observable Results:

- Test Station 3 should capture Configuration BPDUs containing a Root ID equal to the one used by Test Station 2. The Root Path Cost contained in these Configuration BPDUs should be the Path Cost of the Port on the DUT connected to Test Station 2.
- Test Stations 1 and 2 should not capture any Configuration BPDUs.
- The Root Path Cost reported by management on the DUT should be equal to the Path Cost of the Port on the DUT connected to Test Station 2.

Possible problems:

- Management on the DUT may not report the Root Path Cost.

Test STP.op.3.3 – Root Bridge Selection: Bridge ID Values

Purpose: To verify that the DUT properly identifies the Root Bridge and selects the proper Root Port when comparing Root Path Costs.

References:

- IEEE Std. 802.1D-1998: sub-clause 8.6.8.3
- IEEE Std. 802.1D-1998: sub-clause 8.6.9.3

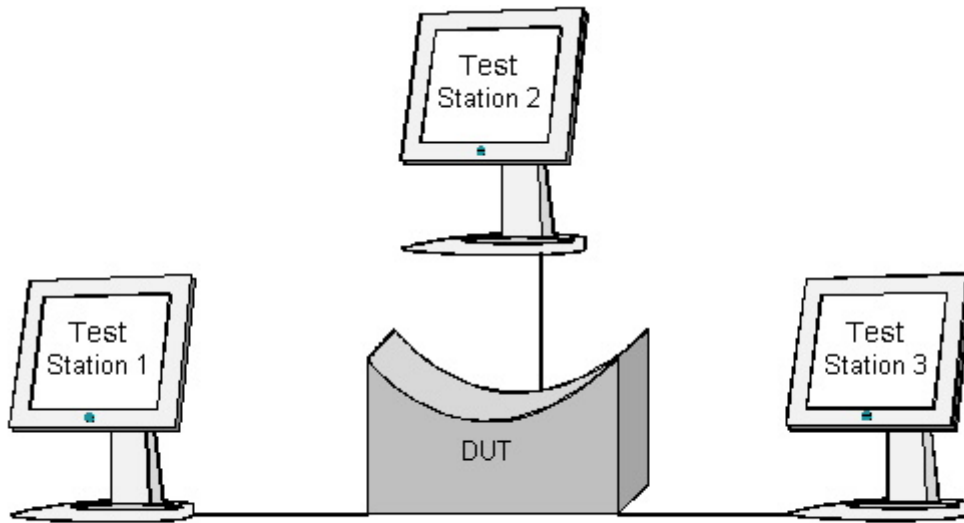
Resource Requirements:

- 3 Test Stations

Discussion: When Spanning Tree is operational, the Root Bridge is selected by comparing information from received Configuration BPDUs to the information stored for the current Root Port. All Bridges participating in Spanning Tree exchange the best value for Root ID that they have stored in order to reach agreement on which Bridge should become Root.

The third parameter compared, if necessary, during the Root Selection Process is the Bridge ID. This test verifies that the DUT properly selects the Root Bridge when comparing Bridge IDs.

Test Layout:



Procedure:

Part A: Root Bridge Selection Based on Bridge ID

1. Ensure that the [default](#) values are configured on the DUT.
2. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT, a Root Path Cost of 0x00000001, and a Bridge ID with a priority of 0x6000 from Test Station 1.
3. Continuously transmit Configuration BPDUs containing a Root ID equal to the one used by Test Station 1, a Root Path Cost of 0x00000001, and a Bridge ID with a priority of 0x7000 from Test Station 2.
4. Wait for the Spanning Tree to converge.
5. Set Test Stations 1, 2, and 3 to capture.
6. Wait until Test Station 3 has received at least 2 Configuration BPDUs.
7. Transmit test traffic containing a unique source MAC address from Test Station 1.
8. Transmit test traffic containing a unique source MAC address from Test Station 2.
9. Transmit test traffic containing a unique source MAC address from Test Station 3.
10. Observe the frames (if any) captured by each Test Station.

Observable Results:

- Test Station 3 should capture Configuration BPDUs containing a Root ID equal to the one used by Test Station 1. The Bridge ID contained in these Configuration BPDUs should be that of the DUT.
- Test Stations 1 and 2 should not capture any Configuration BPDUs.
- Test Station 1 should capture all of the test traffic transmitted by Test Station 3 and no other test traffic.
- Test Station 2 should not capture any test traffic.
- Test Station 3 should capture all of the test traffic transmitted by Test Station 1 and no other test traffic.

Possible problems:

- None.

Test STP.op.3.4 – Root Bridge Selection: Port ID Values

Purpose: To verify that the DUT properly identifies the Root Bridge and selects the proper Root Port when comparing Port ID Values.

References:

- IEEE Std. 802.1D-1998: sub-clause 8.6.8.3
- IEEE Std. 802.1D-1998: sub-clause 8.6.9.3

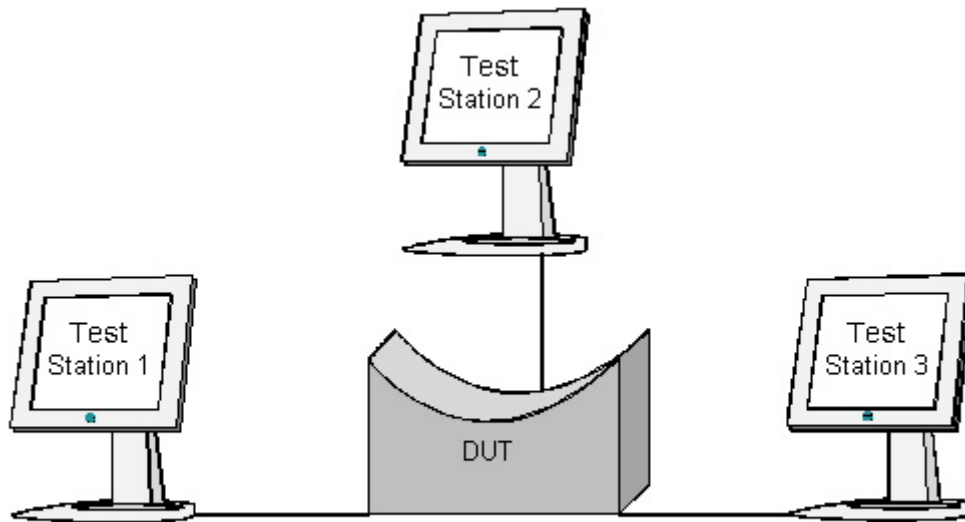
Resource Requirements:

- 3 Test Stations

Discussion: When Spanning Tree is operational, the Root Bridge is selected by comparing information from received Configuration BPDUs to the information stored for the current Root Port. All Bridges participating in Spanning Tree exchange the best value for Root ID that they have stored in order to reach agreement on which Bridge should become Root.

The last parameter compared, if necessary, during the Root Selection Process is the Port ID. This will only happen when two Bridges are connected with two or more cables. This test verifies that the DUT properly selects the Root Bridge when comparing Port IDs.

Test Layout:



Procedure:

Part A: Root Bridge Selection Based on Port ID

1. Ensure that the [default](#) values are configured on the DUT.
2. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT and a Port ID of 0x7001 from Test Station 1. The Root Path Cost should be 0x00000001, and the Bridge ID should have a priority of 0x7000.
3. Transmit Configuration BPDUs from Test Station 2. These Configuration BPDUs should contain the Root ID, Root Path Cost, and Bridge ID used by Test Station 1 and a Port ID of 0x7002.
4. Wait for the Spanning Tree to converge.
5. Set Test Stations 1, 2, and 3 to capture.
6. Wait until Test Station 3 has received at least 2 Configuration BPDUs.
7. Transmit test traffic containing a unique source MAC address from Test Station 1.
8. Transmit test traffic containing a unique source MAC address from Test Station 2.
9. Transmit test traffic containing a unique source MAC address from Test Station 3.
10. Observe the frames (if any) captured by each Test Station.

Observable Results:

- Test Station 3 should capture Configuration BPDUs containing a Root ID equal to the one used by Test Station 1. The Port ID contained in these Configuration BPDUs should be that of the Port on the DUT connected to Test Station 3.
- Test Stations 1 and 2 should not capture any Configuration BPDUs.
- Test Station 2 should not capture any test traffic.
- Test Station 1 should capture all of the test traffic transmitted by Test Station 3 and no other test traffic.
- Test Station 3 should capture all of the test traffic transmitted by Test Station 1 and no other test traffic.

Possible problems:

- None.

GROUP 4: Topology Changes

Scope:

The following tests are designed to help verify the operation of the DUT during a Topology Change. This includes Topology Change detection and propagation.

Overview:

The Spanning Tree Algorithm and Protocol contains a mechanism by which changes in the active topology of a Bridged LAN are detected. Once a Bridge detects a Topology Change it will take steps to ensure the Root Bridge is notified of the Topology Change. If the Root Bridge detects a Topology Change, no such notification is needed. Once the Root Bridge detects or receives notification of a Topology Change, it takes steps to ensure that all Bridges in the Spanning Tree are aware of the Topology Change. As a result all Bridges in the Spanning Tree (including the Root Bridge) will set the ageing time for their Filtering Database(s) to the sum of the current Max Age and Forward Delay parameters. This short ageing time will remove learned station location information that (as a result of changes to the active topology of the Bridged LAN) may no longer be valid from the Filtering Database(s) of Bridges in the Spanning Tree.

Test STP.op.4.1 – Topology Change Detection: Case 1

Purpose: To verify that the DUT detects a topology change when one of its Designated Ports receives a Topology Change Notification BPDU (TCN), and that TCN BPDUs received by the Root Port on the DUT do not result in Topology Change Detection.

References:

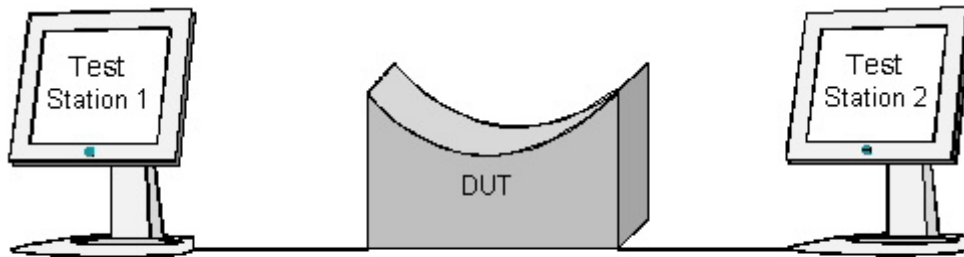
- IEEE Std. 802.1D-1998: sub-clause 8.6.14.2.1
- IEEE Std. 802.1D-1998: sub-clause 8.6.14.3

Resource Requirements:

- 2 Test Stations.

Discussion: There are 4 cases in which a Bridge detects a Topology Change. The first of these occurs when a Designated Port receives a TCN BPDU. A Topology Change is not detected if the Root Port receives a TCN BPDU.

Test Layout:



Procedure:

Part A: Topology Change Detected when TCN BPDU received – DUT is the Root Bridge

1. Ensure that the [default](#) values are configured on the DUT.
2. Ensure that all Ports on the DUT are in the Forwarding Port State, and that Configuration BPDUs received by Test Stations 1 and 2 do not have the Topology Change Flag set.
3. Transmit a TCN BPDU from Test Station 1.
4. Wait 3 seconds.
5. Set Test Stations 1 and 2 to capture.
6. Wait until Test Station 1 has received at least 2 Configuration BPDUs.
7. Observe the Configuration BPDUs captured by Test Stations 1 and 2.

Part B: Topology Change Detected when TCN BPDU received – DUT is not the Root Bridge

8. Ensure that the [default](#) values are configured on the DUT.
9. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT from Test Station 1.
10. Wait until all Ports on the DUT are in the Forwarding Port State, and Test Station 2 is receiving Configuration BPDUs that do not have the Topology Change Flag set and contain the Root ID used by Test Station 1.
11. Transmit a TCN BPDU from Test Station 2.
12. Wait 3 seconds.
13. Set Test Stations 1 and 2 to capture.
14. Wait until Test Station 2 has received at least 2 Configuration BPDUs.
15. Observe the frames captured by Test Stations 1 and 2.

Part C: TCN BPDU received on Root Port Does not Cause Topology Change

16. Ensure that the [default](#) values are configured on the DUT.
17. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT from Test Station 1.
18. Wait until all Ports on the DUT are in the Forwarding Port State, and Test Station 2 is receiving Configuration BPDUs that do not have the Topology Change Flag set and contain the Root ID used by Test Station 1.
19. Transmit a TCN BPDU from Test Station 1.
20. Set Test Stations 1 and 2 to capture.
21. Wait until Test Station 2 has received at least 2 Configuration BPDUs.
22. Observe the frames captured by Test Stations 1 and 2.

Observable Results:

- In Part A, Test Station 1 should capture Configuration BPDUs with the Topology Change Flag set.
- In Part A, Test Station 2 should capture Configuration BPDUs with the Topology Change Flag set.
- In Part B, Test Station 1 should capture TCN BPDUs.
- In Part C, Test Station 1 should not capture any Configuration BPDUs.
- In Part C, the Topology Change Flag should not be set in any of the Configuration BPDUs captured by Test Station 2.
- In Part C, neither Test Station should capture any TCN BPDUs.

Possible Problems:

- In Part C, if the DUT is conformant to IEEE Std. 802.1D™ -2004 the results may differ. The DUT may accept the TCN BPDUs from Test Station 1 on its Root Port and propagate topology change information accordingly. IEEE Std. 802.1D™ -2004 Figure 17-25 shows that the Topology Change state machine does not check if the receiving port of a TCN BPDU is a DesignatedPort or a RootPort.

Test STP.op.4.2 – Topology Change Detection: Case 2

Purpose: To verify that the DUT detects a topology change when one of its Designated Ports enters the Forwarding Port State.

References:

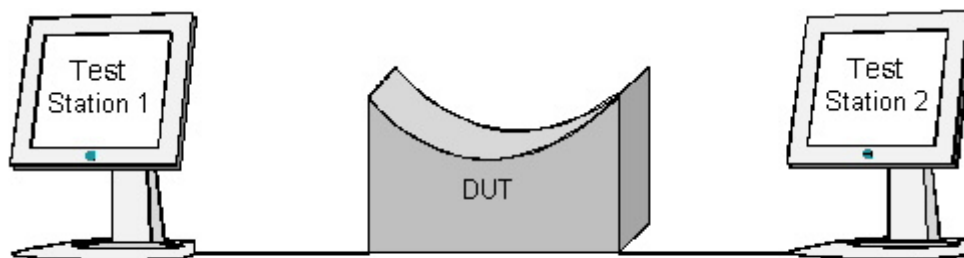
- IEEE Std. 802.1D-1998: sub-clause 8.6.14.2.2
- IEEE Std. 802.1D-1998: sub-clause 8.6.14.3

Resource Requirements:

- 2 Test Stations.

Discussion: There are 4 cases in which a Bridge detects a Topology Change. The second of these occurs when a Designated Port on the Bridge enters the Forwarding Port State.

Test Layout:



Procedure:

Part A: Topology Change Detected when Designated Port enters Forwarding Port State

1. Ensure that the [default](#) values are configured on the DUT.
2. Continuously transmit Configuration BPDUs from Test Station 1 containing a Root ID better than the Bridge ID of the DUT and a Root Path Cost of 0x00000000.
3. Continuously transmit Configuration BPDUs from Test Station 2 containing the Root ID used by Test Station 1 and a Root Path Cost of 0x00000001.
4. Once Test Station 1 is receiving TCN BPDUs, set the Topology Change Acknowledgement Flag in the next Configuration BPDU transmitted by Test Station 1.
5. Ensure that Test Station 1 is no longer receiving TCN BPDUs.
6. Stop Transmitting Configuration BPDUs from Test Station 2.
7. Once Test Station 2 has entered the Forwarding Port State, set Test Stations 1 and 2 to capture.
8. Wait until Test Station 2 has captured at least 2 Configuration BPDUs.
9. Observe the frames captured by Test Stations 1 and 2.

Observable Results:

- Test Station 1 should capture TCN BPDUs.
- Test Station 2 should capture Configuration BPDUs containing the Root ID used by Test Station 1.

Possible Problems:

- None.

Test STP.op.4.3 – Topology Change Detection: Case 3

Purpose: To verify that the DUT detects a Topology Change when one of its Designated Ports enters the Blocking Port State.

References:

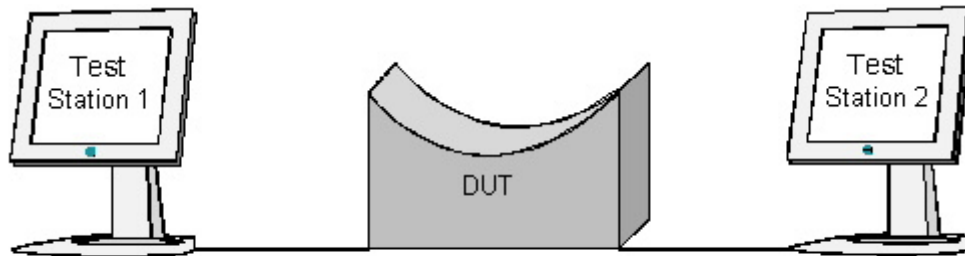
- IEEE Std. 802.1D-1998: sub-clause 8.6.14.2.3
- IEEE Std. 802.1D-1998: sub-clause 8.6.14.3

Resource Requirements:

- 2 Test Stations.

Discussion: There are 4 cases in which a Bridge detects a Topology Change. The third of these occurs when a Designated Port on the Bridge enters the Blocking Port State.

Test Layout:



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InterOperability Laboratory*

Procedure:

Part A: Topology Change Detected when Designated Port enters Blocking Port State

1. Ensure that the [default](#) values are configured on the DUT.
2. Ensure that all Ports on the DUT are in the Forwarding Port State, and that Configuration BPDUs received by Test Stations 1 and 2 do not have the Topology Change Flag set.
3. Continuously transmit Configuration BPDUs from Test Station 1 containing a Root ID better than the Bridge ID of the DUT and a Root Path Cost of 0x00000000.
4. Wait for the Spanning Tree to converge.
5. Set Test Station 1 to capture.
6. Continuously transmit Configuration BPDUs from Test Station 2 containing the Root ID used by Test Station 1 and a Root Path Cost of 0x00000001.
7. Wait for the Spanning Tree to converge.
8. Set Test Station 2 to capture.
9. Observe the frames captured by Test Stations 1 and 2.

Observable Results:

- Test Station 1 should capture TCN BPDUs.
- Test Station 2 should not capture any Configuration or TCN BPDUs.

Possible Problems:

- In Part A, if the DUT is conformant to IEEE Std. 802.1D™ -2004 the results may differ. Test Station 1 may not receive TCN BPDUs from the DUT when the port attached to Test Station 2 enters the Blocking Port State. In IEEE Std. 802.1D™ -2004 Figure 17-24 shows that a port entering the Blocking (or Discarding) Port State does not cause a Topology Change.

Test STP.op.4.4 – Topology Change Detection: Case 4

Purpose: To verify that the DUT detects a topology change when the information held on its Root Port expires and it becomes the Root Bridge.

References:

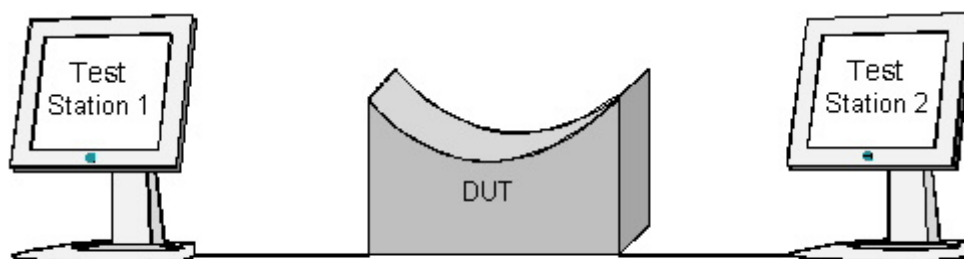
- IEEE Std. 802.1D-1998: sub-clause 8.6.14.2.4
- IEEE Std. 802.1D-1998: sub-clause 8.6.14.3

Resource Requirements:

- 2 Test Stations.

Discussion: There are 4 cases in which a Bridge detects a Topology Change. The fourth of these occurs when a Bridge that previously was not the Root Bridge becomes the Root Bridge.

Test Layout:



Procedure:

Part A: Topology Change Detected when DUT Becomes Root

1. Ensure that the [default](#) values are configured on the DUT.
2. Ensure that the Ports on the DUT connected to Test Stations 1 and 2 are in the Forwarding Port State, and that neither Port is transmitting Configuration BPDUs with the Topology Change Flag set.
3. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT from Test Station 1.
4. Wait until Test Station 2 is receiving Configuration BPDUs containing a Root ID equal to the one used by Test Station 1.
5. Stop transmitting Configuration BPDUs from Test Station 1.
6. Once Test Station 1 begins receiving Configuration BPDUs, set Test Stations 1 and 2 to capture.
7. Wait until Test Station 2 has received at least 2 Configuration BPDUs.
8. Observe the frames captured by both Test Stations.

Observable Results:

- Test Stations 1 and 2 should capture Configuration BPDUs containing a Root ID equal to the Bridge ID of the DUT with the Topology Change Flag set.

Possible Problems:

- In Part A, if the DUT is conformant to IEEE Std. 802.1D™ -2004 the results may differ. During a Topology Change the Bridge that becomes root may not set the Topology Change Flag parameter held for the Bridge, thus no BPDUs with the Topology Change Flag set would be received.

Test STP.op.4.5 – Topology Change Acknowledgement

Purpose: To verify that the DUT ceases transmitting TCN BPDUs on its Root Port once that Port has received a Configuration BPDU with the Topology Change Acknowledgement Flag set, and that the DUT sets the Topology Change Acknowledgement Flag when necessary.

References:

- IEEE Std. 802.1D-1998: sub-clause 8.6.14.2
- IEEE Std. 802.1D-1998: sub-clause 8.6.14.3
- IEEE Std. 802.1D-1998: sub-clause 8.6.15

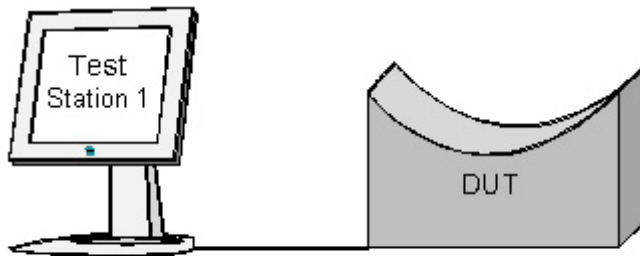
Resource Requirements:

- 1 Test Station.

Discussion: When the Root Port receives a Configuration BPDU with the Topology Change Acknowledgment Flag set, the Topology Change Detected flag parameter held for the Bridge is reset, and the Topology Change Notification Timer is stopped.

When a Designated Port receives a TCN BPDU, the Topology Change Acknowledge flag parameter for the Port is set, and the Port transmits a Configuration BPDU.

Test Layout:



Procedure:

Part A: Root Port Receives Topology Change Acknowledgement

1. Ensure that the [default](#) values are configured on the DUT.
2. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT from Test Station 1.
3. Transmit a TCN BPDU from Test Station 2.
4. Wait until Test Station 1 receives a TCN BPDU.
5. Set the Topology Change Acknowledgement flag in the next BPDU transmitted by Test Station 1.
6. Wait 2 seconds.
7. Set Test Station 1 to capture.
8. Wait 10 seconds.
9. Observe the frames captured by Test Station 1.

Part B: DUT Sets Topology Change Acknowledgement Flag When Necessary

10. Ensure that the [default](#) values are configured on the DUT.
11. Set Test Station 1 to capture.
12. Transmit a TCN BPDU from Test Station 1.
13. Wait until Test Station 1 has received at least 2 Configuration BPDUs.
14. Observe the frames captured by Test Station 1.

Observable Results:

- In Part A, Test Station 1 should not capture any TCN BPDUs.
- In Part B, Test Station 1 should capture one Configuration BPDU with the Topology Change Acknowledgement Flag set.

Possible Problems:

- None.

Test STP.op.4.6 – Topology Change Notification Timer

Purpose: To verify that the DUT properly implements the Topology Change Notification (TCN) Timer.

References:

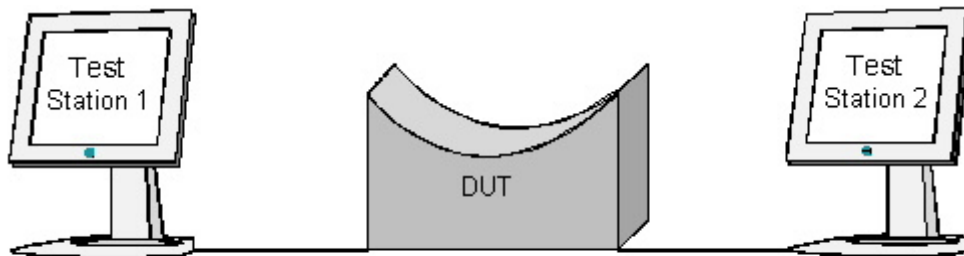
- IEEE Std. 802.1D-1998: sub-clause 8.5.4.2
- IEEE Std. 802.1D-1998: sub-clause 8.6.6
- IEEE Std. 802.1D-1998: sub-clause 8.7.6

Resource Requirements:

- 1 Test Station.

Discussion: When a Bridge that is not the Root Bridge detects a Topology Change, it transmits a TCN BPDU on its Root Port, and sets the TCN timer. Until the Root Port receives a Configuration BPDU with the Topology Change Acknowledgement Flag set, when the TCN timer expires another TCN BPDU will be transmitted on the Root Port and the TCN timer will be restarted. The timeout value of the TCN timer is that of the Bridge's Bridge Hello Time parameter.

Test Layout:



Procedure:

Part A: Topology Change Notification Timer

1. Ensure that the [default](#) values are configured on the DUT.
2. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT and a Hello Time of 0x0100 from Test Station 1.
3. Set Test Station 1 to capture.
4. Transmit a TCN BPDU from Test Station 2.
5. Wait until Test Station 1 has received at least 4 TCN BPDUs.
6. Set the Topology Change Acknowledgement Flag in the next Configuration BPDU transmitted by Test Station 1.
7. Observe the TCN BPDUs captured by Test Station 1.
8. Set Bridge Hello Time on the DUT to 3 seconds.
9. Repeat Steps 2-7 using a Hello Time of 0x0200 in the Configuration BPDUs transmitted by Test Station 1.

Observable Results:

- In Step 7, the time interval between each TCN BPDU captured by Test Station 1 should be equal to 2 seconds.
- In Step 9, the time interval between each TCN BPDU captured by Test Station 1 should be equal to 3 seconds.

Possible Problems:

- In Part A, if the DUT is conformant to IEEE Std. 802.1D™ -2004 the results may differ. The Topology Change triggered by the TCN BPDU causes the DUT to immediately transmit a BPDU with Topology Change information, in the case of the Root Port a TCN BPDU. This will cause more than one TCN BPDU within the first HelloTime if this was triggered in the middle of a HelloTime period .

Test STP.op.4.7 – Topology Change Timer

Purpose: To verify that the DUT properly implements the Topology Change Timer.

References:

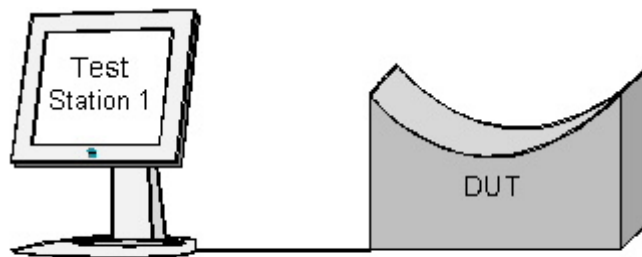
- IEEE Std. 802.1D-1998: sub-clause 8.5.3.13
- IEEE Std. 802.1D-1998: sub-clause 8.5.4.3
- IEEE Std. 802.1D-1998: sub-clause 8.6.14.3
- IEEE Std. 802.1D-1998: sub-clause 8.7.7

Resource Requirements:

- 1 Test Station.

Discussion: Upon detecting or receiving notification of a Topology Change, a Bridge that is Root sets its Topology Change Timer. Configuration BPDUs transmitted by the Root (and each of the other Bridges in the Spanning Tree) will have their Topology Change Flag set until Topology Change Timer expiry occurs. The timeout value of the Root Bridge's Topology Change timer is the value of the Bridge's Topology Change Time parameter. The Topology Change Time parameter is equal to the sum of the Bridge's Bridge Max Age and Bridge Forward Delay parameters.

Test Layout:



Procedure:

Part A: Topology Change Timer

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Bridge Hello Time on the DUT to 1 second.
3. Set Bridge Max Age on the DUT to 6 seconds.
4. Set Bridge Forward Delay on the DUT to 4 seconds.
5. Set Test Station 1 to capture.
6. Transmit a TCN BPDU from Test Station 1.
7. Once Test Station 1 is receiving Configuration BPDUs with the Topology Change Flag set, wait until Test Station 1 is no longer receiving Configuration BPDUs with the Topology Change Flag set.
8. Observe the frames captured by Test Station 1.
9. Repeat Steps 1-8 using the following timer values: Bridge Forward Delay = 15 seconds, Bridge Max Age = 20 seconds, and Bridge Hello Time = 2 seconds.
10. Repeat Steps 1-8 using the following timer values: Bridge Forward Delay = 30 seconds, Bridge Max Age = 40 seconds, and Bridge Hello Time = 10 seconds.

Observable Results:

- In each case, Test Station 1 should capture Configuration BPDUs with the Topology Change Flag set for a period of time equal the sum of the Bridge Max Age and Bridge Forward Delay values that had been set on the DUT.

Possible Problems:

- None.

Test STP.op.4.8 – Ageing Time During Topology Change – DUT is the Root Bridge

Purpose: To verify that the DUT uses the current Forward Delay value as the Ageing Timer (for Dynamic Filtering Database entries) during a Topology Change.

References:

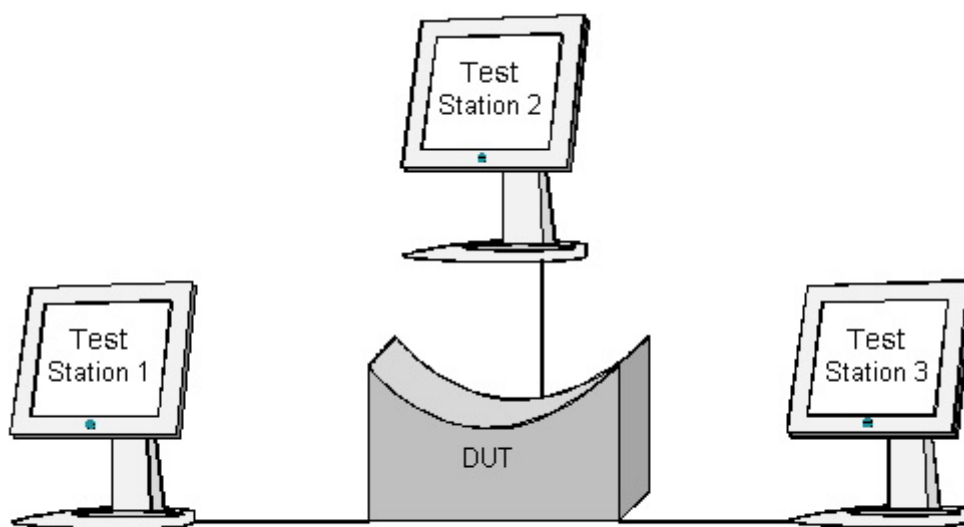
- IEEE Std. 802.1D-1998: sub-clause 8.3.5
- IEEE Std. 802.1D-1998: sub-clause 8.5.1.10

Resource Requirements:

- 3 Test Stations.

Discussion: The value of the ageing time applied to dynamic entries in the Filtering Database becomes equal to that of the value of the Forward Delay time parameter held for the Bridge; i.e., after Forward Delay time has elapsed while the Topology Change flag is set in all Configuration Messages received from the Root, then the only dynamic entries remaining in the Filtering Database are those that have been created or updated during that period.

Test Layout:



Procedure:

Part A: Ageing Timer is equal to Forward Delay during Topology Change – DUT is the Root Bridge – Default Forward Delay Value

1. Ensure that the [default](#) values are configured on the DUT.
2. Ensure that the Ageing Time for the Filtering Database that is associated with the Default VLAN is set to the recommended default value (300 seconds), and that no Filtering Entries for MAC address 0x0000000BFCA1 exist in said FDB.
3. Transmit test traffic containing a destination MAC address of 0x000123456789 and a source MAC address of 0x0000000BFCA1 from Test Station 1.
4. Set Test Stations 1, 2, and 3 to capture.
5. Transmit a TCN BPDU from Test Station 2.
6. Wait 5 seconds.
7. Transmit test traffic containing a destination MAC address of 0x0000000BFCA1 and a source MAC address of 0x0000000BFCA2 from Test Station 3.
8. Wait more than 15 seconds, but less than 20 seconds.
9. Transmit test traffic containing a destination MAC address of 0x0000000BFCA1 and a source MAC address of 0x0000000BFCA3 from Test Station 3.
10. Observe the frames (if any) captured by each Test Station.

Part B: Ageing Timer is equal to Forward Delay during Topology Change – DUT is the Root Bridge – Non-default Forward Delay Value

11. Ensure that the [default](#) values are configured on the DUT.
12. Set Bridge Hello Time on the DUT to 1 second.
13. Set Bridge Max Age on the DUT to 6 seconds.
14. Set Bridge Forward Delay on the DUT to 4 seconds.
15. Ensure that the Ageing Time for the Filtering Database that is associated with the Default VLAN is set to the recommended default value (300 seconds), and that no Filtering Entries for MAC address 0x0000000BFCA1 exist in said FDB.
16. Transmit test traffic containing a destination MAC address of 0x000123456789 and a source MAC address of 0x0000000BFCA1 from Test Station 1.
17. Set Test Stations 1, 2, and 3 to capture.
18. Transmit a TCN BPDU from Test Station 2.
19. Wait 1 second.
20. Transmit test traffic containing a destination MAC address of 0x0000000BFCA1 and a source MAC address of 0x0000000BFCA2 from Test Station 3.
21. Wait more than 4 seconds, but less than 8 seconds.
22. Transmit test traffic containing a destination MAC address of 0x0000000BFCA1 and a source MAC address of 0x0000000BFCA3 from Test Station 3.
23. Observe the frames (if any) captured by each Test Station.

Observable Results:

- In Parts A and B, Test Station 1 should capture test traffic containing a source MAC address of 0x0000000BFCA2.
- In Parts A and B, Test Station 2 should not capture any test traffic containing a source MAC address of 0x0000000BFCA2.
- In Parts A and B, Test Stations 1 and 2 should capture test traffic containing a source MAC address of 0x0000000BFCA3.
- In Parts A and B, Test Station 3 should not capture any test traffic

Possible Problems:

- In Part A and B, if the DUT is conformant to IEEE Std. 802.1D™ -2004 the results may differ. For a Bridge functioning in sendRSTP = TRUE mode for a port, the DUT may flush all filtering database entries for all Ports other than the Port the Topology Change Notification was received on. This is, however, still

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a FAIL for a Bridge conformant to 802.1D™ -2004 running in Classic Spanning Tree mode, as a Port in sendRSTP = FALSE mode must use Rapid Aging for Dynamic Filtering Database entries on all ports other than the port receiving the TCN BPDU.

Test STP.op.4.9 – Ageing Time During Topology Change – DUT is not the Root Bridge

Purpose: To verify that the DUT uses the current Forward Delay value as the Ageing Timer (for Dynamic Filtering Database entries) during a Topology Change.

References:

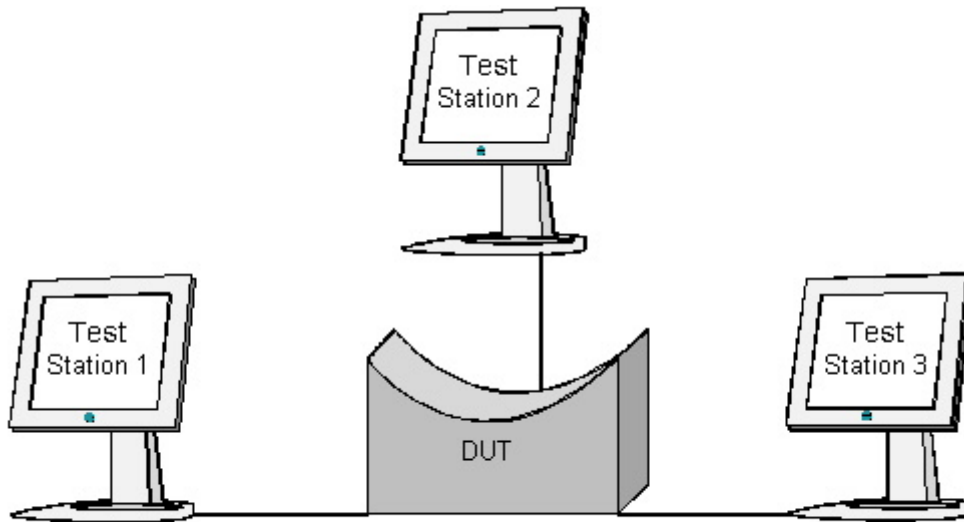
- IEEE Std. 802.1D-1998: sub-clause 8.3.5
- IEEE Std. 802.1D-1998: sub-clause 8.5.1.10

Resource Requirements:

- 3 Test Stations.

Discussion: The value of the ageing time applied to dynamic entries in the Filtering Database becomes equal to that of the value of the Forward Delay time parameter held for the Bridge; i.e., after Forward Delay time has elapsed while the Topology Change flag is set in all Configuration Messages received from the Root, then the only dynamic entries remaining in the Filtering Database are those that have been created or updated during that period.

Test Layout:



Procedure:

Part A: Ageing Timer is equal to Forward Delay during Topology Change – DUT is not the Root Bridge – Default Forward Delay Value

1. Ensure that the [default](#) values are configured on the DUT.
2. Ensure that the Ageing Time for the Filtering Database that is associated with the Default VLAN is set to the recommended default value (300 seconds), and that no Filtering Entries for MAC address 0x000000BFCA1 exist in said FDB.
3. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT from Test Station 1.
4. Transmit test traffic containing a destination MAC address of 0x000123456789 and a source MAC address of 0x000000BFCA1 from Test Station 1.
5. Set Test Stations 1, 2, and 3 to capture.
6. Set the Topology Change Flag in Configuration BPDUs being transmitted by Test Station 1.
7. Wait 5 seconds.
8. Transmit test traffic containing a destination MAC address of 0x000000BFCA1 and a source MAC address of 0x000000BFCA2 from Test Station 3.
9. Wait more than 15 seconds, but less than 20 seconds.
10. Transmit test traffic containing a destination MAC address of 0x000000BFCA1 and a source MAC address of 0x000000BFCA3 from Test Station 3.
11. Observe the frames (if any) captured by each Test Station.

Part B: Ageing Timer is equal to Forward Delay during Topology Change – DUT is not the Root Bridge – Non-default Forward Delay Value

12. Ensure that the [default](#) values are configured on the DUT.
13. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT from Test Station 1. The Bridge Max Age, Bridge Hello Time, and Bridge Forward Delay contained in these Configuration BPDUs should be 6, 1, and 4 seconds, respectively.
14. Ensure that the Ageing Time for the Filtering Database that is associated with the Default VLAN is set to the recommended default value (300 seconds), and that no Filtering Entries for MAC address 0x000000BFCA1 exist in said FDB.
15. Transmit test traffic containing a destination MAC address of 0x000123456789 and a source MAC address of 0x000000BFCA1 from Test Station 1.
16. Set Test Stations 1, 2, and 3 to capture.
17. Set the Topology Change Flag in Configuration BPDUs being transmitted by Test Station 1.
18. Wait 1 second.
19. Transmit test traffic containing a destination MAC address of 0x000000BFCA1 and a source MAC address of 0x000000BFCA2 from Test Station 3.
20. Wait more than 4 seconds, but less than 8 seconds.
21. Transmit test traffic containing a destination MAC address of 0x000000BFCA1 and a source MAC address of 0x000000BFCA3 from Test Station 3.
22. Observe the frames (if any) captured by each Test Station.

Observable Results:

- In Parts A and B, Test Station 1 should capture test traffic containing a source MAC address of 0x000000BFCA2.
- In Parts A and B, Test Station 2 should not capture any test traffic containing a source MAC address of 0x000000BFCA2.
- In Parts A and B, Test Stations 1 and 2 should capture test traffic containing a source MAC address of 0x000000BFCA3.
- In Parts A and B, Test Station 3 should not capture any test traffic

Possible Problems:

- In Part A and B, if the DUT is conformant to IEEE Std. 802.1D™ -2004 the results may differ. For a Bridge functioning in sendRSTP = TRUE mode for a port, the DUT may flush all filtering database entries

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for all Ports other than the Port the Topology Change Notification was received on. This is, however, still a FAIL for a Bridge conformant to 802.1D™ -2004 running in Classic Spanning Tree mode, as a Port in sendRSTP = FALSE mode must use Rapid Aging for Dynamic Filtering Database entries on all ports other than the port receiving the TCN BPDU.

GROUP 5: Bridge Timer Values

Scope:

The following tests cover the Spanning Tree Algorithm and Protocol's various timers.

Overview:

These tests are designed to verify that the device under test (DUT) properly implements the Hello timer, the Message Age timer, and the Forward Delay timer, and that the relationships between these timers are enforced.

Test STP.op.5.1 – Message Age Timer

Purpose: To verify that the DUT implements the Bridge Message Age Timer properly.

References:

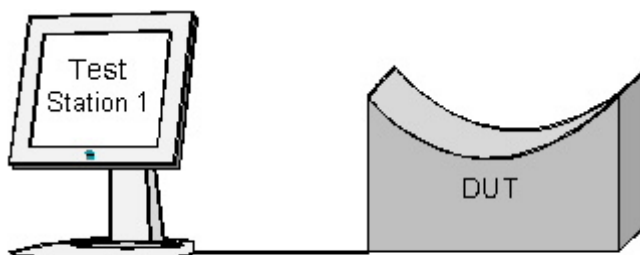
- IEEE Std. 802.1D-1998: sub-clause 8.5.6.1
- IEEE Std. 802.1D-1998: sub-clause 8.6.2.3.2
- IEEE Std. 802.1D-1998: sub-clause 8.7.4
- IEEE Std. 802.1t-2001: Table 8-3

Resource Requirements:

- 1 Test Station

Discussion: The Message Age timer serves to measure the age of the received protocol information recorded for a Port. If the age of this information exceeds the value of Max Age recorded by the Bridge, the information is discarded, and the Bridge configuration is updated (this may result in a topology change). The timeout value of the Message Age Timer is that of the Bridge's Bridge Max Age parameter. The Message Age Timer is set to the value of the Message Age parameter contained in the Configuration BPDU most recently received by the Root Port.

Test Layout:



Procedure:

Part A: Message Age Timer

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Test Station 1 to capture.
3. Wait until Test Station 1 has captured at least 1 Configuration BPDU.
4. Transmit a Configuration BPDU containing a Root ID better than the Bridge ID of the DUT from Test Station 1. The Message Age, Max Age, Hello Time, and Forward Delay in the Configuration BPDU should be 0x0000, 0x1400, 0x0100, and 0x0F00 respectively.
5. Wait 10 seconds longer than the Message Age value contained in the Configuration BPDU transmitted in Step 4.
6. Observe the frames captured by Test Station 1.
7. Repeat Steps 2-6. The Message Age, Max Age, Hello Time, and Forward Delay values used in the Configuration BPDU transmitted in Step 4 should be 0x0000, 0x2800, 0x0100, and 0x1E00 respectively.
8. Repeat Steps 2-6. The Message Age, Max Age, Hello Time, and Forward Delay values used in the Configuration BPDU transmitted in Step 4 should be 0x0000, 0x0600, 0x0100, and 0x1E00 respectively.

Observable Results:

- In each case, once a Configuration BPDU has been transmitted in Step 4, Test Station 1 should not capture Configuration BPDUs for a number of seconds equal to the Max Age value that was used in Step 4. Test Station 1 should then capture Configuration BPDUs containing a Root Bridge ID equal to the Bridge ID of the DUT.

Possible Problems:

- In Part A, if the DUT is conformant to IEEE Std. 802.1w™ -2001 or 802.1D™ -2004 the results may differ. The DUT may Time-out the RootID transmitted by Test Station 1 in (3x HelloTime) and transmit Configuration BPDUs with RootID of the DUT until Test Station 1 transmits another Configuration BPDU. This procedure is defined for the updtRcvdInfoWhile procedure in sub-clause 17.19.19 (17.21.23 for 802.D™ -2004).

Test STP.op.5.2 – Bridge Hello Timer

Purpose: To verify that the DUT implements the Hello Timer properly.

References:

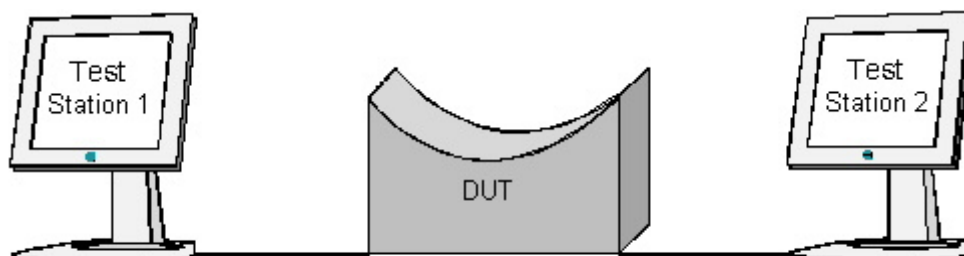
- IEEE Std. 802.1D-1998: sub-clause 8.5.4.1
- IEEE Std. 802.1D-1998: sub-clause 8.7.3
- IEEE Std. 802.1t-1998: Table 8-3

Resource Requirements:

- 2 Test Stations.

Discussion: The Hello Timer causes the Root Bridge to transmit a Configuration BPDU every Hello Time period. This ensures that information stored on Bridges other than the Root Bridge will not be discarded (causing unnecessary network reconfiguration). The value of Hello Time is transmitted in all Configuration BPDUs so that this value is available everywhere on the LAN for management purposes. Valid values for the Bridge Hello Time parameter range from 1.0 to 10.0 seconds.

Test Layout:



Procedure:

Part A: Hello Time when the DUT is the Root Bridge

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Bridge Hello Time, Bridge Max Age, and Bridge Forward Delay on the DUT to 1, 6 and 4 seconds, respectively.
3. Set Test Stations 1 and 2 to capture.
4. Wait until Test Station 1 has received at least 4 Configuration BPDUs.
5. Record the time interval between each of the Configuration BPDUs captured by Test Stations 1 and 2.
6. Repeat Steps 2-5 using Bridge Hello Time, Bridge Max Age, and Bridge Forward Delay values of 2, 20, and 15 seconds, respectively.
7. Repeat Steps 2-5 using Bridge Hello Time, Bridge Max Age, and Bridge Forward Delay values of 10, 40, and 30 seconds, respectively.

Part B: Hello Time when the DUT is not the Root Bridge

8. Ensure that the [default](#) values are configured on the DUT.
9. Continuously transmit (at a rate of 1 every 10 seconds) Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT from Test Station 1. These Configuration BPDUs should contain Max Age, Hello Time, and Forward Delay values of 20, 1, and 15 seconds, respectively.
10. Wait for the Spanning Tree to converge.
11. Set Test Station 2 to capture.
12. Wait until Test Station 2 has received at least 4 Configuration BPDUs.
13. Record the time interval between each of the Configuration BPDUs captured by TS2.

Observable Results:

- In Part A, Test Stations 1 and 2 should capture Configuration BPDUs containing a Root ID equal to the Bridge ID of the DUT.
- In Part A, in each case, the time interval between each of the Configuration BPDUs captured by Test Stations 1 and 2 should be equal to the Bridge Hello Time value set in Step 2.
- In Part B, the time interval between each of the Configuration BPDUs captured by Test Station 2 should be equal to 10 seconds.

Possible Problems:

- In Part B, if the DUT is conformant to IEEE Std. 802.1w™ -2001 or 802.1D™ -2004 the results may differ. The DUT may Time-out the RootID transmitted by Test Station 1 in (3x HelloTime) and transmit Configuration BPDUs with RootID of the DUT until Test Station 1 transmits another Configuration BPDU. This procedure is defined for the updtRcvdInfoWhile procedure in sub-clause 17.19.19 (17.21.23 for 802.D™ -2004).

Test STP.op.5.3 – Bridge Forward Delay Timer

Purpose: To verify that the device under test (DUT) implements the Bridge Forward Delay Timer properly.

References:

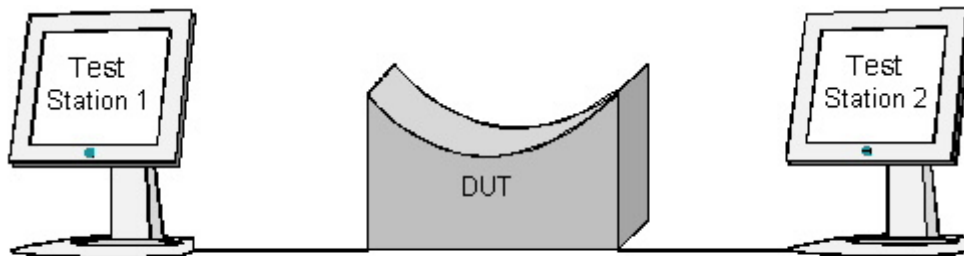
- IEEE Std. 802.1D-1998: sub-clause 8.5.6.2
- IEEE Std. 802.1D-1998: sub-clause 8.7.5
- IEEE Std. 802.1t-1998: Table 8-3

Resource Requirements:

- 2 Test Stations

Discussion: A Port is required to remain in the Listening and Learning States for Bridge Forward Delay time before transitioning to the Learning and Forwarding States, respectively. This prevents transient data loops from forming in the Bridged LAN as a result of a rapid transition into the Forwarding State. The Root Bridge transmits the value of Forward Delay in its Configuration BPDUs so that all Bridges in the Bridged LAN use this Forward Delay value. Valid values for Bridge Forward Delay range from 4.0 to 30.0 seconds.

Test Layout:



Procedure:

Part A: Bridge Forward Delay Timer

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Bridge Hello Time, Bridge Max Age, and Bridge Forward Delay to 1, 6, and 4 seconds, respectively.
3. Ensure that the Ports on the DUT connected to Test Stations 1 and 2 are in the Forwarding State.
4. Continuously transmit test traffic between Test Stations 1 and 2.
5. Set Test Stations 1 and 2 to capture.
6. Disable, then enable the Port on the DUT connected to Test Station 2.
7. Wait until Test Stations 1 and 2 are receiving test traffic again.
8. Record the size of the time interval during which Test Station 1 did not receive test traffic.
9. Record the size of the time interval during which Test Station 2 did not receive test traffic.
10. Repeat steps 2 through 9 using Bridge Forward Delay, Bridge Max Age, and Bridge Hello Time values of 15, 20, and 2 seconds, respectively.
11. Repeat steps 2 through 9 using Bridge Forward Delay, Bridge Max Age, and Bridge Hello Time values of 30, 40, and 10 seconds, respectively.

Observable Results:

- In each case, the time interval during which Test Station 1 did not receive test traffic should be equal to twice the current Bridge Forward Delay value.
- In each case, the time interval during which Test Station 2 did not receive test traffic should be equal to twice the current Bridge Forward Delay value.

Possible Problems:

- If the Port on the DUT connected to Test Station 2 is disabled for more than 1 second, the time interval during which the Port was disabled (in addition to the time needed for the Port to re-establish link with Test Station 2) must be accounted for.
- Up to one-second differences between the recorded time and the time used in Step 2 may occur due to the time taken for a link to become active. A larger difference may mean errors in implementation of the timer.

Test STP.op.5.4 – Parameter Restrictions

Purpose: To verify that the device under test (DUT) enforces the restrictions placed on the relationship between Bridge Max Age, Bridge Forward Delay, and Bridge Hello Time.

References:

- IEEE 802.1t-2001: sub-clause 8.10.2

Resource Requirements:

- 1 Test Station.

Discussion: The following restrictions are placed on the Bridge parameters Bridge Max Age, Bridge Forward Delay, and Bridge Hello Time:

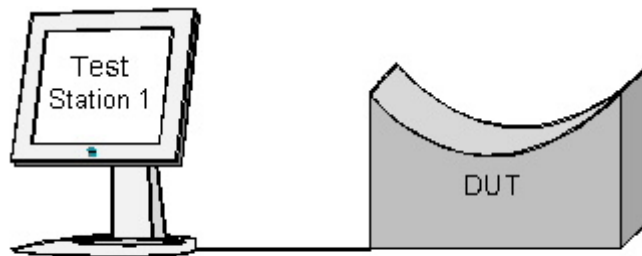
$$2 * (\text{Bridge Forward Delay} - 1.0 \text{ seconds}) \geq \text{Bridge Max Age} \geq 2 * (\text{Bridge Hello Time} + 1.0 \text{ seconds}).$$

$$\text{Bridge Hello Time} > \text{Hold Time}$$

Thus, even if the values selected for Bridge Forward Delay, Bridge Max Age, and Bridge Hello Time fall within the range of acceptable values, it is not conformant to allow those values to be set unless the relationship described above is also true. This serves as a “sanity check” of sorts (i.e. Bridge Hello Time should not be greater than Max Age). That said, the relationship between timer values is not a condition used for validation of received Configuration BPDUs.

Test Setup: Connect Test Station 1 to the DUT as shown in Figure 1. Ensure the DUT is using the default settings defined in the Introduction.

Test Layout:



Procedure:

Part A: Setting Illegal Combinations of Values

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Test Station 1 to capture.
3. Set Bridge Hello Time to 3 seconds and try to set Bridge Max Age to 6 seconds.
4. Set Bridge Hello Time to 2 seconds.
5. Set Bridge Max Age to 7 seconds and try to set Bridge Forward Delay to 4 seconds.
6. Set Bridge Max Age to 6 seconds.
7. Set Bridge Forward Delay to 20 seconds and try to set Bridge Max Age to 40 seconds.
8. Set Bridge Forward Delay to 15 seconds.
9. Continue attempts to set illegal combinations of Bridge Timer values for as long as time allows, or until all possible combinations of illegal values have been attempted.
10. Observe the Bridge Max Age, Bridge Hello Time, and Bridge Forward Delay values contained in Configuration BPDUs captured by Test Station 1.

Observable Results:

- The DUT should not allow any combination of illegal values to be set.
- The Bridge Max Age, Bridge Hello Time, and Bridge Forward Delay values contained in captured Configuration BPDUs should satisfy the parameter restrictions.

Possible Problems:

- If the DUT does not have management capabilities it will be unable to complete the test.

GROUP 6: Port States

Scope:

The following tests are designed to verify that the DUT correctly implements the Disabled, Blocking, Listening, Learning, and Forwarding Port States.

Overview:

Ports that are running the Spanning Tree Algorithm and Protocol will at all times be assigned one and only one "Port State". Valid Port States are: Disabled, Blocking, Listening, Learning, and Forwarding. The operation of the Learning and Forwarding Processes with regard to a Port in a given Port State is clearly defined. The conditions that permit transitions between Port States are clearly defined. The exclusion or inclusion of a Port in the computation of the active topology performed by the Spanning Tree Algorithm and Protocol is determined by the Port State of said Port. Whether or not BPDUs may be submitted for transmission to a Port is determined by that Port's Port State.

Test STP.op.6.1 – The Disabled Port State

Purpose: To verify that Ports which the DUT has placed in the Disabled Port State operate as required by the Spanning Tree Algorithm and Protocol.

References:

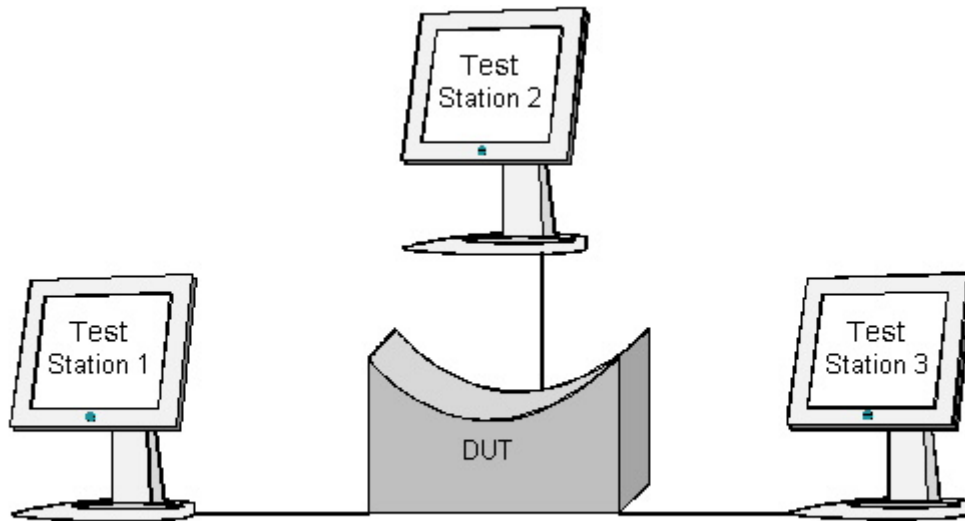
- IEEE 802.1D-1998: sub-clauses 8.3.4, 8.4.5
- IEEE 802.1t-2001: sub-clause 8.4.5

Resource Requirements:

- 3 Test Stations

Discussion: The Disabled Port State is entered from any other Port State when the Port becomes inoperable. When the Port becomes operable, it leaves the Disabled Port State and enters the Blocking Port State. A Port in this state does not participate in frame relay or the operation of the Spanning Tree Algorithm and Protocol. The Forwarding Process shall discard frames received on the Port. It shall not submit forwarded frames to the Port for transmission. The Learning Process shall not incorporate station location information into the Filtering Database. The Bridge Protocol Entity shall not include the Port in its computation of the active topology. The Spanning Tree Algorithm and Protocol shall not process BPDUs received by the Port. BPDUs shall not be submitted to the Port for transmission.

Test Layout:



Procedure:

Part A: Disabled Port State Verification

1. Ensure that the [default](#) values are configured on the DUT.
2. Disable the Port on the DUT connected to Test Station 1.
3. Set Test Stations 1-3 to capture.
4. Ensure that there are no filtering entries for 0x001234567890 in the DUT's Filtering Database(s).
5. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT from Test Station 1.
6. Transmit test traffic containing the broadcast destination MAC address and a source MAC address of 0x001234567890 from Test Station 1.
7. Transmit test traffic from Test Station 2 containing a destination MAC address of 0x001234567890 and a source MAC address that uniquely identifies Test Station 2.
8. Wait until Test Station 2 has received at least 2 Configuration BPDUs.
9. Observe the frames (if any) captured by each Test Station.

Observable Results:

- Test Station 1 should not capture any Configuration BPDUs.
- Test Station 1 should not capture any test traffic.
- Test Stations 2 and 3 should capture Configuration BPDUs containing a Root ID equal to the Bridge ID of the DUT and no other Configuration BPDUs.
- Neither Test Station 2 nor Test Station 3 should capture any of the test traffic transmitted by Test Station 1.
- Test Station 1 should not capture any of the test traffic transmitted by Test Station 2.
- Test Station 3 should capture all of the test traffic transmitted by Test Station 2.

Possible Problems:

- If Ports on the DUT cannot be disabled through management action, this test cannot be performed.

Test STP.op.6.2 – The Blocking Port State

Purpose: To verify that Ports which the DUT has placed in the Blocking Port State operate as required by the Spanning Tree Algorithm and Protocol.

References:

- IEEE 802.1D-1998: sub-clauses 8.3.4, 8.4.1

Resource Requirements:

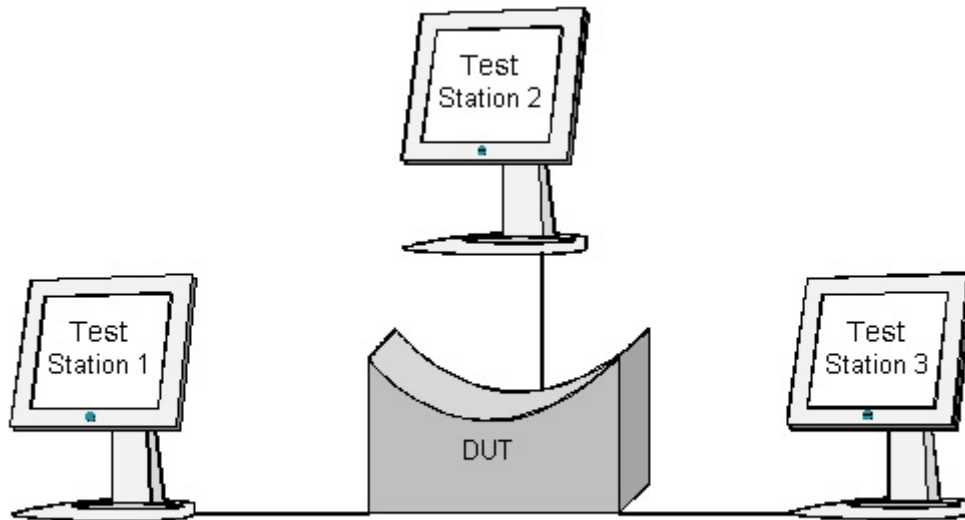
- 1 Test Station

Discussion: The Blocking State is entered following initialization of the Bridge or from the Disabled State when the Port is enabled through the operation of management. The Blocking State may also be entered from the Listening, Learning, or Forwarding States through the operation of the Spanning Tree Algorithm and Protocol (when the Port receives information indicating that another Bridge is the Designated Bridge for the LAN to which the Port is attached). A Port may leave the Blocking State and enter the Disabled State through management action. A Port may leave the Blocking State and enter the Listening State either upon expiry of a protocol timer or receipt of a Configuration Message (on the Port itself or any other Port on the Bridge). In such cases, it is the Spanning Tree Algorithm and Protocol that determines whether the Blocking State should be left, and the Listening State entered.

While in the Blocking State, a Port in this state does not participate in frame relay. The Forwarding Process shall discard frames received on the Port, and it shall not submit forwarded frames to the Port for transmission. The Learning Process shall not add station location information gathered by the Port to the Filtering Database.

While in the Blocking State, the Bridge Protocol Entity shall include the Port in its computation of the active topology. BPDUs received by the Port shall be processed as required by the Spanning Tree Algorithm and Protocol.

Test Layout:



Procedure:

Part A: Blocking Port State Verification

1. Ensure that the [default](#) values are configured on the DUT.
2. Ensure that there are no filtering entries for 0x001234567890 in the DUT's Filtering Database(s).
3. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT and a Root Path Cost of 0x00000000 from Test Station 1.
4. Continuously transmit Configuration BPDUs containing a Root ID equal to the one used by Test Station 1 and a Root Path Cost of 0x00000001 from Test Station 2.
5. Wait for the Spanning Tree to converge.
6. Set Test Stations 1-3 to capture.
7. Transmit test traffic containing the broadcast destination MAC address and a source MAC address of 0x001234567890 from Test Station 2.
8. Transmit test traffic from Test Station 3 containing a destination MAC address of 0x001234567890 and a source MAC address that uniquely identifies Test Station 3.
9. Wait until Test Station 3 has received at least 2 Configuration BPDUs.
10. Observe the frames (if any) captured by each Test Station.
11. Change the Root Path Cost value contained in Configuration BPDUs transmitted by Test Station 1 to 0x00000002.
12. Wait for the Spanning Tree to converge.
13. Set Test Stations 1-3 to capture.
14. Wait until Test Station 3 has received at least 2 Configuration BPDUs.
15. Observe the frames (if any) captured by each Test Station.

Observable Results:

- In Step 10, neither Test Station 1 nor Test Station 3 should capture any of the test traffic transmitted by Test Station 2.
- In Step 10, Test Station 1 should capture all of the test traffic transmitted by Test Station 3.
- In Step 10, Test Stations 1 and 2 should not capture any Configuration BPDUs.
- In Step 10, Test Station 3 should capture Configuration BPDUs containing the Root ID used by Test Stations 1 and 2. The Root Path Cost contained in these Configuration BPDUs should be equal to the Path Cost of the Port on the DUT connected to Test Station 1.
- In Step 15, Test Stations 1 and 2 should not capture any Configuration BPDUs.
- In Step 15, Test Station 3 should capture Configuration BPDUs containing the Root ID used by Test Stations 1 and 2. The Root Path Cost contained in these Configuration BPDUs should be equal to 0x00000001 plus the Path Cost of the Port on the DUT connected to Test Station 1.

Possible Problems:

- None.

Test STP.op.6.3 – The Listening Port State

Purpose: To verify that Ports which the DUT has placed in the Listening Port State operate as required by the Spanning Tree Algorithm and Protocol.

References:

- IEEE 802.1D-1998: sub-clauses 8.3.4, 8.4.2

Resource Requirements:

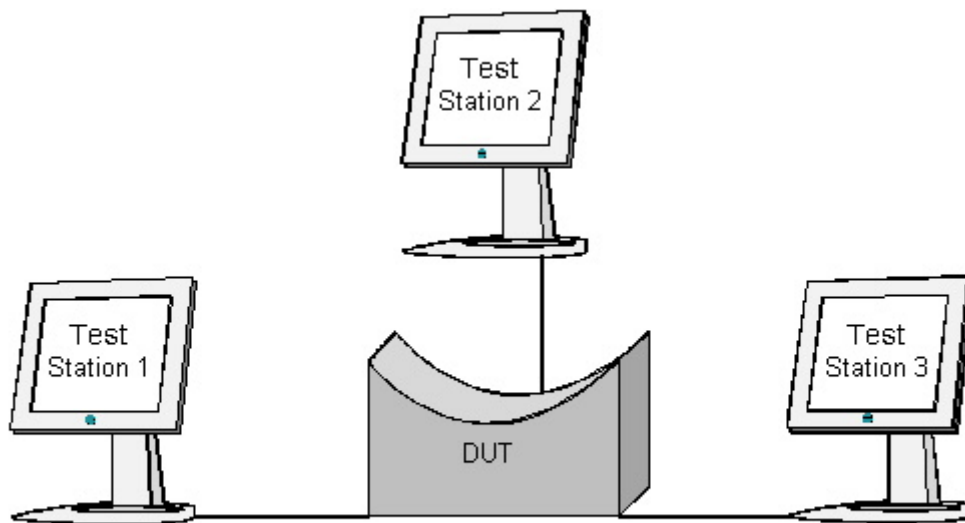
- 3 Test Stations

Discussion: The Learning State is entered from the Blocking State when the operation of the Spanning Tree Algorithm and Protocol determines that the Port should participate in frame relay. The Listening State can be left, and the Learning State entered, upon the expiry of a protocol timer. The Listening State can be left, and the Blocking State entered, upon receipt of a Bridge Protocol Data Unit (on the Port itself or any other Port on the Bridge). In such cases, it is the operation of the Spanning Tree Algorithm and Protocol that determines whether the Listening State should be left, and any other State entered. The Listening State can also be left, and the Disabled or the Blocking State entered, through management action.

While a Port is in the Listening State, the Forwarding Process shall discard received frames. It shall not submit forwarded frames to the Port for transmission. The Learning Process shall not add station location information gathered by the Port to the Filtering Database.

While a Port is in the Listening State, it shall be included in the Bridge Protocol Entity’s computation of the active topology. BPDUs received by the Port shall be processed as required by the Spanning Tree Algorithm and Protocol. BPDUs can be submitted to the Port for transmission.

Test Layout:



Procedure:

Part A: Listening Port State Verification

1. Ensure that the [default](#) values are configured on the DUT.
2. Ensure that there are no filtering entries for 0x001234567890 in the DUT's Filtering Database(s).
3. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT and a Root Path Cost of 0x00000000 from Test Station 1.
4. Transmit a Configuration BPDU containing a Root ID equal to the one used by Test Station 1, a Root Path Cost of 0x00000001, a Message Age of 0x1300, and a Max Age of 0x1400 from Test Station 2.
5. Wait 2 seconds.
6. Set Test Stations 1-3 to capture.
7. Transmit test traffic containing the broadcast destination MAC address and a source MAC address of 0x001234567890 from Test Station 2.
8. Transmit test traffic from Test Station 3 containing a destination MAC address of 0x001234567890 and a source MAC address that uniquely identifies Test Station 3.
9. Wait 2 seconds.
10. Transmit a Configuration BPDU from Test Station 2 containing a Root ID better than the one used by Test Station 1.
11. Wait 2 seconds.
12. Observe the frames (if any) captured by each Test Station.

Observable Results:

- Test Station 1 should capture Configuration BPDUs containing the Root ID used by Test Station 2 in Step 10. Test Station 1 should not capture any other Configuration BPDUs.
- Test Station 2 should capture Configuration BPDUs containing the Root ID used by Test Station 1.
- Test Stations 1 and 3 should not capture any of the test traffic transmitted by Test Station 2.
- Test Stations 2 and 3 should not capture any of the test traffic transmitted by Test Station 3.
- Test Station 1 should capture all of the test traffic transmitted by Test Station 3.

Possible Problems:

- Once the information contained in the Configuration BPDU transmitted in Step 4 expires in Step 5, Steps 5-10 must be completed in less than 15 seconds (that is, before the Port – which should have transitioned into the Listening State in Step 5 – enters the Learning State).

Test STP.op.6.4 – The Learning Port State

Purpose: To verify that Ports which the DUT has placed in the Learning Port State operate as required by the Spanning Tree Algorithm and Protocol.

References:

- IEEE 802.1D-1998: sub-clauses 8.3.4, 8.4.3

Resource Requirements:

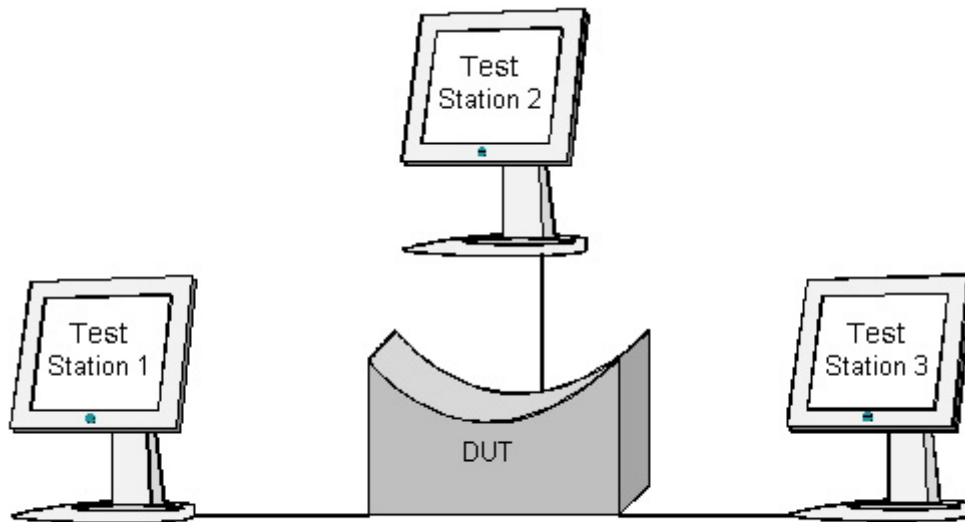
- 3 Test Stations

Discussion: The Learning State is entered from the Listening State on the expiry of a protocol timer. The Learning State can be left, and the Forwarding State entered, upon the expiry of a protocol timer. The Learning State can be left, and the Blocking State entered, upon receipt of a Bridge Protocol Data Unit (on the Port itself or any other Port on the Bridge). In such cases, it is the operation of the Spanning Tree Algorithm and Protocol that determines whether the Listening State should be left, and any other State entered. The Learning State can also be left, and the Disabled or the Blocking State entered, through management action.

While a Port is in the Learning State, the Forwarding Process shall discard received frames. It shall not submit forwarded frames to the Port for transmission. The Learning Process shall incorporate station location information gathered by the Port into the Filtering Database.

While a Port is in the Learning State, it shall be included in the Bridge Protocol Entity's computation of the active topology. BPDUs received by the Port shall be processed as required by the Spanning Tree Algorithm and Protocol. BPDUs can be submitted to the Port for transmission.

Test Layout:



Procedure:

Part A: Learning Port State Verification

1. Ensure that the [default](#) values are configured on the DUT.
2. Ensure that there are no filtering entries for 0x001234567890 in the DUT's Filtering Database(s).
3. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT and a Root Path Cost of 0x00000000 from Test Station 1.
4. Transmit a Configuration BPDU containing a Root ID equal to the one used by Test Station 1, a Root Path Cost of 0x00000001, a Message Age of 0x1300, and a Max Age of 0x1400 from Test Station 2.
5. Wait 17 seconds.
6. Set Test Stations 1-3 to capture.
7. Transmit test traffic containing the broadcast destination MAC address and a source MAC address of 0x001234567890 from Test Station 2.
8. Transmit test traffic from Test Station 3 containing a destination MAC address of 0x001234567890 and a source MAC address that uniquely identifies Test Station 3.
9. Wait 2 seconds.
10. Transmit a Configuration BPDU from Test Station 2 containing a Root ID better than the one used by Test Station 1.
11. Wait 2 seconds.
12. Observe the frames (if any) captured by each Test Station.

Observable Results:

- Test Station 1 should capture Configuration BPDUs containing the Root ID used by Test Station 2 in Step 10. Test Station 1 should not capture any other Configuration BPDUs.
- Test Station 2 should capture Configuration BPDUs containing the Root ID used by Test Station 1.
- Test Stations 1 and 3 should not capture any of the test traffic transmitted by Test Station 2.
- Test Stations 1 and 2 should not capture any of the test traffic transmitted by Test Station 3.

Possible Problems:

- Once the information contained in the Configuration BPDU transmitted in Step 4 expires in Step 5, Steps 5-10 must be completed in less than 30 seconds (that is, before the Port – which should have transitioned into the Learning State in Step 5 – enters the Forwarding State).

Test STP.op.6.5 – The Forwarding Port State

Purpose: To verify that Ports which the DUT has placed in the Forwarding Port State operate as required by the Spanning Tree Algorithm and Protocol.

References:

- IEEE 802.1D-1998: sub-clauses 8.3.4, 8.4.4

Resource Requirements:

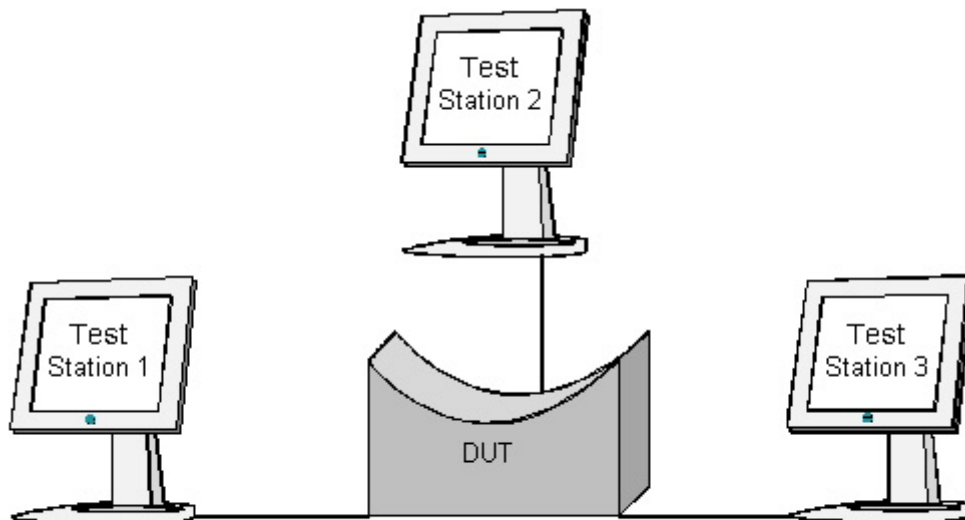
- 3 Test Stations

Discussion: The Forwarding State is entered from the Learning State upon expiry of a protocol timer. The Forwarding State can be left, and the Blocking State entered, upon receipt of a Bridge Protocol Data Unit (on the Port itself or any other Port on the Bridge). In such cases, it is the operation of the Spanning Tree Algorithm and Protocol that determines whether the Forwarding State should be left, and the Blocking State entered. The Forwarding State can also be left, and the Disabled or the Blocking State entered, through management action.

While a Port is in the Forwarding State, the Forwarding Process can forward frames received by the Port. The Forwarding Process can submit forwarded frames to the Port for transmission. The Learning Process shall incorporate station location information gathered by the Port into the Filtering Database.

While a Port is in the Forwarding State, the Bridge Protocol Entity shall include the Port in its computation of the active topology. BPDUs received by the Port shall be processed as required by the Spanning Tree Algorithm and Protocol. BPDUs can be submitted to the Port for transmission.

Test Layout:



Procedure:

Part A: Forwarding Port State Verification

1. Ensure that the [default](#) values are configured on the DUT.
2. Ensure that there are no filtering entries for 0x001234567890 in the DUT's Filtering Database(s).
3. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT and a Root Path Cost of 0x00000000 from Test Station 1.
4. Transmit a Configuration BPDU containing a Root ID equal to the one used by Test Station 1, a Root Path Cost of 0x00000001, a Message Age of 0x1300, and a Max Age of 0x1400 from Test Station 2.
5. Wait 32 seconds.
6. Set Test Stations 1-3 to capture.
7. Transmit test traffic containing the broadcast destination MAC address and a source MAC address of 0x001234567890 from Test Station 2.
8. Transmit test traffic from Test Station 3 containing a destination MAC address of 0x001234567890 and a source MAC address that uniquely identifies Test Station 3.
9. Wait 2 seconds.
10. Transmit from Test Station 2 a Configuration BPDU containing a Root ID better than the one used by Test Station 1.
11. Wait 2 seconds.
12. Observe the frames (if any) captured by each Test Station.

Observable Results:

- Test Station 1 should capture Configuration BPDUs containing the Root ID used by Test Station 2 in Step 10. Test Station 1 should not capture any other Configuration BPDUs.
- Test Station 2 should capture Configuration BPDUs containing the Root ID used by Test Station 1.
- Test Stations 1 and 3 should capture all of the test traffic transmitted by Test Station 2.
- Test Station 2 should capture all of the test traffic transmitted by Test Station 3.
- Test Station 1 should not capture any of the test traffic transmitted by Test Station 3.

Possible Problems:

- None.

GROUP 7: Miscellaneous

Scope:

The following tests cover features of the Spanning Tree Algorithm and Protocol and/or elements of the operation of Bridges which claim conformance to said Protocol that were not addressed by other Groups of Tests in this Test Suite.

Overview:

These tests cover a wide range of possible issues that can (and likely will) affect either the ability of the DUT to operate the Spanning Tree Algorithm and Protocol, or its ability to interoperate with other devices (or both).

Test STP.op.7.1 – MAC Addresses in Configuration BPDUs

Purpose: To ensure that the source MAC address contained in Configuration BPDUs transmitted by each Port on the DUT uniquely identifies the transmitting Port, and that one and only one MAC address is used in the MAC address portion of the Bridge ID contained in all Configuration BPDUs

References:

- IEEE 802.1D-1998: sub-clause 7.12.3
- IEEE 802.1D-1998: sub-clause 7.12.5
- IEEE 802.1D-1998: sub-clause 8.5.3.7

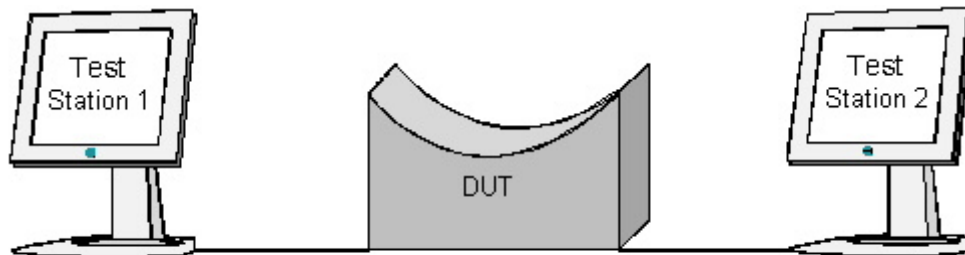
Resource Requirements:

- 2 Test Stations

Discussion: Each Bridge shall be assigned a unique MAC address, termed the Bridge Address. The Bridge Address may be the address of one (and only one) of the Ports on the Bridge, but this is not required.

The source MAC address contained in BPDUs is the individual MAC Address for the Bridge Port through which the BPDUs are transmitted.

Test Layout:



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Procedure:

Part A: Source MAC Address of BPDUs

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Test Stations 1 and 2 to capture.
3. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT from Test Station 1.
4. Transmit a TCN BPDU from Test Station 2.
5. Wait until Test Station 2 has captured at least 2 Configuration BPDUs.
6. Continuously transmit Configuration BPDUs containing a Root ID better than the one used by Test Station 1 from Test Station 2.
7. Transmit a TCN BPDU from Test Station 1.
8. Wait until Test Station 1 has captured at least 2 Configuration BPDUs.
9. Observe the frames captured by each Test Station.

Part B: Single, Unique Bridge Address

10. Ensure that the [default](#) values are configured on the DUT.
11. Set Test Stations 1 and 2 to capture.
12. Wait until Test Station 1 has captured at least 3 Configuration BPDUs.
13. Observe the frames captured by each Test Station.

Observable Results:

- In Part A, the Source MAC address of all BPDUs captured by Test Station 1 should be equal.
- In Part A, the Source MAC address of all BPDUs captured by Test Station 2 should be equal.
- In Part A, the Source MAC address of BPDUs captured by Test Station 1 should not be equal to the Source MAC address of BPDUs captured by Test Station 2.
- In Part B, one and only one MAC address should be contained in the Bridge ID portion of all Configuration BPDUs captured by Test Stations 1 and 2.

Possible Problems:

- None.

Test STP.op.7.2 – The Hold Timer and Reply Generation

Purpose: To verify that the DUT transmits Configuration BPDUs in response to received Configuration BPDUs containing worse information, and that the DUT observes the constraints placed by the Hold Timer on the transmission of Configuration BPDUs.

References:

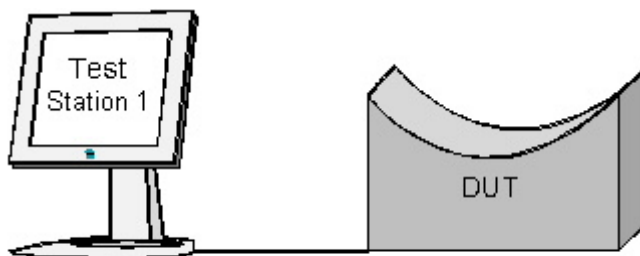
- IEEE 802.1D-1998: sub-clause 8.5.6.3
- IEEE 802.1D-1998: sub-clause 8.6.1.3
- IEEE 802.1D-1998: sub-clause 8.6.5
- IEEE 802.1D-1998: sub-clause 8.7.8
- IEEE 802.1t-2001: Table 8-3v

Resource Requirements:

- 1 Test Station

Discussion: If a Port receives a Configuration BPDU containing information worse than that held by the Port, the “Transmit Configuration BPDU” procedure is invoked for that Port. This procedure cannot proceed so long as the Hold Timer is active. The Hold Timer is set to the value of Hold Time, the value of which is such that no more than 3 Configuration BPDUs can be transmitted in a 2-second interval.

Test Layout:



Procedure:

Part A: The Hold Timer and Reply Generation

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Test Station 1 to capture.
3. Continuously transmit Configuration BPDUs containing a Root ID worse than the Bridge ID of the DUT from Test Station 1. These Configuration BPDUs should be transmitted at a rate of 3 per second.
4. Wait 10 seconds.
5. Observe the frames captured by Test Station 1.

Observable Results:

- Test Station 1 should capture Configuration BPDUs containing a Root ID equal to the Bridge ID of the DUT at a rate greater than 1 per 2 seconds. Test Station 1 should not at any point capture more than 3 Configuration BPDUs in a 3 second interval.

Possible Problems:

- None.

Test STP.op.7.3 – BPDUs Received via Loopback Condition Are Not Processed.

Purpose: To verify that Ports on the DUT do not process Configuration BPDUs received as a result of a loopback condition.

References:

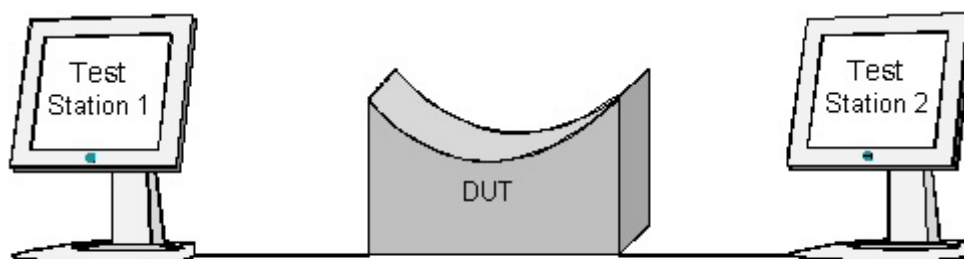
- IEEE Std. 802.1t-2001: sub-clause 9.3.3

Resource Requirements:

- 2 Test Stations

Discussion: When a Port receives a Configuration BPDU that contains the Bridge ID and Port ID of the receiving Port, the Configuration BPDU is dropped.

Test Layout:



Procedure:

Part A: Possible Loopback Condition

1. Ensure that the [default](#) values are configured on the DUT.
2. Set Test Stations 1 and 2 to capture.
3. Continuously transmit Configuration BPDUs containing a Root ID better than the Bridge ID of the DUT from Test Station 1. The Bridge ID and Port ID contained in these Configuration BPDUs should be the Bridge ID and Port ID used by the Port on the DUT connected to Test Station 1.
4. Wait until Test Station 2 has captured 4 or more Configuration BPDUs.
5. Observe the frames captured by Test Stations 1 and 2.

Observable Results:

- Test Stations 1 and 2 should capture Configuration BPDUs containing a Root ID equal to the Bridge ID of the DUT.
- Test Stations 1 and 2 should not capture any Configuration BPDUs containing the Root ID contained in Configuration BPDUs transmitted by Test Station 1.

Possible Problems:

- None.

Test STP.op.7.4 – Timer Values Not Considered During BPDU Validation

Purpose: This test is designed to determine whether the DUT validates Configuration BPDUs based upon the timer values they contain.

References:

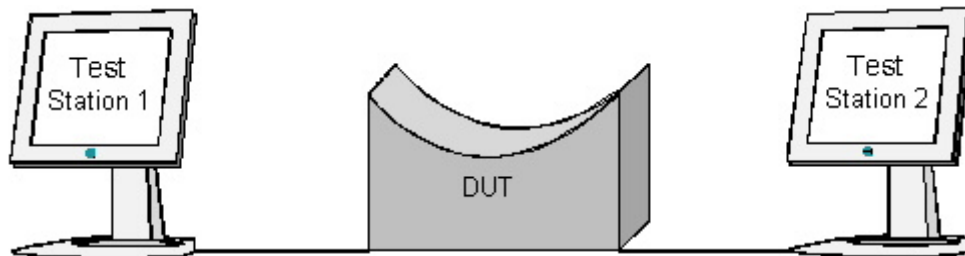
- IEEE Std. 802.1D-1998: sub-clause 8.10.2
- IEEE Std. 802.1D-1998: sub-clause 9.3.3

Resource Requirements:

- 2 Test Stations

Discussion: While the Spanning Tree Algorithm and Protocol specifies a range of permissible timer values as well as a set of parameter restrictions for those values, the timer values contained in a Configuration BPDU are not used as a means of validating that Configuration BPDU. Configuration BPDUs that meet the criteria specified in IEEE 802.1D-1998, clause 9.3.3 shall be processed.

Test Layout:



Procedure:

Part A: Timer Values Outside Permissible Range

1. Ensure that the [default](#) values are configured on the DUT.
2. Continuously transmit Configuration BPDUs containing a Root ID better than that of the DUT. The Message Age, Max Age, Hello Time and Forward Delay values contained in these Configuration BPDUs should be 0x0000, 0xFFFF, 0xFFFF, and 0xFFFF, respectively.
3. Wait 2 seconds.
4. Wait until Test Station 2 has captured at least 2 Configuration BPDUs.
5. Observe the frames captured by each Test Station.

Part B: Timer Values Do Not Meet Parameter Restrictions

6. Ensure that the [default](#) values are configured on the DUT.
7. Continuously transmit Configuration BPDUs containing a Root ID better than that of the DUT. The Message Age, Max Age, Hello Time and Forward Delay values contained in these Configuration BPDUs should be 0x0000, 0x0800, 0x0A00, and 0x0400, respectively.
8. Wait 2 seconds.
9. Wait until Test Station 2 has captured at least 2 Configuration BPDUs.
10. Observe the frames captured by each Test Station.

Observable Results:

- In Part A, Test Station 2 should capture Configuration BPDUs containing a Root ID equal to the one transmitted by Test Station 1.
- In Part B, Test Station 2 should capture Configuration BPDUs containing a Root ID equal to the one transmitted by Test Station 1.

Possible Problems:

- None.