Ethernet Switching Protocols Consortium

Rapid Spanning Tree Conformance Test Suite

Version 3.1

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Contents

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0.3	2001-06-22		First major review and revision
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Fred Mansfield Jr.	University of New Hampshire
Garth Russ	University of New Hampshire
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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 Rapid Spanning Tree capable products.

The operation of Rapid Spanning Tree Protocol (RSTP) provides for the recovery of network connectivity following the failure of a Bridge, Bridge Port, or LAN. The protocol also provides for the recovery of network connectivity following the inclusion of a new Bridge, Bridge Port, or LAN. Unlike the original Spanning Tree Protocol (protocol version 0), which relies upon fixed timer values in all cases, RSTP (protocol version 2) uses fixed timer values only as worst-case delays and to ensure backwards-compatibility. Thus, under normal circumstances and in the absence of legacy equipment, the time needed for recovery of network connectivity is determined by a Device's implementation of the protocol. This can result in extremely "rapid" convergence times. Furthermore, state machine state blocks execute independently of each other and their order of operations is undefined, except by their transition conditions. Variables set by a state block will hold their value until another state block executes and modifies the value. It is therefore possible for a Device to propagate values from a state block that are due to be changed by another state block. Consideration for this possibility has been taken into account in this test suite.

This test suite has been designed based on the set of requirements (expressed in state machine diagrams, tables, and text) defined in IEEE Std. 802.1Q-2011, that pertain to RSTP. The test suite is designed to help determine whether or not the DUT will behave in accordance with the standard during normal operation.

The purpose of standardized protocols and features is to provide a uniform set of requirements that are met by all implementations. Satisfactory completion of conformance testing helps to instill confidence in users that the implementation will be well-behaved in a live network. Non-conformant implementations of standards-based protocols and features can lead to broken networks, reduced connectivity, network loops or other unintended behaviors, as well as confused or frustrated end-users. This test suite aims to provide one method of verifying conformance to IEEE Std. 802.1Q-2011. Successful completion of all tests contained in this suite cannot guarantee that the tested device will operate as desired in all possible environments. However, combined with satisfactory completion of interoperability testing and companion test suites, these tests provide a reasonable level of confidence that the DUT will function well in most Rapid Spanning Tree capable environments.

Abbreviations and Acronyms

IEEE 802.1

BPDU	Bridge Protocol Data Unit
FDB	Filtering Database
LAN	Local Area Network
LLC	Logical Link Control
MAC	Media Access Control
PVID	Port VLAN Identifier
RST	Rapid Spanning Tree
RSTP	Rapid Spanning Tree Protocol
STP	Spanning Tree Protocol
TCN	Topology Change Notification
VLAN	Virtual LAN

RSTP Conformance Test Suite

DUT	Device Under Test
DUT.TS	Port on the DUT connected to Test Station (ex.DUT.TS1 refers to the Port on the DUT connected to Test Station 1)
TS	Test Station (ex. TS1 refers to Test Station 1)

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 constitute 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

Purpose: The Purpose is a brief statement outlining 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 Setup: 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.
****Configurations are cleared at the end of each Test****

Test Procedure: This section of the test description contains the step-by-step instructions for carrying out the test. These steps includesuch 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 withthe observable results given for that test part.

****Continuously transmitted frames are stopped at the end of each Test Part****
****Unless noted, less than 0.1 seconds must elapse between execution of Test Steps****

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.

Group 1: General Parameters

Scope: To verify the Bridge supports various parameters required for operation of the Rapid Spanning Tree Protocol.

Test RSTP.op.1.1 — Source MAC address of BPDUs

Purpose: To determine whether the source MAC address in transmitted BPDUs is the unique MAC address of the transmitting port.

References: [1] IEEE Std. 802.1Q-2011: Sub-clause 8.13.2 [2] IEEE Std. 802.1Q-2011: Sub-clause 13

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: A separate individual MAC Address is associated with each Bridge Port. Frames transmitted between Bridge Ports contain source and destination MAC Addresses in the source and destination address fields of the frames, respectively. Properly formatted BPDUs contain the source MAC address of the transmitting port.

Spanning Tree Protocol entities transmit and receive Bridge Protocol Data Units (BPDUs) to convey parameters used in RSTP. BPDUs also convey parameters that all Spanning Tree protocols use to interoperate with each other to ensure that temporary loops are not created when neighboring bridges are acting on different topology information.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Source MAC Address of BPDUs

1. Ensure the DUT is configured to the test setup as defined above.
2. Wait until TS1 and TS2 have received 1 RST BPDU.

Observable Results:

Part A:

- All BPDUs received by DUT.TS1 must contain a source MAC address identical to DUT.TS1's MAC address.
- All BPDUs received by DUT.TS2 must contain a source MAC address identical to DUT.TS2's MAC address.

Possible Problems: None.

Test RSTP.op.1.2 — Force Protocol Version Parameter

Purpose: To verify that the DUT correctly supports and makes use of the Force Protocol Version parameter.

References:
[1] IEEE Std. 802.1Q-2011: sub-clause 6.5.3
[2] IEEE Std. 802.1Q-2011: sub-clause 6.5.4
[3] IEEE Std. 802.1Q-2011: sub-clause 13.6.2
[4] IEEE Std. 802.1Q-2011: sub-clause 13.26.19
[5] IEEE Std. 802.1Q-2011: sub-clause 13.30

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: It is possible that RSTP's rapid state transitions will increase rates of frame duplication and misordering on the Bridged Local Area Network. Because of this, RSTP supports an administrative parameter, Force Protocol Version, which can cause the bridge to behave more like a classic Spanning Tree bridge. When in STP Compatibility mode, rapid transitions are disabled, mitigating the risk of duplication or disordering. While in this mode, the bridge also communicates through Configuration BPDUs, rather than RST BPDUs, forcing any neighboring ports to disable rapid transitions as well. The values associated with the Force Protocol Version are: 0 for STP compatibility mode, 2 for RSTP operation, and 3 for MSTP operation.

Any modification of the Force Protocol Version parameter results in re-initialization of the Spanning Tree Protocol Entity.

This test is applicable if and only if the DUT supports administrative configuration of the Force Protocol Version parameter.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Force Protocol Version Parameter Changed to 0

1. Ensure the DUT is configured to the test setup as defined above.
2. Set the DUT's Force Protocol Version parameter to 0.
3. Wait 8 seconds.

Part B: Force Protocol Version Parameter Changed to 2

1. Ensure the DUT is configured to the test setup as defined above.
2. Set the DUT's Force Protocol Version parameter to 0.
3. Wait 6 seconds.
4. Set the DUT's Force Protocol Version parameter to 2.
5. Wait 5 seconds.

Part C: Force Protocol Version 0 Disables Rapid Transitions

1. Ensure the DUT is configured to the test setup as defined above.
2. Set the DUT's Force Protocol Version parameter to 0.
3. Wait 6 seconds.
4. From TS2, transmit a RootAgreementRST frame.
5. Wait 5 seconds.
6. From TS1, transmit 10 untagged frames.
7. Wait 2 seconds.

Part D: Force Protocol Version Parameter Change Re-Initializes Spanning Tree Entity

1. Ensure the DUT is configured to the test setup as defined above.
2. Set the DUT's Force Protocol Version parameter to 0.
3. Wait 6 seconds.
4. From TS1, transmit a MakeRootPortConfig frame.
5. Set the DUT's Force Protocol Version parameter to 2.
6. Wait 3 seconds.
7. From TS2, transmit a RootAgreementRST frame.
8. Wait 5 seconds.

Observable Results:

Part A:

- In step 3, TS1 must begin receiving Configuration BPDUs 6 seconds after the Force Protocol Version has been changed.

Part B:

- In step 5, TS1 must begin receiving RST BPDUs 3 seconds after the Force Protocol Version has been changed.

Part C:

- In step 6, TS1 and TS2 must receive Configuration BPDUs.
- TS2 must not receive any of the frames transmitted from TS1.

Part D:

- In step 3, TS1 and TS2 must receive Configuration BPDUs.
- In step 6, TS1 and TS2 must capture BPDUs that contain a Root Bridge Identifier equal to the Bridge Identifier of the DUT.
- In step 8, TS1 and TS2 must receive RST BPDUs.
- TS2 must not receive any of the frames transmitted from TS1.

Possible Problems: None.

Test RSTP.op.1.3 — Unique Bridge and Port Identifiers Exist

Purpose: To determine whether unique identifiers exist for the bridge and each of its ports.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.2
[2] IEEE Std. 802.1Q-2011: sub-clause 13.24.1
[3] IEEE Std. 802.1Q-2011: sub-clause 13.25.32

Resource Requirements: 4 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: In order for the Spanning Tree protocols to operate each bridge must provide a unique Group MAC Address recognized by all the bridges attached to a LAN, a unique Bridge Identifier, and a unique identifier for each Bridge Port. The Bridge Identifier for a given bridge is derived from the Bridge Address and designated priority vectors for the bridge. The Port Identifier for a given port forms a component of the port priority and designated priority vectors for said port. The four most significant bits of the Bridge Identifier and Port Identifier can be configured independently by management.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Check the Uniqueness of Bridge and Ports Identifiers

1. Ensure the DUT is configured to the test setup as defined above.
2. Wait until TS1 through TS4 have received 1 RST BPDU.

Observable Results:

Part A:

- The RST BPDUs captured must have the same Bridge Identifier and a unique Port Identifier for each captured BPDU.

Possible Problems: None.

Test RSTP.op.1.4 — Maximum BPDU Transmission Delay and Maximum RSTP Processing Delay

Purpose: To verify that the delay between internal timer-related events and BPDU transmission does not exceed the maximum allowed value.

References: [1] IEEE Std. 802.1Q-2011: Annex A.10

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: The delay between the occurrence of an external event and the action or actions mandated by the RSTP specification as a consequence of the event shall not exceed the Maximum RSTP processing delay (1.0 seconds). The delay between internal timer-related events and the transmission of all BPDUs on ports mandated by the RSTP specification as a consequence shall not exceed the Maximum BPDU transmission delay (0.2 seconds).

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Maximum RSTP Processing Delay and Maximum BPDU Transmission Delay are not Exceeded

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit a MakeRootPortRST frame.
3. Wait 2 seconds.

Observable Results:

Part A:

- TS2 must capture RST BPDUs with a Root Bridge Identifier of 0x700000BFCBFCBFC0.
- The time interval between the last frame with a Root Bridge Identifier equal to the BridgeIdentifier of the DUT and the first frame with a Root Bridge Identifier of 0x700000BFCBFCBFC0 must be less than 1.4 seconds. -

Possible Problems: None.

Group 2: BPDU Encoding, Frame Format, and Validation

Scope: To verify that the DUT uses the proper frame format and parameter encoding for the BPDUs it transmits and that the DUT properly validates the BPDUs it receives.

Test RSTP.op.2.1 — RST BPDU Frame Format

Purpose: To verify that RST BPDUs transmitted by the DUT are properly formatted.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.27.27 [3] IEEE Std. 802.1Q-2011: sub-clause 14.3.2
[2] IEEE Std. 802.1Q-2011: sub-clause 13.9

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: The Spanning Tree Protocol transmits and receives BPDUs, which convey parameters used to communicate with the Spanning Tree Protocol Entities of other bridges attached to the same LAN and to calculate Spanning Tree Priority Vectors. All BPDUs must follow a format defined by IEEE Std. 802.1Q-2011. An improperly formatted BPDU will be dropped and not used when recalculating the Spanning Tree.

A properly formatted RST BPDU contains the following default values:

Parameter	Root	Not Root
Protocol Identifier	0x0000	0x0000
Protocol Version Identifier	0x02	0x02
BPDU Type	0x02	0x02
Flags	N/A	N/A
Root Identifier	Root Bridge Identifier	
Root Path Cost	0	Root Path Cost Sum
Bridge Identifier	Bridge Identifier	
Port Identifier	Port Identifier	
Message Age	0	Message Age held by the Root Port, plus 1
Max Age	0x1400	Max Age held by the Root Port
Hello Time	0x0200	0x0200
Forward Delay	0x0F00	Forward Delay held by the Root Port
Version 1 Length	0x00	0x00

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: RST BPDU Transmission Using Default Settings

1. Ensure the DUT is configured to the test setup as defined above.
2. Wait until TS1 has received 1 RST BPDU.

Part B: RST BPDU Frame Format when the DUT is not the Root Bridge

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortRST frames every two seconds.
3. Wait 2 seconds.

Observable Results:

Part A:

- TS1 must recieve RST BPDUs. These RST BPDUs must contain the following values:

Type/Length	0x0027
LLC	0x424203
Protocol Identifier	0x0000
Protocol Version Identifier	0x02
BPDU Type	0x02
Flags	0x3C or 0x7C
Root Bridge Identifier	DUT's Bridge Identifier
Root Path Cost	0x00000000 (0)
Designated Bridge Identifier	DUT's Bridge Identifier
Designated Port Identifier	DUT.TS1 Port Identifier
Message Age	0x0000 (0)
Max Age	0x1400 (20)
Hello Time	0x0200 (2)
Forward Delay	0x0F00 (15)
Version 1 Length	0x00 (0)

Part B:

- TS2 must recieve RST BPDUs. These RST BPDUs must contain the following values:

Type/Length	0x0027
LLC	0x424203
Protocol Identifier	0x0000
Protocol Version Identifier	0x02
BPDU Type	0x02
Flags	0x3C or 0x7C
Root Bridge Identifier	0x700000BFCBFCBFC0
Root Path Cost	0x00061A80 (400,000)
Designated Bridge Identifier	DUT's Bridge Identifier
Designated Port Identifier	DUT.TS2 Port Identifier
Message Age	0x0200 (2)
Max Age	0x1400 (20)
Hello Time	0x0200 (2)
Forward Delay	0x0F00 (15)
Version 1 Length	0x00 (0)

Possible Problems: None.

Test RSTP.op.2.2 — Configuration BPDU Frame Format

Purpose: To verify that Configuration BPDUs transmitted by the DUT are properly formatted.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.27.26 [2] IEEE Std. 802.1Q-2011: sub-clause 14.3.1

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: The Spanning Tree Protocol transmits and receives BPDUs, which convey parameters used to communicate with the Spanning Tree Protocol Entities of other bridges attached to the same LAN and to calculate Spanning Tree Priority Vectors. All BPDUs must follow a format defined by IEEE Std. 802.1Q-2011. An improperly formatted BPDU will be dropped and not used when recalculating the Spanning Tree.

A bridge that has received a Configuration BPDU or has Force Protocol Version set to 0 will transmit Configuration BPDUs. This is to ensure the bridge is backwards compatible with earlier versions of the Spanning Tree Protocol.

A properly formatted Configuration BPDU contains the following default values:

Parameter	Root	Not Root
Protocol Identifier	0x0000	0x0000
Protocol Version Identifier	0x00	0x00
BPDU Type	0x00	0x00
Flags	N/A	N/A
Root Identifier	Root Bridge Identifier	
Root Path Cost	0	Root Path Cost Sum
Bridge Identifier	Bridge Identifier	
Port Identifier	Port Identifier	
Message Age	0	Message Age held by the Root Port, plus 1
Max Age	0x1400	Max Age held by the Root Port
Hello Time	0x0200	0x0200
Forward Delay	0x0F00	Forward Delay held by the Root Port

This test is applicable if and only if the DUT supports administrative configuration of the Force Protocol Version parameter.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Configuration BPDU Transmission Using Default Settings

1. Ensure the DUT is configured to the test setup as defined above.
2. Set the DUT's Force Protocol Version parameter to 0.
3. Wait 2 seconds.

Part B: Configuration BPDU Frame Format when the DUT is not the Root Bridge

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortRST frames every two seconds.
3. From TS2, transmit a MigratePort2STP frame.
4. Wait 2 seconds.

Observable Results:
Part A:

- TS1 must capture Configuration BPDUs. These Configuration BPDUs must contain the following values:

Type/Length	0x0026
LLC	0x424203
Protocol Identifier	0x0000
Protocol Version Identifier	0x00
BPDU Type	0x00
Root Bridge Identifier	DUT's Bridge Identifier
Root Path Cost	0x00000000 (0)
Designated Bridge Identifier	DUT's Bridge Identifier
Designated Port Identifier	DUT.TS1 Port Identifier
Message Age	0x0000 (0)
Max Age	0x1400 (20)
Hello Time	0x0200 (2)
Forward Delay	0x0F00 (15)

Part B:

- TS2 must receive Configuration BPDUs. These Configuration BPDUs must contain the following values:

Type/Length	0x0026
LLC	0x424203
Protocol Identifier	0x0000
Protocol Version Identifier	0x00
BPDU Type	0x00
Root Bridge Identifier	0x700000BFCBFCBFC0
Root Path Cost	0x00061A80 (400,000)
Designated Bridge Identifier	DUT's Bridge Identifier
Designated Port Identifier	DUT.TS1 Port Identifier
Message Age	0x0B00 (11)
Max Age	0x1400 (20)
Hello Time	0x0200 (2)
Forward Delay	0x0F00 (15)

Possible Problems: None.

Test RSTP.op.2.3 — TCN BPDU Frame Format

Purpose: To verify that TCN BPDUs transmitted by the DUT are properly formatted.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.27.28 [3] IEEE Std. 802.1Q-2011: sub-clause 14.3.1
[2] IEEE Std. 802.1Q-2011: sub-clause 13.32

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: Topology Change Notification (TCN) BPDUs are transmitted when a bridge that is not the Root Bridge detects or is notified of a topology change, and its Root Port is determined to be connected to the same LAN as an STP Bridge. This is required for STP compatibility. All TCN BPDUs share the same parameter values, including Protocol Identifier, Protocol Version Identifier, and BPDU Type.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: TCN BPDU Frame Format when the DUT is not the Root Bridge

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortConfig frames every two seconds.
3. From TS2, transmit a NotifyTC_RST frame.
4. Wait 2 seconds.

Observable Results:

Part A:

- TS1 must capture TCN BPDUs. These TCN BPDUs must contain the following values:

Type/Length	0x0007
LLC	0x424203
Protocol Identifier	0x0000
Protocol Version Identifier	0x00
BPDU Type	0x80

Possible Problems: None.

Test RSTP.op.2.4 — BPDU Validation: Protocol Identifier

Purpose: To verify that the DUT does not accept frames which contain any Protocol Identifier other than 0x0000 as valid Spanning Tree BPDUs.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 8.13.3
[2] IEEE Std. 802.1Q-2011: sub-clause 14.1.2
[3] IEEE Std. 802.1Q-2011: sub-clause 14.4

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: The Bridge Group Address, 01:80:C2:00:00:00, and the LLC address that specifies the Bridge Protocol Entity, 0x42, may be used for any number of protocols. For this reason a Protocol Identifier specifying the Spanning Tree Protocol is contained in all BPDUs used by any version of the Spanning Tree Protocol.

This Protocol Identifier is used when determining whether a BPDU is valid. The Protocol Identifier must be 0x0000 or the BPDU will be determined invalid.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: BPDU Validation Based on Protocol Identifier: RST BPDUs

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS2, transmit a MakeRootPortBadProtocolIdRST frame.
3. Wait 2 seconds.

Part B: BPDU Validation Based on Protocol Identifier: Configuration BPDUs

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS2, transmit a MakeRootPortBadProtocolIdConfig frame.
3. Wait 2 seconds.

Part C: BPDU Validation Based on Protocol Identifier: TCN BPDUs

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS2, transmit a BadProtocolId_TCN_BPDU frame.
3. Wait 2 seconds.

Observable Results:

Parts A, B, and C:

- TS1 must capture RST BPDUs. These frames must contain a Root Bridge Identifier equal to the Bridge Identifier of the DUT. These frames must not contain any Topology Change information.

Possible Problems: None.

Test RSTP.op.2.5 — BPDU Validation: Message Age

Purpose: To verify that the DUT does not process a Spanning Tree BPDU if its Message Age component is greater than or equal to its Max Age component.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.14 [2] IEEE Std. 802.1Q-2011: sub-clause 13.33

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: It is necessary to age out old information that could be circulating through the network, which would prevent effective propagation of new information. To do this, RSTP treats the Message Age parameter in received BPDUs as an incrementing hop count with Max Age as its maximum value. Message Age is incremented after being received on the Root Port. If Message Age is greater than Max Age, the BPDU is discarded.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: BPDU Validation Based on Message Age: RST BPDUs

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS2, transmit a MakeRootPortStaleRST frame.
3. Wait 2 seconds.
4. Repeat step 2 and 3 using a MakeRootPortVeryStaleRST frame.

Part B: BPDU Validation Based on Message Age: Configuration BPDUs

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS2, transmit a MakeRootPortStaleConfig frame.
3. Wait 2 seconds.
4. Repeat step 2 and 3 using a MakeRootPortVeryStaleConfig frame.

Observable Results:

Parts A and B:

- TS1 must capture RST BPDUs.
- TS1 must not capture more than one RST BPDU containing the Root Bridge Identifier conveyed in the configuration message transmitted by TS2.

Possible Problems: None.

Test RSTP.op.2.6 — BPDU Validation: Number of Octets in BPDU

Purpose: To verify that the DUT does not process a Spanning Tree BPDU if it contains less than the minimum number of octets required for validation.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 14.4

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: When a Bridge receives a BPDU, it must be determined whether the BPDU is formatted correctly. A BPDU that contains too few octects is determined to be invalid and therefore not used.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: BPDU Validation Based on Number of Octets – RST BPDUs

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit a MakeRootPortTooFewOctetsRST frame.
3. Wait 2 seconds.

Part B: BPDU Validation Based on Number of Octets – Configuration BPDUs

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit a MakeRootPortTooFewOctetsConfig frame.
3. Wait 2 seconds.

Observable Results:

Parts A and B:

- TS2 must capture RST BPDUs. These frames must contain a Root Bridge Identifier equal to the Bridge Identifier of the DUT.

Possible Problems: None.

Group 3: Bridge and Port Parameter Configuration

Scope: To verify that the Bridge has the capability to use the full range of permissible values related to various port and Bridge parameters.

Test RSTP.op.3.1 — Bridge Identifier Priority

Purpose: To determine whether the DUT correctly implements the modification of the Bridge Identifier Priority parameter.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.16 [2] IEEE Std. 802.1Q-2011: Table 13-3

Resource Requirements: 1 Test Station capable of transmitting and receiving arbitrary MAC frames.

Discussion: Table 13-3 of IEEE Std. 802.1Q-2011 specifies the default value and range for the Bridge Identifier Priority. If management supports configuration of the Bridge Identifier Priority, then the bridge shall have the capability to use the full range of values (0 – 61,440) in increments of 4,096.

This test is applicable if and only if the DUT supports modification of the Bridge Identifier Priority value.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Valid Bridge Identifier Priorities

1. Ensure the DUT is configured to the test setup as defined above.
2. Set the DUT's Bridge Identifier Priority parameter to 0x0000.
3. Wait 2 seconds.
4. Repeat steps 2 and 3 with a Bridge Identifier Priority parameter of 0xF000, 0x1000, and 0xE000.

Part B: Invalid Bridge Identifier Priorities

1. Ensure the DUT is configured to the test setup as defined above.
2. Set the DUT's Bridge Identifier Priority parameter to 0x0001.
3. Wait 2 seconds.
4. Repeat steps 2 and 3 with a Bridge Identifier Priority parameter of 0xF001, 0x1001, and 0xE001.

Observable Results:

Part A:

- In step 3 and each repetition of step 3, TS1 must capture a RST BPDU with the Bridge Identifier Priority value that was set.

Part B:

- In step 2 and each repetition of step 2, the DUT must not allow this configuration.
- In step 3 and each repetition of step 3, TS1 must capture a RST BPDU with a Bridge Identifier Priority value of 0x8000.

Possible Problems: None.

Test RSTP.op.3.2 — Bridge Forward Delay

Purpose: To determine whether the DUT correctly implements the modification of the Bridge Forward Delay parameter.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.23 [2] IEEE Std. 802.1Q-2011: Table 13-5

Resource Requirements: 2 Test Station capable of transmitting and receiving arbitrary MAC frames.

Discussion: Table 13-5 of IEEE Std. 802.1Q-2011 specifies the default value and range for the Bridge Forward Delay parameter. If management supports configuration of Bridge Forward Delay parameter then the bridge shall have the capability to use the full range of values (4.0-30.0 seconds).

In order to interoperate with previous versions of IEEE Std. 802.1Q and 802.1D, a bridge must enforce the following: 2 x (Bridge_Forward_Delay - 1.0 seconds) >= Bridge_Max_Age >= 2 x (Bridge_Hello_Time + 1.0 seconds)

This test is applicable if and only if the DUT supports the modification of the Bridge Forward Delay parameter and the Bridge Max Age parameter.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Valid Bridge Forward Delays

1. Ensure the DUT is configured to the test setup as defined above.
2. Set the DUT's Bridge Max Age parameter to 6 seconds.
3. Set the DUT's Bridge Forward Delay parameter to 4 seconds.
4. Wait 2 seconds.
5. Repeat steps 3 and 4 with a Bridge Forward Delay parameter of 7, 15, and 30 seconds.

Part B: Invalid Bridge Forward Delays

1. Ensure the DUT is configured to the test setup as defined above.
2. Set the DUT's Bridge Max Age parameter to 6 seconds.
3. Set the DUT's Bridge Forward Delay parameter to 1 second.
4. Wait 2 seconds.
5. Repeat steps 3 and 4 with a Bridge Forward Delay parameter of 0, 40, and 50 seconds.

Part C: DUT Propagates Valid Forward Delay from BPDUs

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit a MakeRootPortBigMsgTimesRST frame.
3. Wait 10 seconds.
4. Set the DUT's Bridge Max Age parameter to 6 seconds.
5. From TS1, transmit a MakeRootPortSmallMsgTimesRST frame.
6. Wait 2 seconds.

Part D: DUT Does Not Propagate Invalid Forward Delay from BPDUs

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit a RST BPDU with a Forward Delay value of 31 seconds.
3. Wait 2 seconds.

Observable Results:

Part A:

- In step 4 and each repetition of step 4, TS1 must capture an RST BPDU with the Bridge Forward Delay value that was set.

Part B:

- In step 3 and each repetition of step 3, the DUT must not allow this configuration.
- In step 4 and each repetition of step 4, TS1 must capture an RST BPDU with a Bridge Forward Delay value of 15 seconds.

Part C:

- In step 3, TS2 must capture RST BPDUs with a Forward Delay value of 30 seconds.
- In step 6, TS2 must capture RST BPDUs with a Forward Delay value of 4 seconds.

Part D:

- TS2 must capture RST BPDUs with a Forward Delay value of 15 seconds.

Possible Problems: None.

Test RSTP.op.3.3 — Bridge Max Age

Purpose: To determine whether the DUT correctly implements the modification of the Bridge Max Age parameter.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.23 [2] IEEE Std. 802.1Q-2011: Table 13-5

Resource Requirements: 2 Test Station capable of transmitting and receiving arbitrary MAC frames.

Discussion: Table 13-5 of IEEE Std. 802.1Q-2011 specifies the default value and range for the Bridge Max Age parameter. If management supports configuration of the Bridge Max Age parameter, then the Bridge shall have the capability to use the full range of values (6.0-40.0 seconds).

In order to interoperate with previous versions of IEEE Std. 802.1Q and 802.1D, a bridge must enforce the following: 2 x (Bridge_Forward_Delay - 1.0 seconds) >= Bridge_Max_Age >= 2 x (Bridge_Hello_Time + 1.0 seconds)

This test is applicable if and only if the DUT supports the modification of the Bridge Max Age parameter.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Valid Bridge Max Ages

1. Ensure the DUT is configured to the test setup as defined above.
2. Set the DUT's Bridge Forward Delay to 30 seconds.
3. Set the DUT's Bridge Max Age to 6 seconds.
4. Wait 2 seconds.
5. Repeat steps 3 and 4 with a Bridge Max Age parameter of 10, 15, 20, and 40 seconds.

Part B: Invalid Bridge Max Ages

1. Ensure the DUT is configured to the test setup as defined above.
2. Set the DUT's Bridge Forward Delay to 30 seconds.
3. Set the DUT's Bridge Max Age to 5 seconds.
4. Wait 2 seconds.
5. Repeat steps 3 and 4 with a Bridge Max Age parameter of 0, 4, 41, and 50 seconds.

Part C: DUT Propagates Valid Max Age from BPDUs

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit a MakeRootPortBigMsgTimesRST frame.
3. Wait 10 seconds.
4. From TS1, transmit a MakeRootPortSmallMsgTimesRST frame.
5. Wait 2 seconds.

Part D: DUT Does Not Propagate Invalid Max Age from BPDUs

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit a RST BPDU with a Max Age of 41 seconds.
3. Wait 2 seconds.

Observable Results:

Part A:

- In step 4 and each repetition of step 4, TS1 must capture an RST BPDU with the Bridge Max Age value that was set.

Part B:

- In step 2 and each repetition of step 2, the DUT must not allow this configuration.
- In step 3 and each repetition of step 3, TS1 must capture an RST BPDU with a Bridge Max Age value of 20 seconds.

Part C:

- In step 3, TS2 must capture RST BPDUs with a Max Age value of 40 seconds.
- In step 5, TS2 must capture RST BPDUs with a Max Age value of 6 seconds.

Part D:

- TS2 must capture RST BPDUs with a Max Age value of 20 seconds.

Possible Problems: None.

Test RSTP.op.3.4 — Bridge Hello Time

Purpose: To determine whether the DUT correctly implements the Bridge Hello Time parameter.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.23 [2] IEEE Std. 802.1Q-2011: Table 13-5

Resource Requirements: 2 Test Station capable of transmitting and receiving arbitrary MAC frames.

Discussion: The Hello Time timer is used when transmitting BPDUs. A BPDU is transmitted in each HelloTime period.

Table 13-5 of IEEE Std. 802.1Q-2011 states that the Bridge Hello Time parameter is fixed at 2 seconds.

In order to interoperate with previous versions of IEEE Std. 802.1Q and 802.1D, a bridge must enforce the following: 2 x (Bridge_Forward_Delay - 1.0 seconds) >= Bridge_Max_Age >= 2 x (Bridge_Hello_Time + 1.0 seconds)

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Ensuring Bridge Hello Time

1. Ensure the DUT is configured to the test setup as defined above.
2. Wait 2 seconds.

Part B: Invalid Hello Time Values

1. Ensure the DUT is configured to the test setup as defined above.
2. Set the DUT's Bridge Hello Time parameter to 1 second.
3. Repeat step 2 with a Bridge Hello Time parameter of 3, 10, and 100 seconds.

Part C: DUT Does Not Propagate Invalid Hello Time from BPDUs

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortBigMsgTimesRST frames every second.
3. Wait 10 seconds.

Observable Results:

Part A:

- In step 2, TS1 must capture a RST BPDU containing a Bridge Hello Time value of 2 seconds.

Part B:

- In step 2 and each repetition of step 2, the DUT must not allow this configuration.

Part C:

- TS2 must capture RST BPDUs with a Hello Time value of 2 seconds.

Possible Problems: None.

Test RSTP.op.3.5 — Point-to-Point Parameters

Purpose: To determine whether the DUT properly supports the operPointToPointMAC and adminPointToPointMAC parameters.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 6.6.3
[2] IEEE Std. 802.1Q-2011: sub-clause 13.15.3
[3] IEEE Std. 802.1Q-2011: Figure 13-25

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: The Internal Sublayer Service makes available a pair of parameters that permit inspection of, and control over, the administrative and operational state of the point-to-point status of the MAC entity. The administrative parameter, adminPointToPointMAC, can take the values *ForceTrue*, *ForceFalse*, and *Auto*. The operational parameter, operPointToPointMAC, takes a Boolean value of *True* or *False*. When the administrative parameter is set to *Auto*, a set of MAC-specific procedures set the operational parameter *True* if the port is determined to be connected to a point-to-point LAN (otherwise the operational parameter is set *False*). Designated ports that are not edge ports cannot make rapid transitions into the Forwarding port state unless the operational parameter is *True*.

Parts A and B are applicable if and only if the DUT supports modification of the adminPointToPointMAC parameter.

Part D is applicable if and only if the DUT supports the modification of the Duplex of an interface.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: operPointToPointMAC is True when adminPointToPointMAC is ForceTrue

1. Ensure the DUT is configured to the test setup as defined above.
2. Set DUT.TS1's adminPointToPointMAC parameter to *ForceTrue*.
3. From TS2, transmit a MakeRootPortRST frame every two seconds.
4. From TS1, transmit a MakeBackupPortRST frame.
5. Wait 6 seconds.
6. From TS1, transmit a RootAgreementRST frame.
7. Wait 2 seconds.
8. From TS1, transmit 10 untagged frames with a source address of 00-03-05-AA-08-11.
9. From TS2, transmit 10 untagged frames with a source address of 00-03-05-AA-09-22.
10. Wait 2 seconds.

Part B: operPointToPointMAC is False when adminPointToPointMAC is ForceFalse

1. Ensure the DUT is configured to the test setup as defined above.
2. Set DUT.TS1's adminPointToPointMAC parameter to *ForceFalse*.
3. From TS2, transmit a MakeRootPortRST frame every two seconds.
4. From TS1, transmit a MakeBackupPortRST frame.
5. Wait 6 seconds.
6. From TS1, transmit a RootAgreementRST frame.
7. Wait 2 seconds.
8. From TS1, transmit 10 untagged frames with a source address of 00-03-05-BB-08-11.
9. From TS2, transmit 10 untagged frames with a source address of 00-03-05-BB-09-22.
10. Wait 2 seconds.

Part C: operPointToPointMAC is True when adminPointToPointMAC is Auto and the Port is connected to a point-to-point LAN

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS2, transmit a MakeRootPortRST frame every two seconds.
3. From TS1, transmit a MakeBackupPortRST frame.
4. Wait 6 seconds.
5. From TS1, transmit a RootAgreementRST frame.
6. Wait 2 seconds.
7. From TS1, transmit 10 untagged frames with a source address of 00-03-05-CC-07-11.
8. From TS2, transmit 10 unicast frames with a source address of 00-03-05-CC-08-22.
9. Wait 2 seconds.

Part D: operPointToPointMAC is False when adminPointToPointMAC is Auto, and the Port is not connected to a point-to-point LAN

1. Ensure the DUT is configured to the test setup as defined above.
2. Set DUT.TS1 to force half-duplex operation.
3. From TS2, transmit a MakeRootPortRST frame every two seconds.
4. From TS1, transmit a MakeBackupPortRST frame.
5. Wait 6 seconds.
6. From TS1, transmit a RootAgreementRST frame.
7. Wait 2 seconds.
8. From TS1, transmit 10 unicast frames with a source address of 00-03-05-DD-08-11.
9. From TS2, transmit 10 unicast frames with a source address of 00-03-05-DD-09-22.
10. Wait 2 seconds.

Observable Results:

Parts A and C:

- TS1 must receive all traffic transmitted by TS2.
- TS2 must receive all traffic transmitted by TS1.

Parts B and D:

- TS1 must not receive any traffic transmitted by TS2.
- TS2 must not receive any traffic transmitted by TS1.

Possible Problems: None.

Test RSTP.op.3.6 — Port Identifier Priority

Purpose: To determine whether the DUT correctly implements the modification of the Port Identifier Priority parameter.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.16 [2] IEEE Std. 802.1Q-2011: Table 13-3

Resource Requirements: 1 Test Station capable of transmitting and receiving arbitrary MAC frames.

Discussion: IEEE Std. 802.1Q-2011: Table 13-3 specifies the default value and range for the Port Identifier Priority parameter. If Bridge management supports configuration of Port Identifier Priority, then the Bridge shall have the capability to use the full range of values (0 – 240) in increments of 16.

This test is applicable if and only if the DUT supports modification of the Port Identifier Priority parameter.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Ensuring Port Identifier Priority

1. Ensure the DUT is configured to the test setup as defined above.
2. Wait 2 seconds.

Part B: Valid Port Identifier Priorities

1. Ensure the DUT is configured to the test setup as defined above.
2. Set the DUT.TS1's Port Identifier Priority parameter to 0x00.
3. Wait 2 seconds.
4. Repeat steps 2 and 3 with a Port Identifier Priority parameter of 0xF0, 0x10, and 0xE0.

Part C: Invalid Port Identifier Priorities

1. Ensure the DUT is configured to the test setup as defined above.
2. Set the DUT.TS1's Port Identifier Priority parameter to 0x01.
3. Wait 2 seconds.
4. Repeat steps 2 and 3 with a Port Identifier Priority parameter of 0xF1, 0x11, and 0xE1.

Observable Results:

Part A:

- In step 2, TS1 must capture a RST BPDU containing a Port Identifier Priority value of 0x80.

Part B:

- TS1 must capture a RST BPDU with the Port Identifier Priority value that was set.

Part C:

- In step 2 and each repetition of step 2, the DUT must not allow this configuration.
- In step 3 and each repetition of step 3, TS1 must capture a RST BPDU with a Port Identifier Priority value of 0x80.

Possible Problems: None.

Test RSTP.op.3.7 — Port Path Cost

Purpose: To determine whether the DUT correctly implements the modification of the Port Path Cost parameter.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.8
[2] IEEE Std. 802.1Q-2011: sub-clause 13.16
[3] IEEE Std. 802.1Q-2011: Table 13-4

Resource Requirements: 1 Test Station capable of transmitting and receiving arbitrary MAC frames.

Discussion: The Port Path Cost is used to select active topologies. The cost is added to the receiving Bridge Port's Path Cost. The lowest Root Path Cost to the Root Bridge dictates which bridge port is assigned the Root Port role.

IEEE Std. 802.1Q-2011: Table 13-4 specifies the Port Path Cost values. If the Port Path Cost can be updated by management, then the Bridge shall have the capability to use the full range of Port Path Cost values (1-200,000,000).

This test is applicable if and only if the DUT supports the modification of the Port Path Cost parameter.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Valid Port Path Cost Values

1. Ensure the DUT is configured to the test setup as defined above.
2. Set Port DUT.TS1's Port Path Cost to 1.
3. Wait 2 seconds.
4. Repeat steps 2 and 3 with a Port Path Cost parameter of 5, 500, 5000, 500,000, and 200,000,000.

Part B: Invalid Port Path Cost Values

1. Ensure the DUT is configured to the test setup as defined above.
2. Set Port DUT.TS1's Port Path Cost to 0.
3. Wait 2 seconds.
4. Repeat steps 2 and 3 with a Port Path Cost parameter of 200,000,001, 300,000,001, and 600,000,001.

Part C: Valid Port Path Cost Values From Received BPDUs

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS2, transmit a MakeRootPortRST frame every two seconds.
3. Wait 2 seconds.
4. Set Port DUT.TS2's Port Path Cost to 1.
5. Wait 2 seconds.
6. Repeat steps 4 and 5 with a Port Path Cost parameter of 5, 500, 5000, 500,000, and 200,000,000.

Part D: Invalid Port Path Cost Values From Received BPDUs

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS2, transmit a MakeRootPortRST frame every two seconds.
3. Wait 2 seconds.
4. Set Port DUT.TS1's Port Path Cost to 0.
5. Wait 2 seconds.
6. Repeat steps 4 and 5 with a Port Path Cost parameter of 200,000,001, 300,000,001, and 600,000,001.

Observable Results:

Part A:

- In step 3 and each repetition of step 3, TS1 must receive a RST BPDU with a Root Path Cost value of 0.

Part B:

- In step 2 and each repetition of step 2, the DUT must not allow this configuration.
- In step 3 and each repetition of step 3, TS1 must receive a RST BPDU with a Root Path Cost value of 0.

Part C:

- In step 5 and each repetition of step 5, TS1 must receive a RST BPDU with a Root Path Cost value that is the value transmitted in the MakeRootPortRST frames plus the Port Path Cost set in step 4.

Part D:

- In step 4 and eash repetition of step 4, the DUT must not allow this configuration.
- In step 5 and each repetition of step 5, TS1 must receive a RST BPDU with a Root Path Cost value that is the value transmitted in the MakeRootPortRST frame plus 200,000.

Possible Problems: None.

Group 4: Timers

Scope: To verify the operation of timers controlled by various state machines.

Test RSTP.op.4.1 — edgeDelayWhile Timer

Purpose: To determine whether the DUT correctly implements the edgeDelayWhile timer.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.23.1 [2] IEEE Std. 802.1Q-2011: sub-clause 13.28

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: The AutoEdgePort parameter is used by the Bridge Detection state machine to determine whether it is appropriate to set the Operational Edge Port parameter True automatically in the event the bridge does not receive a BPDU after a fixed interval (Migrate Time). In the event a port does become an edge port, it will be able to transition immediately from the discarding to the forwarding port state. The value of edgeDelayWhile is set and maintained by the operation of the Port Receive Machine and the Port Role Transitions Machine. The value of edgeDelayWhile is decremented by operation of the Port Timers state machine.

This test is applicable if and only if the DUT supports the AutoEdgePort parameter.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: edgeDelayWhile Timer

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortRST frames every two seconds.
3. Set the AutoEdgePort parameter for DUT.TS2 to True.
4. From TS2, transmit a MakeAlternatePortRST frame.
5. Wait 6 seconds.
6. From TS1, transmit 10 untagged frames with a source mac address of 00-04-01-AA-06-11.
7. Wait 2 seconds.

Observable Results:

Part A:

- TS2 must receive all traffic from TS1 with a source MAC address of 00-04-01-AA-06-11.

Possible Problems: None.

Test RSTP.op.4.2 — fdWhile Timer

Purpose: To determine whether the DUT correctly implements the fdWhile timer.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.23.2
[2] IEEE Std. 802.1Q-2011: sub-clause 13.28
[3] IEEE Std. 802.1Q-2011: sub-clause 13.35

Resource Requirements: 3 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: The fdWhile timer is used to delay port state transitions until other Bridges (especially Bridges using an older version of the Spanning Tree Protocol) receive information necessary to correctly reduce the current topology into a single fully and simply connected Spanning Tree. The value of fdWhile is set and maintained by the operation of the Port Role Transitions state machine. The value of fdWhile is decremented by the operation of the Port Timers state machine.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Initial Port State to Designated Forwarding

1. Ensure the DUT is configured to the test setup as defined above.
2. Disable ports DUT.TS2 and DUT.TS3.
3. Enable ports DUT.TS2 and DUT.TS3.
4. From TS3, transmit a MigratePort2STP frame.
5. Wait 20 seconds.
6. From TS1, transmit 10 untagged frames with a source address of 00-04-02-AA-06-11.
7. Wait 4 seconds.
8. From TS1, transmit 10 untagged frames with a source address of 00-04-02-AA-08-11.
9. Wait 9 seconds.
10. From TS1, transmit 10 untagged frames with a source address of 00-04-02-AA-0A-11.
11. Wait 4 seconds.
12. From TS1, transmit 10 untagged frames with a source address of 00-04-02-AA-0C-11.
13. Wait 2 seconds.

Part B: Alternate Port to Designated Forwarding

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit a MakeRootPortRST frame every two seconds.
3. From TS2, transmit a MakeAlternatePortRST frame.
4. From TS3, transmit a MakeAlternatePortConfig frame.
5. Wait 21 seconds.
6. From TS1, transmit 10 untagged frames with a source address of 00-04-02-BB-06-11.
7. Wait 4 seconds.
8. From TS1, transmit 10 untagged frames with a source address of 00-04-02-BB-08-11.
9. Wait 9 seconds.
10. From TS1, transmit 10 untagged frames with a source address of 00-04-02-BB-0A-11.
11. Wait 4 seconds.
12. From TS1, transmit 10 untagged frames with a source address of 00-04-02-BB-0C-11.
13. Wait 2 seconds.

Observable Results:

Parts A and B:

- In step 7, TS2 and TS3 must not capture any traffic from TS1.
- In steps 9 and 11 , TS2 must capture all traffic from TS1. TS3 must not capture any test traffic.
- In step 13, TS2 and TS3 must capture all traffic from TS1.

Possible Problems: None.

Test RSTP.op.4.3 — helloWhen Timer

Purpose: To determine whether the DUT correctly implements the helloWhen timer.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.23.3 [2] IEEE Std. 802.1Q-2011: sub-clause 13.28

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: The helloWhen timer is used to ensure that at least one BPDU is transmitted by a Designated Port in each Hello Time period. The value of helloWhen is set and maintained by the operation of Port Transmit state machine. The value of helloWhen is decremented by the operation of the Port Timers state machine.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: helloWhen based on Bridge Hello Time

1. Ensure the DUT is configured to the test setup as defined above.
2. Wait 2 seconds.

Part B: helloWhen based on Received Information, 1 seconds.

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortSmallMsgTimesRST frames every second.
3. Wait 2 seconds.

Part C: helloWhen based on Received Information, 0 seconds.

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortHelloTimeZeroRST frames every second.
3. Wait 2 seconds.

Part D: helloWhen based on Received Information, 0 < helloWhen < 1 seconds.

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortHelloTimeLessThanOneRST frames every half second.
3. Wait 2 seconds.

Part E: helloWhen based on Received Information, 10 seconds.

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortBigMsgTimesRST frames every ten seconds.
3. Wait 10 seconds.

Observable Results:

Part A:

- TS2 must capture RST BPDUs with a Root Bridge Identifer equal to the DUT's Bridge Identifier.
- TS2 must capture RST BPDUs every two seconds.
- TS2 must capture RST BPDUs with a Hello Time value of 2 seconds.

Parts B through E:

- TS2 must capture RST BPDUs with a Root Bridge Identifier equal to the Root Bridge Identifier conveyed in BPDUs transmitted by TS1.
- TS2 must capture RST BPDUs every two seconds.
- TS2 must capture RST BPDUs with a Hello Time value of 2 seconds.

Possible Problems: None.

Test RSTP.op.4.4 — rcvdInfoWhile Timer

Purpose: To determine whether the DUT correctly implements the rcvdInfoWhile timer.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.23.6
[2] IEEE Std. 802.1Q-2011: sub-clause 13.28
[3] IEEE Std. 802.1Q-2011: sub-clause 13.27.30

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: Not all failure conditions can be detected and signaled by changes in MAC_Operational status. The rcvdInfoWhile timer is used to ensure that information conveyed in received Configuration Messages is discarded unless refreshed by regular reception of Configuration Messages from the Designated Port. The value of rcvdInfoWhile is set and maintained by the operation of the Port Information Machine. The value of rcvdInfoWhile is decremented by operation of the Port Timers state machine.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Information Aged Out when Message Age greater than Max Age

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS2, transmit a MakeRootPortVeryStaleRST frame.
3. Wait 2 seconds.

Part B: Information Aged Out when Message Age less than Max Age

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS2, transmit a MakeRootPortAlmostStaleRST frame.
3. Wait 5 seconds.

Part C: Information Aged Out when Message Age = 1, Max Age = 40

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS2, transmit a MakeRootPortBigMsgTimesRST frame.
3. Wait 32 seconds.

Observable Results:

Part A:

- TS1 must capture RST BPDUs with the Root Bridge Identifier equal to the Bridge Identifier of the DUT.

Part B:

- TS1 must capture RST BPDUs containing a Root Bridge Identifier of 0x700000BFCBFCBFC0 for 6 seconds.

Part C:

- TS1 must capture RST BPDUs containing a Root Bridge Identifier of 0x700000BFCBFCBFC0 for 30 seconds.

Possible Problems: None.

Test RSTP.op.4.5 — tcWhile Timer

Purpose: To determine whether the DUT correctly implements the tcWhile timer.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.23.9
[2] IEEE Std. 802.1Q-2011: sub-clause 13.27.10
[3] IEEE Std. 802.1Q-2011: sub-clause 13.28
[4] IEEE Std. 802.1Q-2011: sub-clause 13.29
[5] IEEE Std. 802.1Q-2011: sub-clause 13.32

Resource Requirements: 4 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: The tcWhile timer governs the duration during which Topology Change Notification (TCN) messages are transmitted. This ensures that station location information will be relearned when new paths become part of the active topology. The value of tcWhile is set by the operation of the Topology Change Machine. The value of the tcWhile timer is decremented by the operation of the Port Timers state machine.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Root Port has sendRSTP = True, Default Bridge Timer Values

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortRST frames every two seconds.
3. From TS2, transmit a MigratePort2STP frame.
4. From TS4, transmit a NotifyTC_RST frame.
5. Wait 36 seconds.

Part B: Root Port has sendRSTP = False, Default Bridge Timer Values

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortConfig frames every two seconds.
3. From TS2, transmit a MigratePort2STP frame.
4. From TS4, transmit a NotifyTC_RST frame.
5. Wait 36 seconds.

Part C: Root Port has sendRSTP = True, Large Bridge Timer Values

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortBigMsgTimesRST frames every two seconds.
3. From TS2, transmit a MigratePort2STP frame.
4. From TS4, transmit a NotifyTC_RST frame.
5. Wait 71 seconds.

Part D: Root Port has sendRSTP = False, Large Bridge Timer Values

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortBigMsgTimesConfig frames every two seconds.
3. From TS2, transmit a MigratePort2STP frame.
4. From TS4, transmit a NotifyTC_RST frame.
5. Wait 71 seconds.

Observable Results:

Part A:

- TS1 must capture exactly 2 RST BPDUs with the Topology Change flag set.
- TS2 must capture Configuration BPDUs with the Topology Change flag set for between 30 and 35 seconds, inclusively.
- TS3 must capture exactly 2 RST BPDUs with the Topology Change flag set.

Part B:

- TS1 must capture TCN BPDUs for between 30 and 35 seconds, inclusively.
- TS2 must capture Configuration BPDUs with the Topology Change Flag set for between 30 and 35 seconds, inclusively.
- TS3 must capture exactly 2 RST BPDUs with the Topology Change flag set.

Part C:

- TS1 must capture exactly 2 RST BPDUs with the Topology Change flag set.
- TS2 must capture Configuration BPDUs with the Topology Change flag set for between 60 and 70 seconds, inclusively.
- TS3 must capture exactly 2 RST BPDUs with the Topology Change flag set.

Part D:

- TS1 must capture TCN BPDUs for between 60 and 70 seconds, inclusively.
- TS2 must capture Configuration BPDUs with the Topology Change flag set for between 60 and 70 seconds, inclusively.
- TS3 must capture exactly 2 RST BPDUs with the Topology Change flag set.

Possible Problems: None.

Test RSTP.op.4.6 — txCount Timer

Purpose: To determine whether the DUT correctly enforces the txCount parameter when transmitting BPDUs.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.24.10 [3] IEEE Std. 802.1Q-2011: sub-clause 13.32
[2] IEEE Std. 802.1Q-2011: sub-clause 13.25.60

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: A primary design requirement of RSTP is that BPDUs do not consume more than a very small percentage of the total available communications bandwidth. The txCount parameter is used to impose a BPDU transmission rate limit on each port. When a port transmits a BPDU, its txCount parameter is incremented; BPDUs may not be transmitted until txCount is less than Transmit Hold Count.

The value of txCount is set by the operation of the Port Transmit state machine. The value of txCount is decremented by the operation of the Port Timers state machine. Table 13-5 specifies a default value of 6 seconds with a permitted range of 1 to 10 seconds.

Parts B, C, and D are applicable if and only if the DUT supports the modification of the Transmit Hold Count parameter.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: txCount Incremented to the Default Value

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS2, transmit MakeRootPortRST frames every tenth of a second. Decrement the Root Path Cost in each successive MakeRootPortRST frame by 1.
3. Wait 2 seconds.

Part B: txCount Incremented to the Minimum Value

1. Ensure the DUT is configured to the test setup as defined above.
2. Set the DUT's Transmit Hold Count parameter to 1.
3. From TS2, transmit MakeRootPortRST frames every tenth of a second. Decrement the Root Path Cost in each successive MakeRootPortRST frame by 1.
4. Wait 2 seconds.

Part C: txCount Incremented to the Maximum Value

1. Ensure the DUT is configured to the test setup as defined above.
2. Set the DUT's Transmit Hold Count parameter to 10.
3. From TS2, transmit MakeRootPortRST frames every tenth of a second. Decrement the Root Path Cost in each successive MakeRootPortRST frame by 1.
4. Wait 2 seconds.

Part D: txCount Reset to 0 when Transmit Hold Count is Modified

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS2, transmit MakeRootPortRST frame every tenth of a second. Decrement the Root Path Cost in each successive MakeRootPortRST frame by 1.
3. Wait 2 seconds.
4. Set the DUT's Transmit Hold Count parameter to 10.
5. Wait 2 seconds.

Observable Results:

Part A:

- TS1 must not capture more than 7 RST BPDUs in any one-second interval.

Part B:

- TS1 must not capture more than 2 RST BPDUs in any one-second interval.

Part C:

- TS1 must not capture more than 11 RST BPDUs in any one-second interval.

Part D:

- TS1 must not capture more than 11 RST BPDUs in any one-second interval.

Possible Problems: None.

Test RSTP.op.4.7 — mdelayWhile Timer

Purpose: To determine whether the DUT properly implements the Migration Delay timer.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.23.4
[2] IEEE Std. 802.1Q-2011: sub-clause 13.24.5
[3] IEEE Std. 802.1Q-2011: sub-clause 13.25.25
[4] IEEE Std. 802.1Q-2011: sub-clause 13.28
[5] IEEE Std. 802.1Q-2011: sub-clause 13.30

Resource Requirements: 1 Test Station capable of transmitting and receiving arbitrary MAC frames.

Discussion: The Migration Delay timer allows RSTP Bridges to synchronize their migration state before changing the type of BPDUs they transmit.

The value of mdelayWhile is set to a fixed value, Migrate Time, by the operation of the Port Protocol Migration state machine. The value of mdelayWhile is decremented by the operation of the Port Timers state machine.

Table 13-5 specifies the value of Migrate Time to be fixed at 3.0 seconds.

The mCheck parameter can be set by management to force the Port Protocol Migration state machine to transmit RST BPDUs for Migrate Time to test whether all STP Bridges attached to the device have been removed. The mCheck parameter is an optional parameter.

Part C is applicable if and only if the DUT supports modification of the mCheck parameter.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: mdelayWhile Governs Transition for Selecting STP

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit a MigratePort2STP frame.
3. Wait 0.5 seconds.
4. From TS1, transmit MigratePort2RSTP frames every tenth of a second.
5. From TS1, transmit a MigratePort2STP frame.
6. Wait 3 seconds.

Part B: mdelayWhile Governs Transition for Selecting RSTP

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit a MigratePort2STP frame.
3. Wait 4 seconds.
4. From TS1, transmit a MigratePort2RSTP frame.
5. Wait 0.5 seconds.
6. From TS1, transmit MigratePort2STP frames every tenth of a second.
7. From TS1, transmit a MigratePort2RSTP frame.
8. Wait 3 seconds.

Part C: mdelayWhile Ignored When mcheck is True for Selecting STP

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit a MigratePort2STP frame.
3. Wait until TS1 has received a Configuration BPDU.
4. Set Port DUT.TS1's mCheck parameter True.
5. Wait 3 seconds.

Observable Results:

Part A:

- TS1 must receive only Configuration BPDUs.

Part B:

- TS1 must receive only RST BPDUs.

Part C:

- TS1 must receive only RST BPDUs.

Possible Problems: None.

Group 5: Port Role Transitions and Selections

Scope: To determine whether the DUT properly computes Port Role assignments based on the current set of priority vectors, and that Ports assigned a given Port Role properly assume that Port Role.

Test RSTP.op.5.1 — Designated Port Transition

Purpose: To determine that ports on the DUT which have been assigned the Designated Port Role properly transition into the Root and Alternate Port Roles.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.25.8
[2] IEEE Std. 802.1Q-2011: sub-clause 13.27
[3] IEEE Std. 802.1Q-2011: sub-clause 13.33
[4] IEEE Std. 802.1Q-2011: sub-clause 13.35

Resource Requirements: 3 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: The Port Role Transitions state machine is used to determine when a port will transition from one role to another. If a Port Role is not equal to the selectedRole assigned by the Port Role Selection state machine, the port will transition into its selectedRole in the manner described by the Port Role Transitions state machine. Due to the fact that sendRSTP is true, it takes HelloTime x 3 for the port to transition from one role to another.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Designated Port Transitions

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortConfig frames every two seconds.
3. From TS2, transmit MakeAlternatePortRST frames every two seconds.
4. From TS3, transmit a NotifyTC_RST frame.
5. From TS1, transmit 10 untagged frames with a source mac address of 00-05-01-AA-05-11.
6. From TS2, transmit 10 untagged frames with a source mac address of 00-05-01-AA-06-22.
7. From TS3, transmit 10 untagged frames with a source mac address of 00-05-01-AA-07-33.
8. From TS2, cease transmission of MakeAlternatePortRST frames.
9. Wait 3 seconds.
10. From TS1, cease transmission of MakeRootPortConfig frames.
11. Wait 11 seconds.
12. From TS1, transmit 10 untagged frames with a source mac address of 00-05-01-AA-08-11.
13. From TS2, transmit 10 untagged frames with a source mac address of 00-05-01-AA-09-22.
14. From TS3, transmit 10 untagged frames with a source mac address of 00-05-01-AA-10-33.
15. Wait 2 seconds.

Observable Results:

Part A:

- In step 5, TS3 must receive all of the frames transmitted from TS1. TS2 must not receive any frames transmitted from TS1.
- In step 6, TS1 and TS3 must not receive any of the frames transmitted from TS2.
- In step 7, TS1 must receive all of the frames transmitted from TS3. TS2 must not receive any of the frames transmitted from TS3 traffic.
- In step 11, TS1 must receive TCN BPDUs.
- In step 12, TS2 and TS3 must receive all of the frames transmitted from TS1.
- In step 13, TS1 and TS3 must receive all of the frames transmitted from TS2.
- In step 14, TS1 and TS2 must receive all of the frames transmitted from TS3.

Possible Problems: None.

Test RSTP.op.5.2 — Root Port to Alternate Port Transition

Purpose: To determine that a port on the DUT which has been assigned the Root Port Role properly transitions into the Alternate Port Role and back again.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 13.27
[2] IEEE Std. 802.1Q-2011: sub-clause 13.33
[3] IEEE Std. 802.1Q-2011: sub-clause 13.35

Resource Requirements: 3 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: The Port Role Transitions state machine is used to determine when a port will transition from one role to another. If a Port Role is not equal to the selectedRole assigned by the Port Role Selection state machine, the port will transition into its selectedRole in the manner described by the Port Role Transitions state machine. Due to the fact that sendRSTP is true, it takes HelloTime x 3 for the port to transition from one role to another.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Root Port Transitions

1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit a MakeRootPortRST frame every two seconds.
3. From TS1, transmit 10 untagged frames with a source mac address of 00-05-02-AA-03-11.
4. Wait 2 seconds.
5. From TS1, transmit MakeAlternatePortRST frames every two seconds.
6. From TS2, transmit MakeRootPortRST frames every two seconds
7. From TS1, transmit 10 untagged frames with a source mac address of 00-05-02-AA-06-11.
8. From TS2, cease transmission of MakeRootPortRST frames.
9. Wait 6 seconds.
10. From TS1, transmit 10 untagged frames with a source mac address of 00-05-02-AA-08-11.
11. Wait 2 seconds.

Observable Results:

Part A:

- In step 4, TS3 must receive all of the frames transmitted from TS1.
- In step 9, TS3 must not receive any of the frames transmitted from TS1.
- In step 11, TS3 must receive all of the frames transmitted from TS1.

Possible Problems: None.

Test RSTP.op.5.3 — Root Port Selection

Purpose: To determine that the updtRolesBridge() procedure of the Port Role Selection state machine sets a port's selectedRole to RootPort when appropriate.

References:
[1] IEEE Std. 802.1Q-2011: sub-clause 13.9
[2] IEEE Std. 802.1Q-2011: sub-clause 13.25.17
[3] IEEE Std. 802.1Q-2011: sub-clause 13.27
[4] IEEE Std. 802.1Q-2011: sub-clause 13.33
[5] IEEE Std. 802.1Q-2011: sub-clause 13.35

Resource Requirements:

Discussion: If the port priority vector was received in a Configuration Message and is not aged (infoIs = Received), and the root priority vector is now derived from it, selectedRole is set to RootPort and updtInfo is reset. The root priority vector is defined as the best priority vector in the set of priority vectors. The set of priority vectors is comprised of the bridge priority vector, and all root path priority vectors whose DesignatedBridgeID is not equal to the actual BridgeID. A port which has been assigned the Root Port Role and is not operating in STP Compatibility Mode will transmit RST BPDUs when tcWhile !=0, and (once all other ports on the bridge are in agreement with Spanning Tree information) in response to a SuperiorDesignatedMsg with the proposal flag set.

Test Setup: Refer to the default test setup in Appendix A.

Test Procedure:

Part A: Root Port Role Selection Based on RootBridgeID
1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortRST frames every two seconds.
3. Wait 2 seconds.

Part B: Root Port Role Selection Based on Root Path Cost
1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortPathCostRST frames every two seconds.
3. From TS2, transmit MakeRootPortRST frames every two seconds.
4. Wait 2 seconds.

Part C: Root Port Role Selection Based on DesignatedBridgeID
1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortDesignatedBridgeIDRST frames every two seconds.
3. From TS2, transmit MakeRootPortRST frames every two seconds.
4. Wait 2 seconds.

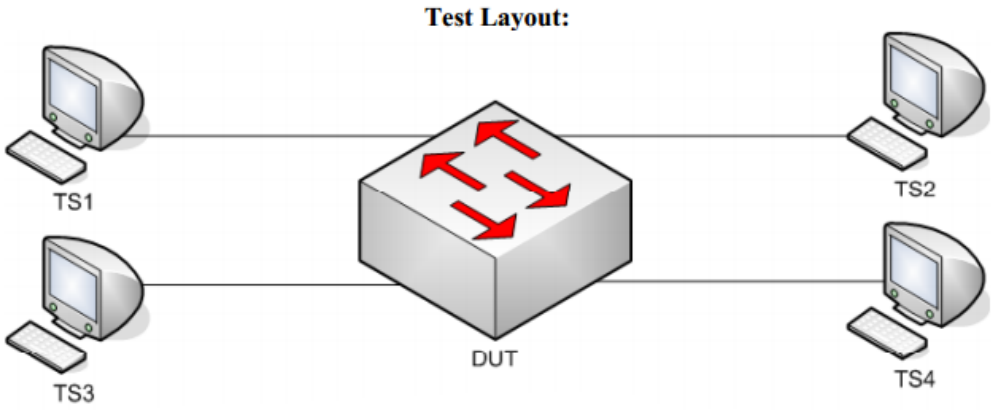
Part D: Root Port Role Selection Based on DesignatedPortID
1. Ensure the DUT is configured to the test setup as defined above.
2. From TS1, transmit MakeRootPortDesignatedPortIDRST frames every two seconds.
3. From TS2, transmit MakeRootPortRST frames every two seconds.
4. Wait 2 seconds.

Part E: Root Port Role Selection Based on BridgePortID
1. Ensure the DUT is configured to the test setup as defined above.
2. From TS2, transmit MakeRootPortRST frames every two seconds.
3. From TS1, transmit MakeRootPortRST frames every two seconds.
4. Wait 2 seconds.

Observable Results:
Parts A through E:
- TS1 should capture RST BPDUs indicating the Root Port Role

Possible Problems: None.

Appendix A: Default Test Setup



Bridge Parameters:

- RSTP Enabled
- Force Protocol Version = 2 (RSTP)
- Bridge Priority = 0x8000
- Bridge Max Age = 20 seconds
- Bridge Hello Time = 2 seconds
- Bridge Forward Delay = 15 seconds
- FDB ageing time = 300 seconds
- TxHoldCount = 6

Port Parameters:

- RSTP enabled
- PVID = 1
- Member of the Untagged set for Default VLAN (VID 0x001). Not a member of any other VLAN.
- Acceptable Frame Types Parameter = Admit All Frames
- Port Priority = 0x80
- Port Path Cost = 0x00030D40
- AdminEdge = False
- AutoEdge = False
- sendRSTP = True*
- learning = True+
- forwarding = True+
- tcWhile = 0+
- txCount = 0+

* Setting this parameter True before performing a given test may require mcheck to be asserted for the Port. If this is not possible, then re-initialize the Port and wait until it:

1. Enters the Forwarding Port State
2. Has tcWhile = 0

+ These parameters cannot be explicitly configured.

Appendix B: Frame Document

MakeRootPortRST		
The receiving Port transitions to the RootPortRole.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortBetterPriorityRST		
The receiving Port transitions to the RootPortRole with better RootPriority than MakeRootPortRST.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	60 00 00 BF CB FC BF C9
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C8
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortBigMsgTimesRST		
The receiving Port transitions to the RootPortRole with better RootPriority than MakeRootPortRST.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	28 00
49..50	Hello Time	0A 00
51..52	Forward Delay	1E 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortSmallMsgTimesRST		
The receiving Port transitions to the RootPortRole with the minimum Message Times values.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	06 00
49..50	Hello Time	01 00
51..52	Forward Delay	04 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortHelloTimeZeroRST		
The receiving Port transitions to the RootPortRole with a HelloTime value of Zero.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	00 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortHelloTimeLessThanOneRST		
The receiving Port transitions to the RootPortRole with a HelloTime value of Zero.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	00 50
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortBadProtocolIdRSTT		
Attempts to transition the receiving Port to the RootPort using a bad Protocol Identifier.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	BE EF
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortTooFewOctetsRST		
Attempts to transition the receiving Port to the RootPort using an insufficient number of octets for an RST BPDU.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 26
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortAlmostStaleRST		
The receiving Port transitions to the RootPortRole with a MessageAge value close to that of the MaxAge.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	12 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortStaleRST		
Attempts to transition the receiving Port to the RootPort with a MessageAge equal to the MaxAge.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	14 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortStaleRST		
Attempts to transition the receiving Port to the RootPort with a MessageAge greater than the MaxAge.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	DE AD
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeAlternatePortRST*		
The receiving Port transitions to the AlternatePortRole.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C2
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

* This frame will only function as intended if another Port on the DUT is receiving one of the several valid types of ”MakeRootPort” frames.

MakeBackupPortRST*		
The receiving Port transitions to the BackupPortRole.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40 + Path Cost of DUT RootPort
35..42	DesignatedBridgeIdentifier	<BridgeID of DUT>
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

* This frame will only function as intended if another Port on the DUT is receiving one of the several valid types of ”MakeRootPort” frames.

** The DesignatedPortID contained in a MakeBackupPortRST frame has the following components:
Port Priority = Zero
Port Number = A Port number indicating a Port on the DUT that is not connected to any Test Station.

RootAgreementRST		
The receiving Port transitions to the ForwardingPort State.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	78
23..30	RootBridgeIdentifier	**
31..34	Root Path Cost	**
35..42	DesignatedBridgeIdentifier	**
43..44	DesignatedPortIdentifier	**
45..46	Message Age	***
47..48	Max Age	***
49..50	Hello Time	***
51..52	Forward Delay	***
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

** The message priority vector contained in a RootAgreementRST frame must match the values contained in Configuration Messages being received by the Test Station at the time of its transmission.

*** The message times transmitted in a RootAgreementRST frame must match the values contained in Configuration Messages being received by the Test Station at the time of its transmission.

NotifyTC_RST		
The receiving Port on the DUT initiates a Topology Change.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	79
23..30	RootBridgeIdentifier	F0 00 00 BF CB FC BF CA
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF CB
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortConfig		
The receiving Port transitions to the RootPortRole and sets sendRSTP = FALSE.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 26
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	00
21..	BPDU Type	00
22..	BPDU Flags	00
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortBigMsgTimesConfig		
The receiving Port transitions to the RootPortRole with sendRSTP = FALSE and the maximum Message Times values.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 26
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	00
21..	BPDU Type	00
22..	BPDU Flags	00
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	28 00
49..50	Hello Time	0A 00
51..52	Forward Delay	1E 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortBadProtocolIdConfig		
Attempts to transition the receiving Port to the RootPortRole with sendRSTP = FALSE using a bad Protocol Identifier.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 26
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	BE EF
20..	Protocol Version Identifier	00
21..	BPDU Type	00
22..	BPDU Flags	00
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortTooFewOctetsConfig		
Attempts to transition the receiving Port to the RootPortRole with sendRSTP = FALSE using an insufficient number of octets.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 25
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	00
21..	BPDU Type	00
22..	BPDU Flags	00
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortStaleConfig		
Attempts to transition the receiving Port to the RootPortRole with sendRSTP = FALSE using a MessageAge equal to the MaxAge.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 26
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	00
21..	BPDU Type	00
22..	BPDU Flags	00
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	14 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortVeryStaleConfig		
Attempts to transition the receiving Port to the RootPortRole with sendRSTP = FALSE using a MessageAge greater than the MaxAge.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 26
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	00
21..	BPDU Type	00
22..	BPDU Flags	00
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	DE AD
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeAlternatePortConfig		
The receiving Port transitions to the AlternatePortRole with sendRSTP = FALSE.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 26
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	00
21..	BPDU Type	00
22..	BPDU Flags	00
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C2
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MigratePort2STP		
The receiving Port transition to mode sendRSTP = FALSE.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 26
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	00
21..	BPDU Type	00
22..	BPDU Flags	00
23..30	RootBridgeIdentifier	F0 00 00 BF CB FC BF CF
31..34	Root Path Cost	00 00 00 00
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF CF
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

NotifyTC_Config		
The receiving Port on the DUT initiates a Topology Change and sets It's mode to sendRSTP = FALSE.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 26
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	00
21..	BPDU Type	00
22..	BPDU Flags	00
23..30	RootBridgeIdentifier	F0 00 00 BF CB FC BF CA
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF CB
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortPathCostRST		
The receiving Port transitions to the RootPortRole with better PortPathCost than MakeRootPortRST.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 00 00
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortDesignatedBridgeIDRST		
The receiving Port transitions to the RootPortRole with better Designated-BridgeID than MakeRootPortRST.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	E0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	80 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortDesignatedPortIDRST		
The receiving Port transitions to the RootPortRole with better DesignatedPortID than MakeRootPortRST.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	70 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	70 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

MakeRootPortBetterPriorityRST		
The receiving Port transitions to the RootPortRole with better RootPriority than MakeRootPortRST.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 27
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	02
21..	BPDU Type	02
22..	BPDU Flags	3C
23..30	RootBridgeIdentifier	60 00 00 BF CB FC BF C0
31..34	Root Path Cost	00 03 0D 40
35..42	DesignatedBridgeIdentifier	F0 00 00 BF CB FC BF C1
43..44	DesignatedPortIdentifier	70 01
45..46	Message Age	01 00
47..48	Max Age	14 00
49..50	Hello Time	02 00
51..52	Forward Delay	0F 00
53..	Version One Length	00
54..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

TCN_BPDU		
The receiving Port on the DUT initiates a Topology Change and sets It's mode to sendRSTP = FALSE.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 07
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	00 00
20..	Protocol Version Identifier	00
21..	BPDU Type	80
22..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

BadProtocolId_TCN_BPDU		
Attempts to cause the receiving Port to initiate a Topology Chance and set It's mode to sendRSTP = FALSE.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	01 80 C2 00 00 00
07..12	Source MAC Address	<TS Source MAC>
13..14	Length/Type	00 07
15..17	Logical Link Control	42 42 03
18..19	Protocol Identifier	BE EF
20..	Protocol Version Identifier	00
21..	BPDU Type	80
22..60	Pad	All zeros
61..64	Frame Check Sequence	Calculated at runtime

TestTrafficTS1		
These frames identify Traffic originating from Test Station 1.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	00 98 76 54 32 10
07..12	Source MAC Address	00 BF C1 00 DA 7A
13..14	Length/Type	00 64
	Logical Link Control	B0 BD EC 0D ED
		10 0F DE BB 1E
		SC 0D ED FA CA
		DE S1 DE 1E F1
		D1 DE AB 0B AA
		AA BB BB CC CC
		DD DD FF FF 11
		11 22 22 33 33
		44 44 55 55 66
		66 77 77 88 88
		99 99 00 00 FF
		FF EE EE DD DD
		CC CC BB BB AA
		AA 00 00 99 99
		88 88 77 77 66
		66 55 55 44 44
		33 33 22 22 11
		11 AA AA BB BB
		CC CC DD DD EE
		EE FF FF 00 00
61..64	Frame Check Sequence	Calculated at runtime

TestTrafficTS2		
These frames identify Traffic originating from Test Station 2.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	00 98 76 54 32 10
07..12	Source MAC Address	00 BF C2 00 DA 7A
13..14	Length/Type	00 64
	Logical Link Control	B0 BD EC 0D ED
		20 0F DE BB 1E
		SC 0D ED FA CA
		DE S1 DE 1E F1
		D1 DE AB 0B AA
		AA BB BB CC CC
		DD DD FF FF 11
		11 22 22 33 33
		44 44 55 55 66
		66 77 77 88 88
		99 99 00 00 FF
		FF EE EE DD DD
		CC CC BB BB AA
		AA 00 00 99 99
		88 88 77 77 66
		66 55 55 44 44
		33 33 22 22 11
		11 AA AA BB BB
		CC CC DD DD EE
		EE FF FF 00 00
61..64	Frame Check Sequence	Calculated at runtime

TestTrafficTS3		
These frames identify Traffic originating from Test Station 3.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	00 98 76 54 32 10
07..12	Source MAC Address	00 BF C3 00 DA 7A
13..14	Length/Type	00 64
	Logical Link Control	B0 BD EC 0D ED
		30 0F DE BB 1E
		SC 0D ED FA CA
		DE S1 DE 1E F1
		D1 DE AB 0B AA
		AA BB BB CC CC
		DD DD FF FF 11
		11 22 22 33 33
		44 44 55 55 66
		66 77 77 88 88
		99 99 00 00 FF
		FF EE EE DD DD
		CC CC BB BB AA
		AA 00 00 99 99
		88 88 77 77 66
		66 55 55 44 44
		33 33 22 22 11
		11 AA AA BB BB
		CC CC DD DD EE
		EE FF FF 00 00
61..64	Frame Check Sequence	Calculated at runtime

TestTrafficTS4		
These frames identify Traffic originating from Test Station 4.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	00 98 76 54 32 10
07..12	Source MAC Address	00 BF C4 00 DA 7A
13..14	Length/Type	00 64
	Logical Link Control	B0 BD EC 0D ED
		40 0F DE BB 1E
		SC 0D ED FA CA
		DE S1 DE 1E F1
		D1 DE AB 0B AA
		AA BB BB CC CC
		DD DD FF FF 11
		11 22 22 33 33
		44 44 55 55 66
		66 77 77 88 88
		99 99 00 00 FF
		FF EE EE DD DD
		CC CC BB BB AA
		AA 00 00 99 99
		88 88 77 77 66
		66 55 55 44 44
		33 33 22 22 11
		11 AA AA BB BB
		CC CC DD DD EE
		EE FF FF 00 00
61..64	Frame Check Sequence	Calculated at runtime

TestTrafficDA1		
These frames contain a Destination Address equal to the Source Address of TestTrafficSA1 frames.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	00 BF C7 51 DA 7A
07..12	Source MAC Address	00 BF C1 00 DA 7A
13..14	Length/Type	00 64
	Logical Link Control	E3 0E 35 70 08
		58 46 EA B8 E1
		7E 9D D0 C0 D3
		98 8A 86 DC 9D
		71 50 30 94 E8
		92 2A 31 B6 53
		15 1A 28 A9 9E
		AB A9 65 BB 53
		64 95 1A 0C 86
		C0 8C 74 76 B3
		B4 19 50 92 B7
		70 7E 08 7D E9
		AB 9D 70 E7 9A
		37 C9 DE CD 66
		65 A8 0C 0C419
		00 A0 C9 4C 41
		10 62 88 90 75
		46 0E 93 BE 94
		12 20 05 06 1C
		70 D6 7A C4 37
61..64	Frame Check Sequence	Calculated at runtime

TestTrafficDA2		
These frames contain a Destination Address equal to the Source Address of TestTrafficSA2 frames.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	00 BF C7 52 DA 7A
07..12	Source MAC Address	00 BF C2 00 DA 7A
13..14	Length/Type	00 64
	Logical Link Control	4E 0B E7 20 25
		6C BC EA B9 4D
		DD C8 65 8D A1
		A9 4C AD 58 5D
		20 89 01 78 A9
		D4 26 14 B0 CD
		35 C9 0D 6E 31
		E5 CC 17 AB AB
		A0 2C 24 3C 71
		DB 82 70 12 8B
		49 56 AD 1D 57
		7D 3C 32 6D E3
		01 2B C5 5E 6C
		B3 1A 97 72 CB
		9E E2 EC 72 5E
		4D B6 5B AB 3E
		49 06 CD AE 65
		DE 51 A5 27 E0
		35 54 46 73 7B
		88 41 81 CB C3
61..64	Frame Check Sequence	Calculated at runtime

TestTrafficDA3		
These frames contain a Destination Address equal to the Source Address of TestTrafficSA3 frames.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	00 BF C7 53 DA 7A
07..12	Source MAC Address	00 BF C3 00 DA 7A
13..14	Length/Type	00 64
	Logical Link Control	7B D0 E9 C8 B2
		87 7D 33 B7 11
		D4 6D B2 E6 06
		70 82 76 C1 62
		C4 EC 35 08 D2
		71 31 A7 7D 42
		A8 42 A7 B2 05
		7C 6C A4 01 38
		0A 22 8E 6C AE
		BC 00 65 C5 7B
		3D 67 26 AA 56
		05 02 4A 8C 36
		D2 38 8E D2 47
		28 00 53 0D 20
		6E 47 AD B7 5D
		C5 30 48 66 55
		DA 13 CD A0 9E
		4C 96 D0 37 9C
		B5 87 0B AD 74
		96 85 2A A1 94
61..64	Frame Check Sequence	Calculated at runtime

TestTrafficDA4		
These frames contain a Destination Address equal to the Source Address of TestTrafficSA4 frames.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	00 BF C7 54 DA 7A
07..12	Source MAC Address	00 BF C4 00 DA 7A
13..14	Length/Type	00 64
	Logical Link Control	55 26 A7 CA BB
		7A 9A 6E D8 13
		C0 1B 56 CE 68
		D7 B6 48 A2 07
		ED 32 86 40 EB
		AB 23 5A CB 2B
		B6 45 D3 26 A2
		C2 40 51 DB 0D
		9B C2 97 62 C7
		AB E0 3D 92 03
		C6 50 76 9C 13
		1D 93 2D B0 7B
		95 88 12 48 4E
		4D ED 93 85 46
		CC 14 53 1D 7A
		71 02 27 BA 8C
		5B E3 C9 CD E8
		72 1A 2D BD 26
		6B 93 25 3E 3E
		D2 6E D0 72 4E
61..64	Frame Check Sequence	Calculated at runtime

TestTrafficSA1		
These frames each contain a unique Source MAC Address.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	00 98 76 54 32 10
07..12	Source MAC Address	00 BF C7 51 DA 7A
13..14	Length/Type	00 64
	Logical Link Control	52 A0 09 99 E7
		6C E1 43 B7 83
		E0 AB 2E 9B 74
		54 77 0C A4 44
		44 86 63 57 57
		82 25 94 CD 9A
		E1 05 41 92 7C
		60 69 61 ED C2
		81 1A 23 9D 45
		34 CA C4 41 36
		99 9C 79 88 69
		B0 94 0C 6C B9
		5E A5 AC 06 49
		B3 4B 43 69 58
		8B D6 7B 3D 51
		0E 11 EA 26 01
		40 14 93 11 AB
		DC CB 34 07 8C
		B3 8A BA 1D 36
		CD DE 99 58 B4
61..64	Frame Check Sequence	Calculated at runtime

TestTrafficSA2		
These frames each contain a unique Source MAC Address.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	00 98 76 54 32 10
07..12	Source MAC Address	00 BF C7 52 DA 7A
13..14	Length/Type	00 64
	Logical Link Control	C8 1C E6 2C D6
		B9 33 A5 16 B6
		2B D8 D4 0D 10
		94 B6 7E 8B EE
		7C 35 23 08 1C
		05 E4 B6 A8 CE
		AE 3D E3 AD ED
		8B 1C 40 AE 8D
		AD 5B 72 C0 11
		5A 73 E9 90 29
		3E 93 53 6D C0
		2C C5 A0 21 45
		57 A1 41 1A A3
		DB 5D 69 C8 E5
		05 C8 51 6B 85
		10 8A C8 68 89
		39 6D 00 11 CE
		B2 3C E4 18 19
		D0 96 6A DD 1B
		D4 9E 86 61 E6
61..64	Frame Check Sequence	Calculated at runtime

TestTrafficSA3		
These frames each contain a unique Source MAC Address.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	00 98 76 54 32 10
07..12	Source MAC Address	00 BF C7 53 DA 7A
13..14	Length/Type	00 64
	Logical Link Control	C3 9A BD 1E 23
		03 CC 80 69 AD
		47 15 A7 4A 42
		40 9C 12 57 2C
		43 EB E0 BB A0
		A1 62 37 6A A9
		6B 06 3E 4D A9
		BB 55 2E 29 E0
		E8 07 63 C3 32
		00 95 6E 42 1C
		64 5E E3 A0 28
		C7 A6 EB 55 5B
		A2 57 32 A0 9E
		57 7C 87 80 9B
		5C D9 CD 3D 22
		04 C1 53 E6 13
		4C 4C 7E 84 78
		DA 7B 5B 82 91
		8D A5 5A E2 7A
		07 E0 A1 2B 06
61..64	Frame Check Sequence	Calculated at runtime

TestTrafficSA4		
These frames each contain a unique Source MAC Address.		
Field (Octet(s))		**Value (Hexadecimal)**
01..06	Destination MAC Address	00 98 76 54 32 10
07..12	Source MAC Address	00 BF C7 54 DA 7A
13..14	Length/Type	00 64
	Logical Link Control	77 34 CD 10 99
		43 7D 9C 07 59
		3A EC 60 57 42
		3E 6C DC 90 38
		B1 C6 7D 36 C6
		DE 91 87 0E D1
		34 C1 0C E3 49
		14 ED E1 B7 6A
		04 61 2D A6 21
		96 63 77 79 E6
		DD 76 B7 BE C1
		66 13 AB 06 46
		BD 40 99 AB C9
		DD A9 E7 C6 90
		13 60 DD 11 43
		AB 77 18 4A 32
		57 E0 B7 C9 BA
		2B A0 71 56 2B
		76 66 48 C3 80
		E0 A6 08 EB 7C
61..64	Frame Check Sequence	Calculated at runtime