

Bridge Functions Consortium

Multiple Spanning Tree Protocol
Operations Test Suite
Version 1.3



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MODIFICATION RECORD

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INTRODUCTION

The University of New Hampshire's InterOperability Laboratory (UNH-IOL) operates with the primary focus to improve the interoperability of standards based products by providing an environment where a product can be tested against other implementations of a standard. In addition to interoperability testing, this suite of tests has been developed to help implementers evaluate the operations/functionality of their MSTP capable products.

IEEE Std 802.1Q™-2005; Sub-Clause 13 states:

“The MSTP algorithm and protocol provides simple and full connectivity for frames assigned to any given VLAN throughout a Bridged Local Area Network comprising arbitrarily interconnected Bridges, each operating MSTP, STP (Clause 8 of IEEE Std 802.1D, 1998 Edition), or RSTP (Clause 17 of IEEE Std 802.1D). MSTP allows frames assigned to different VLANs to follow separate paths, each based on an independent Multiple Spanning Tree Instance (MSTI), within Multiple Spanning Tree (MST) Regions composed of LANs and or MST Bridges. These Regions and the other Bridges and LANs are connected into a single Common Spanning Tree (CST).”

This Test Suite has been designed based on the set of clauses in IEEE Std 802.1Q™-2005 that pertain to MSTP. The test suite is designed to help determine whether or not the DUT will behave in accordance with the standard during normal operation.

These tests are not designed to evaluate performance. The relative performance of MSTP capable devices (e.g. bridge configuration time, device startup time, etc.) is beyond the scope of this document.

These tests do not guarantee the DUT conforms to IEEE Std 802.1Q™-2005, nor are they designed as interoperability tests. Rather, they provide one method to isolate problems within a MSTP capable device that will affect interoperability. Successful completion of all tests contained in this suite does not guarantee that the tested device will operate with other MSTP capable devices. However, combined with satisfactory completion of interoperability testing, these tests provide a reasonable level of confidence that the DUT will function well in most MSTP capable environments.

REFERENCES

The following documents are referenced in this text:

- | | |
|--------------------------|---|
| [IEEE Std 802.1Q™-2005] | “Virtual Bridged Local Area Networks”, IEEE Computer Society, LAN/MAN Standards Committee |
| [IEEE Std. 802.1D™-2004] | “Media Access Control (MAC) Bridges”, IEEE Computer Society, LAN/MAN Standards Committee |
| [IEEE Std. 802.1w™-2001] | “Part 3: Media Access Control (MAC) Bridges – Amendment 2: Rapid Reconfiguration”, IEEE Computer Society, LAN/MAN Standards Committee |
| [IEEE Std. 802.1D™-1998] | “Part 3: Media Access Control (MAC) Bridges”, IEEE Computer Society, LAN/MAN Standards Committee |
| MSTP.op.frames | UNH-IOL MSTP Operations Test Suite, Frame Reference Tables |

ABBREVIATIONS AND ACRONYMS

IEEE 802.1	
BPDU	Bridge Protocol Data Unit
CIST	Common and Internal Spanning Tree
CST	Common Spanning Tree
FCS	Frame Check Sequence (a.k.a. Cyclic Redundancy Check – CRC)
ID	Identifier
IST	Internal Spanning Tree
LAN	Local Area Network
MAC	Medium Access Control
MCID	MST Configuration Identifier
MST	Multiple Spanning Tree
MST BPDU	Multiple Spanning Tree Bridge Protocol Data Unit
MSTI	Multiple Spanning Tree Instance
MSTP	Multiple Spanning Tree Protocol
PDU	Protocol Data Unit
PVID	Port VID
RST BPDU	Rapid Spanning Tree Bridge Protocol Data Unit
SST	Single Spanning Tree
ST	Spanning Tree
ST BPDU	Spanning Tree Bridge Protocol Data Unit
STP	Spanning Tree Protocol
TCN BPDU	Topology Change Notification BPDU
VID	VLAN Identifier
VLAN	Virtual LAN

MSTP Operations 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)

DEFINITION OF TERMS

IEEE 802.1	
Boundary Port	A Bridge Port attaching an MST Bridge to a LAN that is not in the same region.
Common and Internal Spanning Tree (CIST)	The single Spanning Tree calculated by STP and RSTP together with the logical continuation of that connectivity through MST Bridges and regions, calculated by MSTP to ensure that all LANs in the Bridged Local Area Network are simply and fully connected.
Common Spanning Tree (CST)	The single Spanning Tree calculated by STP and RSTP, and by MSTP to connect MST Regions.
Detagged frame	The detagged frame of an untagged frame is the frame itself. The detagged frame of a tagged frame (i.e. a VLAN-tagged or priority-tagged frame) is the frame that results from untagging the frame by the appropriate procedure.
Frame	A unit of data transmission on an IEEE 802 LAN MAC that conveys a PDU between MAC Service users. There are three types of frame; untagged, VLAN-tagged, and priority-tagged.
Internal Spanning Tree (IST)	The connectivity provided by the CIST within a given MST Region.
Legacy region	A set of LAN segments interconnected such that there is physical connectivity between any pair of segments using only IEEE Std 802.1D, 1998 Edition-conformant, VLAN-unaware MAC Bridges.
MST Bridge	A Bridge capable of supporting the CST, and one or more MSTIs, and of selectively mapping frames classified in any given VLAN to the CST or a given MSTI.
MST Configuration Table	A configurable table that allocates each and every possible VLAN to the Common Spanning Tree or a specific Multiple Spanning Tree Instance
MST Region	A set of LANs and MST Bridges physically connected via Ports on those MST Bridges, where each LAN's CIST Designated Bridge is an MST Bridge, and each Port is either the Designated Port on one of the LANs, or else a non-Designated Port of an MST Bridge that is connected to one of the LANs, whose MCID matches exactly the MCID of the Designated Bridge of that LAN.
Multiple Spanning Tree (MST) Configuration Identifier	A name for, revision level, and a summary of a given allocation of VLANs to Spanning Trees.
Multiple Spanning Tree Instance (MSTI)	One of a number of Spanning Trees calculated by MSTP within an MST Region, to provide a simply and fully connected active topology for frames classified as belonging to a VLAN that is mapped to the MSTI by the MST Configuration Table used by MST Bridges of that MST Region.
Priority-tagged frame	A tagged frame whose tag header carries priority information, but carries no VLAN identification information.

Single Spanning Tree (SST) Bridge	A Bridge capable of supporting only a single spanning tree, the CST. The single spanning tree may be supported by the Spanning Tree Algorithm and Protocol (STP) defined in IEEE Std. 802.1D, 1998 Edition, or by the Rapid Spanning Tree Algorithm and Protocol (RSTP), defined in IEEE Std 802.1D, 2004 Edition.
Spanning Tree	A simply and fully connected active topology formed from the arbitrary physical topology of connected Bridged Local Area Network components by relaying frames through selected bridge ports and not others. The protocol parameters and states used and exchanged to facilitate the calculation of that active topology and to control the bridge relay function.
Tagged frame	A tagged frame is a frame that contains a tag header immediately following the Source MAC address field of the frame [...]. There are two types of tagged frames; VLAN-tagged frames and priority-tagged frames.
Tag header	A tag header allows user priority information, and optionally, VLAN identification information, to be associated with a frame.
Untagged frame	An untagged frame is a frame that does not contain a tag header immediately following the Source MAC Address field of the frame [...].
Virtual Bridged Local Area Network (LAN)	A Bridged LAN in which the existence of one or more VLAN-aware Bridges allows the definition, creation, and maintenance of VLANs.
Virtual Local Area Network (VLAN)	A subset of the active topology of a Bridged Local Area Network. Associated with each VLAN is a VLAN Identifier (VID).
VLAN-aware	A property of Bridges or end stations that recognize and support VLAN-tagged frames.
VLAN-tagged frame	A tagged frame whose tag header carries both VLAN identification and priority information.
VLAN-unaware	A property of Bridges or end stations that do not recognize VLAN-tagged frames.

Frame Types	
BPDU	Generically refers to all Spanning Tree BPDUs, regardless of version.
ST BPDU	Refers only to version 0 BPDUs (classic Spanning Tree IEEE Std 802.1D-1998).
RST BPDU	Refers only to version 2 BPDUs (Rapid Spanning Tree IEEE Std 802.1w-2001 and IEEE Std 802.1D-2004).
MST BPDU	Refers only to version 3 BPDUs (Multiple Spanning Tree IEEE Std 802.1Q-2005).

TEST ORGANIZATION

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

Test Label: The test label and title comprise the first line of the test block. The test label is the concatenation of the short test suite name, group number, and the test number within the group, separated by periods. The test number is the group number and the test number, also separated by a period. So, test label MSTP.op.1.2 refers to the second test of the first test group in the MSTP Operations suite. The Test number is 1.2.

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

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

Resource Requirements: The Resource Requirements section specifies the software, hardware, and test equipment that will be needed to perform the test. 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.

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

Test Layout: This diagram shows how the Test Systems, DUT, and any other Devices used should be connected for this test. Elements of the Procedure may change the Layout.

****Configurations are cleared at the end of each Test****

Procedure: This section of the test description contains the step-by-step instructions for carrying out the test. These steps include such things as enabling interfaces, disconnecting links between devices, and sending MAC frames from a Test Station. The test procedure also cues the tester to make observations, which are interpreted in accordance with the observable results given for that test part.

****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.

DEFAULT TEST VALUES

Unless otherwise specified, all tests in this group will use the following default values:

VLAN Settings:

All Test Stations should be members of VLANs 1, 2, 3 and 10

CIST Bridge Settings:

CIST Priority: **0x8000**

CIST Port Settings: (all ports unless otherwise noted)

CIST Port Priorities: **0x80**

CIST Port Path Costs: **0x00030D40**

MSTI Bridge Settings:

Configuration Identifier Format Selector: **0x00**

MST Configuration Name: **UNH-IOL:BFC** (no spaces)

Hex Value: **0x554E482D494F4C3A20424643000000000000000000 00000000000000000000**

MST Revision Level: **0x0000**

MST Max Hops: **20**

MST Instance Configuration		
MST ID	DUT Priority	Member VLANs
1 (0x001)	36864 (0x9000)	2-3
2 (0x002)	40960 (0xA000)	10

(All other VLANs must be assigned to the CIST or MSTI 0)

MST Configuration Digest: See table above

Hex Value: **0xDF54822EB6208025E35A8EB54A92872A**

Bridge Settings:

Max Age: **20 Seconds**

Hello Time: **2 Seconds (every port)**

Forward Delay: **15 Seconds**

Migrate Time: **3 seconds**

Force Protocol Version: **3**

MSTI Port Settings: (all ports and instances unless otherwise noted)

MSTI Port Priorities: **0x80**

MSTI Port Path Costs: **0x00030D40**

General Port Settings: (all ports unless otherwise noted)

OperEdge = **FALSE**

AdminEdge = **FALSE**

The DUT must be in the default test state at the start of each Test in this Group

Tests may be modified, if it is not possible to configure the device accordingly

GROUP 1: MST BPDU Format and Processing

Scope

This Group of tests examines the DUT's MST BPDU Frame Formats and Parameter Encoding behavior and MST BPDU validation procedure.

Overview

This Group tests the Frame Format of the following:

BPDU Types:

- MST BPDUs

BPDU Parameters:

- Protocol ID
- Protocol Version ID
- BPDU Type
- CIST Flags
- CIST Root ID
- CIST External Path Cost
- CIST Regional Root ID
- CIST Port ID
- Message Age
- Max Age
- Forward Delay
- Version One Length
- Version Three Length
- MST Configuration ID
- CIST Internal Root Path Cost
- CIST Bridge ID
- CIST Remaining Hops
- MSTI Configuration Messages

Validation of BPDUs based on the following criteria:

- Protocol ID
- Message Age

Test MSTP.op.1.1 – Basic MST BPDUs Verification

Purpose: To verify that the DUT properly processes basic MST BPDUs with valid field values, and transmits properly formatted MST BPDUs.

References:

- IEEE Std. 802.1D-2004: Table 17-1 – RSTP Timer and Transmit Hold Count parameter values
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 13.29 – Port Protocol Migration state machine
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDUs parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 14.6 - Encoding and decoding of STP Configuration, RST, and MST BPDUs
- IEEE Std. 802.1Q-2005: sub-clause -13.26.23 updtRolesTree()

Resource Requirements:

- 3 Test Stations

Discussion:

IEEE Std 802.1Q-2005 Figures 14-1 and 14-2, in addition to sub-clause 14.6, specify the proper format and encoding of MST BPDUs. To ensure cross-vendor interoperability an MST Bridge must accept and process MST BPDUs meeting the basic validation requirements of IEEE Std. 802.1Q-2005 sub-clause 14.4. An MST Bridge shall transmit MST BPDUs on any Port that has not received an ST BPDUs within 3 seconds (default Migrate Time value), as specified by the Port Protocol Migration state machine. The MST BPDUs are designed to be processed by RST Bridges, although containing additional information beyond RST BPDUs fields.

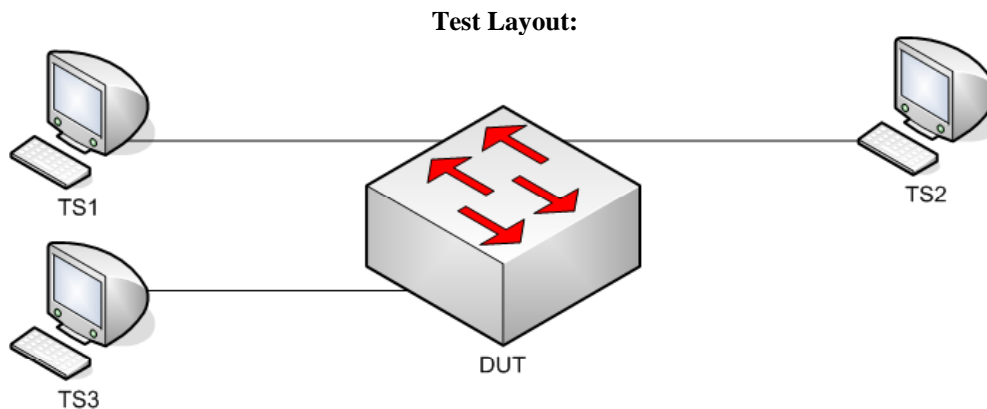


Figure 1.1 – Basic MST BPDUs Verification

Procedure:

Part A: Valid BPDU Transmission – Intra-Region BPDU

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.IntraMakeRootPort frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Start capture on TS1, TS2 and TS3.
5. Wait until TS2 and TS3 capture two MST BPDUs.
6. Stop capture on TS1, TS2 and TS3, and observe the captured frames.

Part B: Valid BPDU Transmission – Inter-Region BPDU

7. Ensure that the [Default Test Values](#) are configured on the DUT.
8. Continuously transmit, from TS1, MST.InterMakeRootPort frames at a rate of one every two seconds.
9. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
10. Start capture on TS1, TS2 and TS3.
11. Wait until TS2 and TS3 capture two MST BPDUs.
12. Stop capture on TS1, TS2 and TS3, and observe the captured frames.

Part C: Valid BPDU Transmission

13. Ensure that the [Default Test Values](#) are configured on the DUT.
14. Continuously transmit, from TS1, MST.WorseRootIDthanDUT frames at a rate of one every two seconds.
15. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
16. Start capture on TS1, TS2 and TS3.
17. Wait until TS1, TS2 and TS3 capture two MST BPDUs.
18. Stop capture on TS1, TS2 and TS3, and observe the captured frames.

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Observable results:

- In Part A, during Step 5, TS2 and TS3 must capture properly formatted MST BPDUs containing the following fields and values:

BPDU Field Name	Field Value
Protocol ID / Protocol Version ID	0x0000 / 0x03
BPDU Type	0x02
CIST Flags	Designated Port and Discarding (TS2) Designated Port and Forwarding (TS3)
CIST Root ID	CIST Root ID contained in MST.IntraMakeRootPort
CIST External Path Cost	CIST External Path Cost contained in MST.IntraMakeRootPort
CIST Regional Root ID	CIST Regional Root ID contained in MST.IntraMakeRootPort
CIST Port ID	DUT.TS2 and DUT.TS3's CIST Port ID, respectively
Message Age	Message Age contained in MST.IntraMakeRootPort
Max Age	Max Age contained in MST.IntraMakeRootPort
Hello Time	DUT.TS2 and DUT.TS3's Port Hello Time, respectively
Forward Delay	Forward Delay contained in MST.IntraMakeRootPort
Version 1 Length	0x00
CIST Internal Root Path Cost	Internal Root Path Cost contained in MST.IntraMakeRootPort + DUT.TS1's Port Path Cost
CIST Bridge ID	DUT's CIST Bridge ID
CIST Remaining Hops	Remaining Hops contained in MST.IntraMakeRootPort – 1
MSTI 1 Flags	Designated Port and Discarding (TS2) Designated Port and Forwarding (TS3)
MSTI 1 Regional Root Identifier	DUT's MSTIID 1 Bridge ID
MSTI 1 Internal Root Path Cost	0x00000000
MSTI 1 Bridge ID Priority	0x90
MSTI 1 Port ID Priority	0x80
MSTI 1 Remaining Hops	0x14
MSTI 2 Flags	Designated Port and Discarding (TS2) Designated Port and Forwarding (TS3)
MSTI 2 Regional Root Identifier	DUT's MSTIID 2 Bridge ID
MSTI 2 Internal Root Path Cost	0x00000000
MSTI 2 Bridge ID Priority	0xA0
MSTI 2 Port ID Priority	0x80
MSTI 2 Remaining Hops	0x14

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- In Part B, during Step 11, TS2 and TS3 must capture properly formatted MST BPDUs containing the following fields and values:

BPDU Field Name	Field Value
Protocol ID / Protocol Version ID	0x0000 / 0x03
BPDU Type	0x02
CIST Flags	Designated Port and Discarding (TS2) Designated Port and Forwarding (TS3)
CIST Root ID	CIST Root ID contained in MST.InterMakeRootPort
CIST External Path Cost	CIST External Path Cost contained in MST.InterMakeRootPort + DUT.TS1's Port Path Cost
CIST Regional Root ID	DUT's CIST Bridge ID
CIST Port ID	DUT.TS2 and DUT.TS3's CIST Port ID, respectively
Message Age	Message Age contained in MST.InterMakeRootPort + 1 second
Max Age	Max Age contained in MST.InterMakeRootPort
Hello Time	DUT.TS2 and DUT.TS3's Port Hello Time, respectively
Forward Delay	Forward Delay contained in MST.InterMakeRootPort
Version 1 Length	0x00
CIST Internal Root Path Cost	0x00000000
CIST Bridge ID	DUT's CIST Bridge ID
CIST Remaining Hops	0x14
MSTI 1 Flags	Designated Port and Discarding (TS2) Designated Port and Forwarding (TS3)
MSTI 1 Regional Root Identifier	DUT's MSTIID 1 Bridge ID
MSTI 1 Internal Root Path Cost	0x00000000
MSTI 1 Bridge ID Priority	0x90
MSTI 1 Port ID Priority	0x80
MSTI 1 Remaining Hops	0x14
MSTI 2 Flags	Designated Port and Discarding (TS2) Designated Port and Forwarding (TS3)
MSTI 2 Regional Root Identifier	DUT's MSTIID 2 Bridge ID
MSTI 2 Internal Root Path Cost	0x00000000
MSTI 2 Bridge ID Priority	0xA0
MSTI 2 Port ID Priority	0x80
MSTI 2 Remaining Hops	0x14

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- In Part C, during Step 17, TS1, TS2 and TS3 must capture properly formatted MST BPDUs containing the following fields and values:

BPDU Field Name	Field Value
Protocol ID / Protocol Version ID	0x0000 / 0x03
BPDU Type	0x02
CIST Flags	Designated Port and Discarding (TS2) Designated Port and Forwarding (TS3)
CIST Root ID	DUT's CIST Bridge ID
CIST External Path Cost	0x00000000
CIST Regional Root ID	DUT's CIST Bridge ID
CIST Port ID	DUT.TS2 and DUT.TS3's CIST Port ID, respectively
Message Age	0x0000
Max Age	DUT's Max Age
Hello Time	DUT.TS2 and DUT.TS3's Port Hello Time, respectively
Forward Delay	DUT's Forward Delay
Version 1 Length	0x00
CIST Internal Root Path Cost	0x00000000
CIST Bridge ID	DUT's CIST Bridge ID
CIST Remaining Hops	0x14
MSTI 1 Flags	Designated Port and Discarding (TS2) Designated Port and Forwarding (TS3)
MSTI 1 Regional Root Identifier	DUT's MSTIID 1 Bridge ID
MSTI 1 Internal Root Path Cost	0x00000000
MSTI 1 Bridge ID Priority	0x90
MSTI 1 Port ID Priority	0x80
MSTI 1 Remaining Hops	0x14
MSTI 2 Flags	Designated Port and Discarding (TS2) Designated Port and Forwarding (TS3)
MSTI 2 Regional Root Identifier	DUT's MSTIID 1 Bridge ID
MSTI 2 Internal Root Path Cost	0x00000000
MSTI 2 Bridge ID Priority	0xA0
MSTI 2 Port ID Priority	0x80
MSTI 2 Remaining Hops	0x14

- In Parts A, B and C, each port on the DUT must use a unique source MAC address.
- In Parts A, B and C, all BPDUs captured by TS1, TS2 and TS3 must be untagged.

Possible Problems:

- None.

Test MSTP.op.1.2 – Protocol ID Verification

Purpose: To verify that the DUT does not process MST BPDUs with a Protocol ID not equal to 0x0000.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 13.29 – Port Protocol Migration state machine
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 3 Test Stations

Discussion:

The Protocol ID is encoded in the first and second octets of an MST BPDU. A Protocol ID of 0x0000 identifies the frame as a BPDU. Frames containing a Protocol ID not equal to 0x0000 are not BPDUs and shall not be processed by an MST Bridge's MSTP entity.

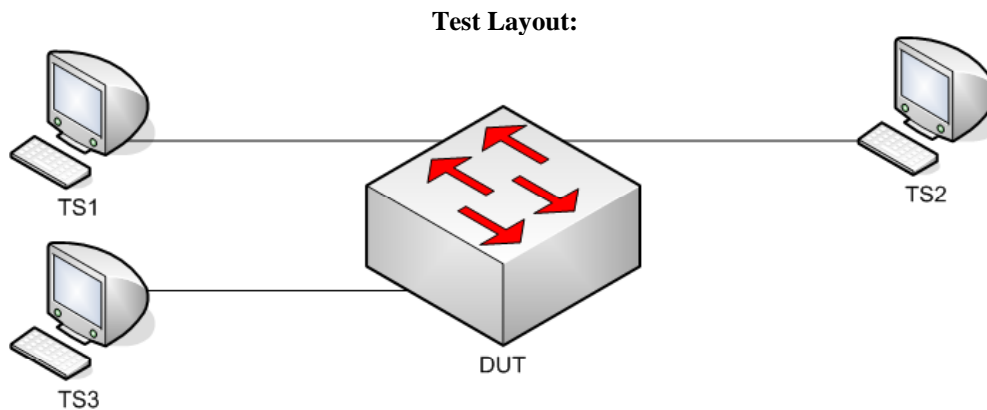


Figure 1.2 – Protocol ID Verification

Procedure:

Part A: Invalid Protocol ID

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.MakeRootPortBadProtoID1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Start capture on TS1, TS2 and TS3.
5. Wait until TS2 and TS3 capture 2 MST BPDUs.
6. Stop capture on TS1, TS2 and TS3, and observe the captured frames.
7. Repeat Steps 2 through 6, using MST.MakeRootPortBadProtoID2 in Step 2.
8. Repeat Steps 2 through 6, using MST.MakeRootPortBadProtoID3 in Step 2.

Observable results:

- In Part A, during Step 6, and the repetitions of Step 6, TS1, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to the DUT's CIST Bridge ID.

Possible Problems:

- None.

Test MSTP.op.1.3 – Protocol Version ID Verification

Purpose: To verify that the DUT processes MST BPDUs containing varying Protocol Version ID values.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 13.29 – Port Protocol Migration state machine
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 3 Test Stations

Discussion:

The Protocol Version ID is encoded in the third octet of an MST BPDUs. A compliant device must not validate an MST BPDUs based on the value encoded in the Protocol Version ID field. This allows future versions of the Spanning Tree Protocol to use this field while providing support for legacy versions.

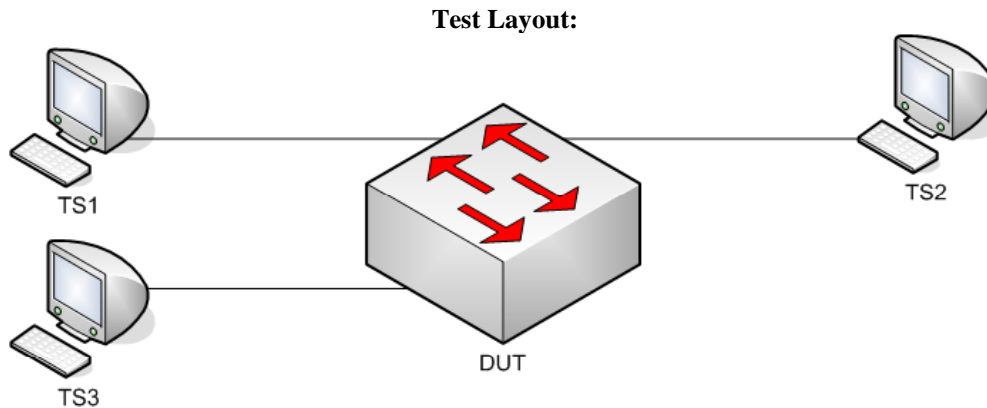


Figure 1.3 – Protocol Version ID Verification

Procedure:

Part A: Future Protocol Version ID

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.MakeRootPortProtoVerID1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Start capture on TS1, TS2 and TS3.
5. Wait until TS2 and TS3 capture 2 MST BPDUs.
6. Stop capture on TS1, TS2 and TS3, and observe the captured frames.
7. Repeat Steps 2 through 7, using MST.MakeRootPortProtoVerID2 in Step 2.
8. Repeat Steps 2 through 7, using MST.MakeRootPortProtoVerID3 in Step 2.

Observable results:

- In Part A, during Step 6, and the repetitions of Step 6, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.

Possible Problems:

- None.

Test MSTP.op.1.4 – BPDU Type Field Verification

Purpose: To verify that the DUT does not process MST BPDUs containing invalid BPDU Type values.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 13.29 – Port Protocol Migration state machine
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-21 – Topology Change state machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 3 Test Stations

Discussion:

Each version of STP defines one or more valid BPDU types, encoded in the fourth octet of transmitted BPDUs. For Protocol Version 0x03 of STP, the BPDU Type field is encoded with a value equal to 0x02. For Protocol Version 0x02, any other value in the BPDU Type field denotes an invalid BPDU Type and must not be processed.

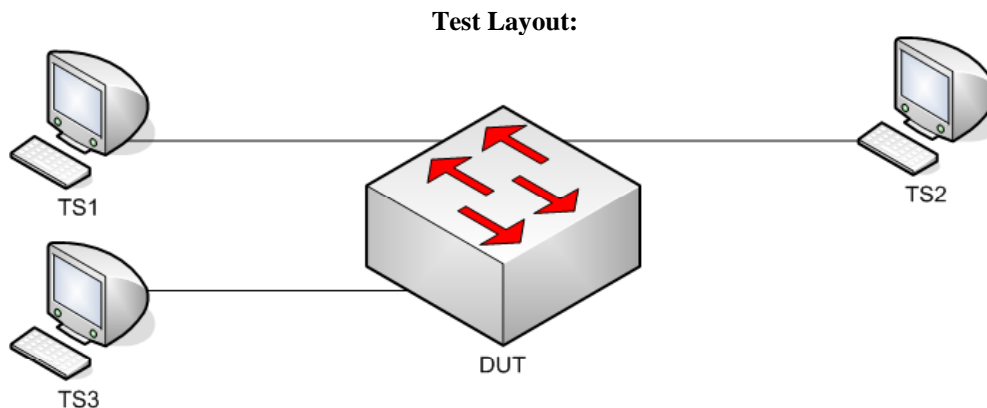


Figure 1.4 – BPDU Type Field Verification

Procedure:

Part A: Invalid BPDU Types –DUT CIST Root

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.MakeRootPortBadBPDUType1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Start capture on TS1, TS2 and TS3.
5. Wait until TS1, TS2 and TS3 capture 2 MST BPDUs.
6. Stop capture on TS1, TS2 and TS3, and observe the captured frames.
7. Repeat Steps 2 through 7, using MST.MakeRootPortBadBPDUType2 in Step 2.
8. Repeat Steps 2 through 7, using MST.MakeRootPortBadBPDUType3 in Step 2.

Observable results:

- In Part A, during Step 6, and the repetitions of Step 6, TS1, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to the DUT's CIST Bridge ID.

Possible Problems:

- None.

Test MSTP.op.1.5 – CIST Root/CIST Regional Root ID Field Verification

Purpose: To verify that the DUT processes MST BPDUs with varying CIST Root ID, CIST External Path Cost and CIST Regional Root Identifier field values.

References:

- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs

Resource Requirements:

- 4 Test Stations

Discussion:

The CIST Root ID contained in MST BPDUs transmitted by an MST Bridge is a result of the CIST Priority Vector Calculation process. If an MST Bridge has not received a BPDU from a Bridge within the Region it participates in containing a CIST Root ID better than the Bridge's CIST Bridge ID, then the Bridge considers itself the CIST Regional Root and will transmit MST BPDUs containing a CIST Regional Root ID equal to its own CIST Bridge ID, and ST BPDUs containing a Bridge ID equal to its own CIST Bridge ID. Otherwise, the Bridge will appoint the Port receiving the best CIST Internal Path Cost as the CIST Root Port and transmit BPDUs containing the CIST Root Port's *port priority vector* on all of its Designated Ports. If an MST Bridge that is the CIST Regional Root for the has not received a BPDU from outside the Region it participates in containing a CIST Root ID (MST BPDUs), or Root Bridge ID (ST BPDUs), better than the Bridge's CIST Bridge ID, then it will consider itself the CIST Root Bridge and will transmit MST BPDUs containing a CIST Root ID equal its own CIST Bridge ID, and ST BPDUs containing a Root Bridge ID equal to its own CIST Bridge ID. Otherwise, the Bridge will appoint the Port receiving the best CIST Root ID as the CIST Root Port and transmit BPDUs containing the CIST Root Port's *port priority vector* on all of its Designated Ports.

The Bridge ID or Root Bridge ID, or CIST Root ID, is the concatenation of a 2-byte Bridge Priority and a 6-byte Bridge MAC address. MST Bridges allow Bridge Priority value configuration of only the four most significant bits, thereby supporting a range of Bridge Priority values from 0 to 61440, in increments of 4096. However, IEEE Std 802.1D-1998 ST Bridges allow Bridge Priority value configuration to any value between 0 and 65535. Therefore, MST Bridges must support processing a full range of Bridge Priority values.

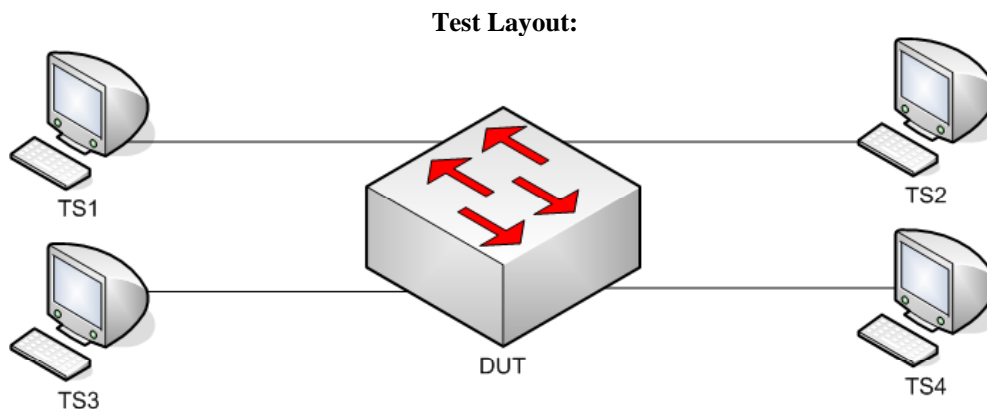


Figure 1.5 – CIST Root/CIST Regional Root ID Field Verification

Procedure:

Part A: MST BPDU CIST Root ID Verification – Priority Portion – Intra-Region BPDU

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.IntraRootID0000_000000000000 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, MST.IntraRootID0001_000000000000 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2, TS3 and TS4 capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7 using MST.IntraRootID7776_777777777777 and MST.IntraRootID7777_777777777777 in Steps 2 and 4, respectively.

Part B: MST BPDU CIST Root ID Verification – MAC Address Portion – Intra-Region BPDU

9. Ensure that the [Default Test Values](#) are configured on the DUT.
10. Continuously transmit, from TS1, MST.IntraRootID0000_000000000000 frames at a rate of one every two seconds.
11. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
12. Continuously transmit, from TS3, MST.IntraRootID0000_000000000001 frames at a rate of one every two seconds.
13. Start capture on TS1, TS2, TS3 and TS4.
14. Wait until TS2, TS3 and TS4 capture 2 MST BPDUs.
15. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
16. Repeat Steps 10 through 15 using MST.IntraRootID7777_777777777776 and MST.IntraRootID7777_777777777777 in Steps 10 and 12, respectively.

Part C: MST BPDU CIST Root ID Verification – Priority Portion – Inter-Region BPDU

17. Ensure that the [Default Test Values](#) are configured on the DUT.
18. Continuously transmit, from TS1, MST.InterRootID0000_000000000000 frames at a rate of one every two seconds.
19. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
20. Continuously transmit, from TS3, MST.InterRootID0001_000000000000 frames at a rate of one every two seconds.
21. Start capture on TS1, TS2, TS3 and TS4.
22. Wait until TS2, TS3 and TS4 capture 2 MST BPDUs.
23. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
24. Repeat Steps 18 through 23 using MST.InterRootID7776_777777777777 and MST.InterRootID7777_777777777777 in Steps 18 and 20, respectively.

Part D: MST BPDU CIST Root ID Verification – MAC Address Portion – Inter-Region BPDU

25. Ensure that the [Default Test Values](#) are configured on the DUT.
26. Continuously transmit, from TS1, MST.InterRootID0000_000000000000 frames at a rate of one every two seconds.
27. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
28. Continuously transmit, from TS3, MST.InterRootID0000_000000000001 frames at a rate of one every two seconds.
29. Start capture on TS1, TS2, TS3 and TS4.
30. Wait until TS2, TS3 and TS4 capture 2 MST BPDUs.
31. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
32. Repeat Steps 26 through 31 using MST.InterRootID7777_777777777776 and MST.InterRootID7777_777777777777 in Steps 26 and 28, respectively.

Observable results:

- In Parts A, B, C and D TS2, TS3 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.

Possible Problems:

- None.

Test MSTP.op.1.6 – Root Path Cost Field Verification

Purpose: To verify that the DUT processes MST BPDUs with varying Root Path Cost field values.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 13.29 – Port Protocol Migration state machine
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-21 – Topology Change state machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format
- IEEE Std. 802.1Q-2005: Table 13-3 – Internal Port Path Costs

Resource Requirements:

- 4 Test Stations

Discussion:

The External Root Path Cost for an MST Bridge is the cost of the CIST network path from the Root Port of the MST Regional Root Bridge to the CIST Root Bridge. The External Root Path Cost is not modified within an MST Region; therefore, the CIST External Path Cost value on all MST Bridges within an MST Region is equal. The CIST External Path Cost value is transmitted in BPDUs and may be used to determine the active topology. An MST Bridge encodes the CIST External Path Cost in the Root Path Cost field of ST BPDUs and the CIST External Path Cost field of MST BPDUs. The CIST External Path Cost for the CIST Root Bridge is zero. The CIST External Path Cost for all other Bridges is the sum of the *ExtRootPathCost* portion of the Root Port's *port priority* vector and Path Cost parameter value configured on the CIST Root Port.

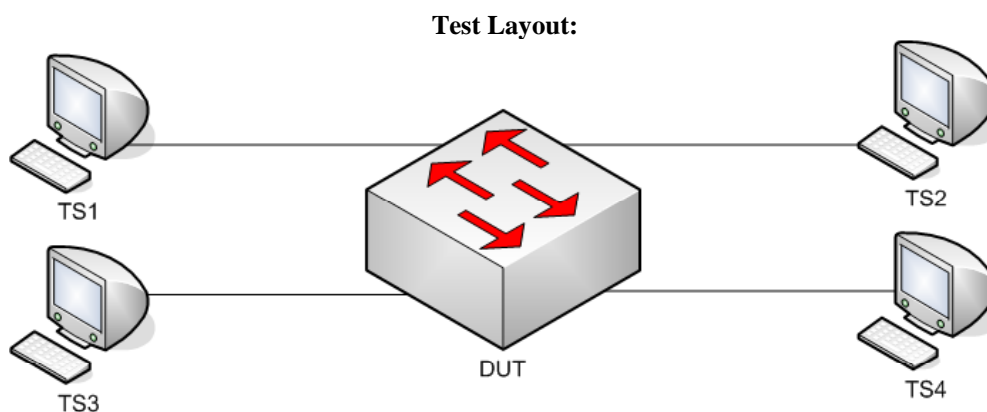


Figure 1.6 – Root Path Cost Field Verification

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Procedure:

Part A: Root Path Cost – Intra-Region BPDU – MST sourced

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.IntraCISTRootPath00000000 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, MST.IntraCISTRootPath00000001 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2, TS3 and TS4 capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Part B: Root Path Cost equal to 0x00000000 – Inter-Region BPDU – MST sourced

8. Ensure that the [Default Test Values](#) are configured on the DUT.
9. Continuously transmit, from TS1, MST.InterCISTRootPath00000000 frames at a rate of one every two seconds.
10. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
11. Continuously transmit, from TS3, MST.InterCISTRootPath00000001 frames at a rate of one every two seconds.
12. Start capture on TS1, TS2, TS3 and TS4.
13. Wait until TS2, TS3 and TS4 capture 2 MST BPDUs.
14. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Part C: Root Path Cost equal to 0xFFFFFFFF – Inter-Region BPDU – MST sourced – Informational

15. Ensure that the [Default Test Values](#) are configured on the DUT.
16. Continuously transmit, from TS1, MST.InterCISTRootPathFFFFFFFFFE frames at a rate of one every two seconds.
17. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
18. Continuously transmit, from TS3, MST.InterCISTRootPathFFFFFFFFF frames at a rate of one every two seconds.
19. Start capture on TS1, TS2, TS3 and TS4.
20. Wait until TS2 and TS4 capture 2 MST BPDUs.
21. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Part D: Configuration of invalid Port Path Cost values

22. Ensure that the [Default Test Values](#) are configured on the DUT.
23. Attempt to configure DUT.TS1's CIST Path Cost to 0xBEBC201 (200,000,001).
24. Attempt to configure DUT.TS1's CIST Path Cost to 0xFFFFFFFF (4,294,967,295).

Observable results:

- In Part A, during step 7, TS2, TS3 and TS4 must capture properly formatted MST BPDUs with CIST Root ID and a External Root Path Cost equal to that in frames transmitted by TS1.
- In Part B, during step 14, TS2 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part B, during step 14, TS2 and TS4 must capture properly formatted MST BPDUs with an External Root Path Cost equal to that in frames transmitted by TS1 frame plus DUT.TS1's Port Path Cost.
- In Part B, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Part C, during step 21, record the behavior of the DUT with respect to External Root Path Cost.
- In Part D, during step 23 and 24, the DUT must not allow any of the attempted configurations.

Possible Problems:

- None.

Test MSTP.op.1.7 – Bridge ID Field Verification

Purpose: To verify that the DUT processes MST BPDUs with varying CIST Bridge ID field values and properly determines the CIST Root Port based on Bridge ID.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 13.29 – Port Protocol Migration state machine
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-21 – Topology Change state machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDUs parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

MST BPDUs contain a CIST Bridge ID field consisting of the concatenation of a 2-byte Bridge Priority and a 6-byte Bridge MAC address. RST and MST Bridges allow Bridge Priority value configuration of only the four most significant bits, thereby supporting a range of Bridge Priority values from 0 to 61440, in increments of 4096. However, IEEE Std 802.1D-1998 ST Bridges support Bridge Priority value configuration of any value between 0 and 65535. Therefore, MST Bridges must support processing of a full range of Bridge Priority values. The 6-byte Bridge MAC address component of the CIST Bridge ID ensures that the Bridge will be distinguished from all other Bridges on the LAN. Generally, the Bridge MAC address is the MAC address of the Bridge STP entity, and is different than the MAC address(es) of the Bridge Port(s). The CIST Bridge ID contained in an MST BPDU is always equal to the CIST Bridge ID of the transmitting Bridge.

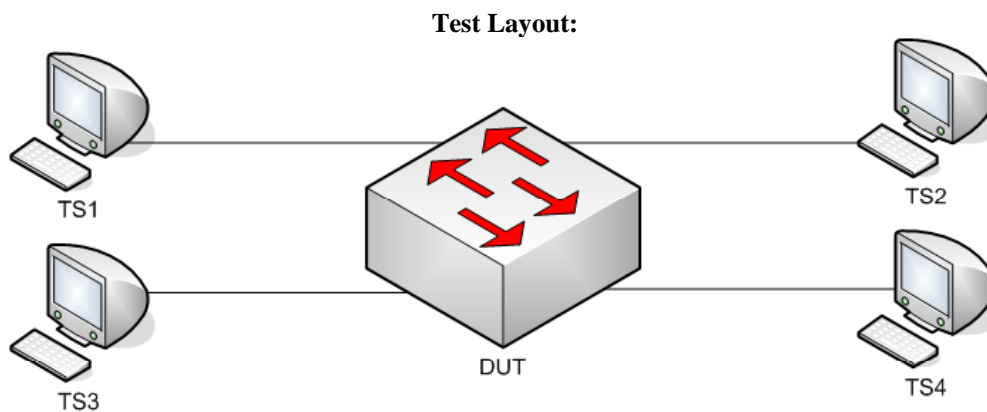


Figure 1.7 – Bridge ID Field Verification

Procedure:

Part A: Priority portion of the Bridge ID – Intra-Region BPDU

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.IntraCISTBridgeID7776_7777777777 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, MST.IntraCISTBridgeID7777_7777777777 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2, TS3 and TS4 capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using MST.IntraCISTBridgeIDFFFFE_FFFFFFFF and MST.IntraCISTBridgeIDFFFF_FFFFFFFF in Steps 2 and 4, respectively.

Part B: MAC Address portion of the Bridge ID – Intra-Region BPDU

9. Ensure that the [Default Test Values](#) are configured on the DUT.
10. Continuously transmit, from TS1, MST.IntraCISTBridgeID7777_7777777776 frames at a rate of one every two seconds.
11. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
12. Continuously transmit, from TS3, MST.IntraCISTBridgeID7777_7777777777 frames at a rate of one every two seconds.
13. Start capture on TS1, TS2, TS3 and TS4.
14. Wait until TS2, TS3 and TS4 capture 2 MST BPDUs.
15. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames (if any).
16. Repeat Steps 10 through 15, using MST.IntraCISTBridgeIDFFFF_FFFFFFFF and MST.IntraCISTBridgeIDFFFF_FFFFFFFF in Steps 10 and 12, respectively.

Part C: Priority portion of the Bridge ID – Inter-Region BPDU

17. Ensure that the [Default Test Values](#) are configured on the DUT.
18. Continuously transmit, from TS1, MST.InterCISTBridgeID7776_7777777777 frames at a rate of one every two seconds.
19. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
20. Continuously transmit, from TS3, MST.InterCISTBridgeID7777_7777777777 frames at a rate of one every two seconds.
21. Start capture on TS1, TS2, TS3 and TS4.
22. Wait until TS2, TS3 and TS4 capture 2 MST BPDUs.
23. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames (if any).
24. Repeat Steps 18 through 23, using MST.InterCISTBridgeIDFFFFE_FFFFFFFF and MST.InterCISTBridgeIDFFFF_FFFFFFFF in Steps 18 and 20, respectively.

Part D: MAC Address portion of the Bridge ID – Inter-Region BPDU

25. Ensure that the [Default Test Values](#) are configured on the DUT.
26. Continuously transmit, from TS1, MST.InterCISTBridgeID_7777_7777777776 frames at a rate of one every two seconds.
27. Continuously transmit, from TS3, MST.InterCISTBridgeID_7777_7777777777 frames at a rate of one every two seconds.
28. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
29. Start capture on TS1, TS2, TS3 and TS4.
30. Wait until TS2, TS3 and TS4 capture 2 MST BPDUs.
31. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames (if any).
32. Repeat Steps 26 through 31, using MST.InterCISTBridgeID_FFFF_FFFFFFFF and MST.InterCISTBridgeID_FFFF_FFFFFFFF in Steps 26 and 28, respectively.

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Part E: Configuration of valid CIST Bridge Priority values

33. Ensure that the [Default Test Values](#) are configured on the DUT.
34. Configure DUT's CIST Bridge Priority to 0xF000.
35. Start capture on TS1, TS2, TS3 and TS4.
36. Wait until TS1, TS2 and TS3 capture 2 ST, MST and MST BPDUs, respectively.
37. Stop capture on TS1, TS2 and TS3, and observe the captured frames.
38. Configure DUT's CIST Bridge Priority to 0xA000.
39. Repeat Steps 35 through 37.
40. Configure DUT's CIST Bridge Priority to 0x6000.
41. Repeat Steps 35 through 37.
42. Configure DUT's CIST Bridge Priority to 0x3000.
43. Repeat Steps 35 through 37.
44. Configure DUT's CIST Bridge Priority to 0x0000.
45. Repeat Steps 35 through 37.

Part F: Configuration of invalid CIST Bridge Priority values

46. Ensure that the [Default Test Values](#) are configured on the DUT.
47. Configure DUT's CIST Bridge Priority to 0x0001.
48. Start capture on TS1, TS2 and TS3.
49. Wait until TS1, TS2 and TS3 capture 2 ST, MST and MST BPDUs, respectively.
50. Stop capture on TS1, TS2 and TS3, and observe the captured frames.
51. Configure DUT's CIST Bridge Priority to 0x7999.
52. Repeat Steps 48 through 50.
53. Configure DUT's CIST Bridge Priority to 0x8100.
54. Repeat Steps 48 through 50.
55. Configure DUT's CIST Bridge Priority to 0xFFFF.
56. Repeat Steps 48 through 50.

Observable results:

- In Parts A and B TS2, TS3 and TS4 must capture properly formatted MST BPDUs with CIST Regional Root ID equal to that in frames transmitted by TS1.
- In Parts C and D TS2 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Parts C and D, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Part E, TS1, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to the DUT's configured CIST Bridge ID, in steps 34,38,40,42 and 44.
- In Part F, the DUT must not allow any of the attempted configurations in steps 47,51,53 and 55.

Possible Problems:

- None.

Test MSTP.op.1.8 – Port ID Field Verification

Purpose: To verify that the DUT processes MST BPDUs with varying Port ID field values, and to examine the DUT's Port ID configuration mechanism.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format
- IEEE Std. 802.1t-2001: sub-clause 14.3 - Data Types
- IEEE Std. 802.1D-2004: sub-clause 14.3 – Data Types
- IEEE Std. 802.1Q-2005: sub-clause 12.3 – Data Types

Resource Requirements:

- 4 Test Stations

Discussion:

xST Bridge Version:	802.1D-1998	802.1t-2001	802.1D-2004	802.1Q-2005
Required Port Number Range:	1 – 255	1 – 4095	1 – 4095	1 – 4095
Required Port Priority Range:	0 – 255	0 – 240*	0 – 240*	0 – 240*

* = Increments of 16 (IEEE 802.1t-2001 updated IEEE 802.1D-1998)

Table 1.1 – xSTP Port ID Support

IEEE 802.1D-1998 ST BPDUs contain a Port ID field consisting of the concatenation of an 8-bit Port Priority value and an 8-bit Port Number value. IEEE 802.1t-2001 ST BPDUs, RST BPDUs and MST BPDUs contain a Port ID field consisting of the concatenation of the four most significant bits of the Port Priority value and a 12-bit Port Number value.

The CIST Port ID distinguishes the Port from all other Ports on the Bridge and allows the network administrator one additional method to administratively control selection of the Root and Root Port. The CIST Port ID may be used as a tiebreaker when two Bridges are directly connected with more than one link, and when a Bridge is directly connected to itself. The CIST Port ID contained in a BPDU is always that of the Port from which it was transmitted.

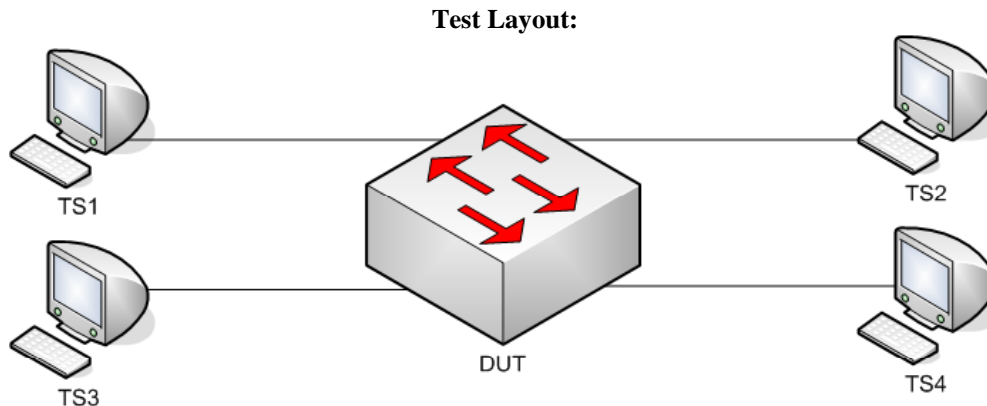


Figure 1.8 – Port ID Field Verification

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Procedure:

Part A: Various CIST Port ID values

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.PortID0000 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, MST.PortID0001 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS4 capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using MST.PortID0100 and MST.IntraPortID0101 in Steps 2 and 4, respectively.
9. Repeat Steps 2 through 7, using MST.PortIDF000 and MST.IntraPortIDF001 in Steps 2 and 4, respectively.
10. Repeat Steps 2 through 7, using MST.PortIDFFFE and MST.IntraPortIDFFFF in Steps 2 and 4, respectively.

Part B: Configuration of valid Port Priority values

11. Ensure that the [Default Test Values](#) are configured on the DUT.
12. Configure DUT.TS1's, DUT.TS2's and DUT.TS3's CIST Port Priority to 0x00, 0x20, and 0x50, respectively.
13. Start capture on TS1, TS2 and TS3.
14. Wait until TS1, TS2 and TS3 each capture 2 MST BPDUs.
15. Stop capture on TS1, TS2 and TS3, and observe the captured frames.
16. Repeat Steps 12 through 15, using a CIST Port Priority values equal to 0x60, 0x70 and 0x90, in Step 12.
17. Repeat Steps 12 through 15, CIST using a Port Priority value equal to 0xA0, 0xD0 and 0xF0 in Step 12.

Part C: Configuration of invalid Port Priority values

18. Ensure that the [Default Test Values](#) are configured on the DUT.
19. Configure DUT.TS1's, DUT.TS2's and DUT.TS3's CIST Port Priority to 0x01, 0x23 and 0x55, respectively.
20. Start capture on TS1, TS2 and TS3.
21. Wait until TS1, TS2 and TS3 each capture 2 MST BPDUs.
22. Stop capture on TS1, TS2 and TS3, and observe the captured frames.
23. Repeat Steps 19 through 22, using a Port Priority value equal to 0x68, 0x89 and 0x98, in Step 19.
24. Repeat Steps 19 through 22, using a Port Priority value equal to 0xAA, 0xDC and 0xFF, in Step 19.

Observable results:

- In Part A, during step 7, and repetitions of step 7, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Part A, during step 7, and repetitions of step 7, TS2 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part B, during step 12, and repetitions of step 12, the DUT must allow all of the attempted configurations.
- In Part B, during step 15, and repetitions of step 15, TS1, TS2 and TS3 must capture properly formatted MST BPDUs with Port ID equal to the Port ID configured on each Port in Steps 12, 16 and 17.
- In Part C, during step 19, and repetitions of step 19, the DUT must not allow any of the attempted configurations.
- In Part C, during step 22, and repetitions of step 22, TS1, TS2 and TS3 must capture properly formatted MST BPDUs with Port ID equal to the Port ID configured on each Port in Step 18.

Possible Problems:

- None.

Test MSTP.op.1.9 – Message Age Field Verification

Purpose: To verify that the DUT only processes MST BPDUs containing a Message Age less than the Max Age, and that the Message Age is incremented properly in MST BPDUs transmitted by the DUT (when it is not the Root).

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.22 – updtRcvdInfoWhile()
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDUs parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

xST Bridge Version:	802.1D-1998	802.1t-2001	802.1D-2004	802.1Q-2005
Message Age Increment Range:	1 – 4	1 – 4	1	1
Recommended Message Age Increment:	1	1	1	1

Table 1.2 – xSTP Message Age Range

The Message Age field represents a decimal number of seconds encoded in hex. The first byte of the Message Age field represents integer seconds in the range 0 to 255. The Message Age field marks the age of the CIST information contained in an MST BPDUs relative to the information’s origination at the CIST Root Bridge. When a Port receives an MST BPDUs containing better information than that which is currently held for the Port, the information is recorded, and the Port’s Message Age Timer is set to the Message Age contained in the received MST BPDUs. The Message Age Timer is started – it will increment at regular intervals until new or same information is received or Message Age Timer Expiry occurs.

When an MST Bridge is the CIST Root, it transmits MST BPDUs containing a Message Age of zero. MST Bridges that are the CIST Regional Root transmit MST BPDUs containing a Message Age value equal to the current value of the Message Age Timer for the CIST Root Port of the MST Region it participates in incremented by 1. MST Bridges that are not the CIST Regional Root transmit MST BPDUs containing a Message Age value equal to the Message Age Timer of the Bridge’s CIST Root Port. MST BPDUs containing a Message Age that is greater than or equal to their Max Age are immediately aged by the updtRcvdInfoWhile() procedure.

$2 \times (\text{Bridge_Forward_Delay} - 1.0 \text{ seconds}) \geq \text{Bridge_Max_Age} \geq 2 \times (\text{Bridge_Hello_Time} + 1.0 \text{ seconds})$

Test Layout:

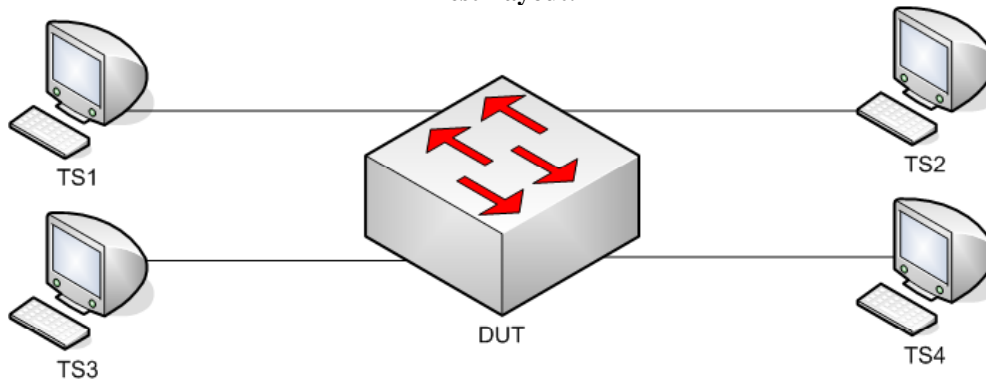


Figure 1.9 – Message Age Field Verification

Procedure:

Part A: Various Message Age Values – Intra-Region BPDU

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.IntraMessageAge_0000 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, MST.IntraMessageAge_0001 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS4 capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using MST.IntraMessageAge_1200 and MST.IntraMessageAge_1201 in Steps 2 and 4, respectively.

Part B: Valid Message Age Value near DUT's Max Age – Intra-Region BPDU

9. Ensure that the [Default Test Values](#) are configured on the DUT.
10. Continuously transmit, from TS1, MST.IntraMessageAge_1300 frames at a rate of one every two seconds.
11. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
12. Continuously transmit, from TS3, MST.IntraMessageAge_1301 frames at a rate of one every two seconds.
13. Start capture on TS1, TS2, TS3 and TS4.
14. Wait until TS2 and TS4 capture 2 MST BPDUs.
15. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Part C: Valid Message Age Value > DUT's Max Age – Inter-Region BPDU

16. Ensure that the [Default Test Values](#) are configured on the DUT.
17. Continuously transmit, from TS1, MST.InterMessageAge_2000 frames at a rate of one every two seconds.
18. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
19. Continuously transmit, from TS3, MST.InterMessageAge_2001 frames at a rate of one every two seconds.
20. Start capture on TS1, TS2, TS3 and TS4.
21. Wait until TS2, TS3 and TS4 capture 2 MST BPDUs.
22. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
23. Repeat Steps 17 through 22, using MST.InterMessageAge_FFFE and MST.InterMessageAge_FFFF in Steps 17 and 19, respectively.

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Part D: BPDU Containing Message Age Value == BPDU's Max Age Value – Intra-Region BPDU

24. Ensure that the [Default Test Values](#) are configured on the DUT.
25. Continuously transmit, from TS1, MST.IntraMessageAge_1400 frames at a rate of one every two seconds.
26. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
27. Start capture on TS1, TS2, and TS3.
28. Wait until TS2, and TS3 capture 2 MST BPDUs.
29. Stop capture on TS1, TS2, and TS3, and observe the captured frames.

Observable results:

- In Part A, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Part A, during step 7 and the repetitions of step 7, TS2 and TS4 must capture properly formatted MST BPDUs with Message Age equal to that in frames transmitted by TS1.
- In Part B, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Part B, during step 15 and the repetitions of step 15, TS2 and TS4 must capture properly formatted MST BPDUs with Message Age equal to that in frames transmitted by TS1.
- In Part C, during step 22 and the repetitions of step 22, TS1, TS2, TS3 and TS4 must capture properly formatted MST BPDUs with Message Age equal to 0x0000.
- In Part C, during step 22 and the repetitions of step 22, TS1, TS2, TS3 and TS4 must capture properly formatted MST BPDUs with a CIST Root ID equal to the DUT's CIST Bridge ID.
- In Part D, during step 29, TS2 and TS3 must capture properly formatted MST BPDUs with Message Age equal to 0x1400 and Remaining Hops equal to 0x13.
- In Part D, during step 29, TS2 and TS3 must capture properly formatted MST BPDUs with a CIST Root ID equal to that in frames transmitted by TS1.

Possible Problems:

- None.

Test MSTP.op.1.10 – Max Age Field Verification

Purpose: To verify that the DUT only accepts MST BPDUs containing a valid Max Age value greater than the Message Age value, and that the Max Age value is properly encoded in MST BPDUs transmitted by the DUT.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine

Resource Requirements:

- 4 Test Stations

Discussion:

xST Bridge Version:	802.1D-1998	802.1t-2001	802.1D-2004	802.1Q-2005
Max Age Value Range:	6 – 40	6 – 40	6 – 40	6 – 40
Recommended Max Age Value:	20	20	20	20

Table 1.3 – xSTP Max Age Range

The Max Age field represents a decimal number of seconds encoded in hex. The first byte of the Max Age field represents integer seconds in the range 0 to 255; the second byte represents the decimal value in seconds in the range 0 to 255/256 in increments of 1/256.

The Max Age field provides all xST Bridges in a LAN a value with which to determine if received information is valid or too old. The age of information contained in an xST BPDU is increased at each hop from the information’s origination at the Root Bridge. Information that transverse more hops than desired by the network administrator will be considered old, as the xST BPDU will contain a Message Age value greater than, or equal to, the Max Age value.

When an MST Bridge is the Root, it transmits xST BPDUs containing a Message Age value equal to zero and a Max Age value equal to the Bridge’s configured Max Age value. Non-Root MST Bridges transmit xST BPDUs containing a Message Age value equal to the current value of the Message Age Timer for the CIST Root Port on the MST Region incremented by a value greater than zero plus any transmission delay, but less than the maximum allowed Message Age Increment Overestimate, and a Max Age value equal to the Max Age value received in xST BPDUs on the Bridge’s Root Port. xST BPDUs containing a Message Age that is greater than or equal to their Max Age are immediately aged by the updRcvdInfoWhileCist() procedure.

$2 \times (\text{Bridge_Forward_Delay} - 1.0 \text{ seconds}) \geq \text{Bridge_Max_Age} \geq 2 \times (\text{Bridge_Hello_Time} + 1.0 \text{ seconds})$

Test Layout:

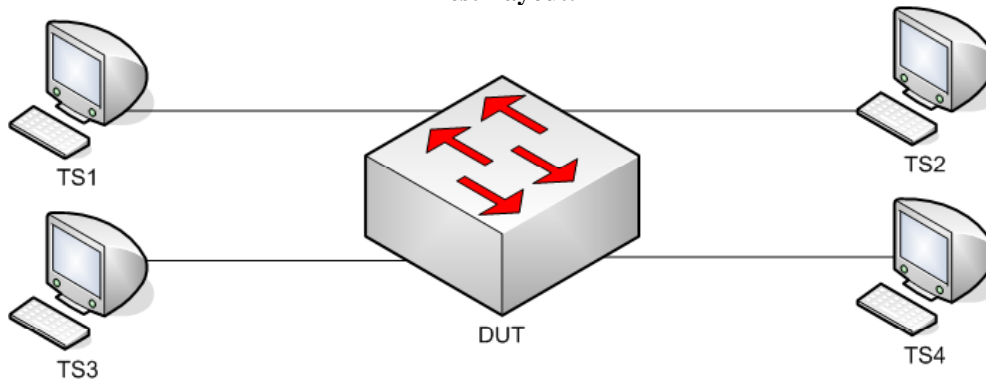


Figure 1.10 – Max Age Field Verification

Procedure:

Part A: MST BPDU Containing Valid Max Age Value

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.MaxAge_0600 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, MST.MaxAge_0601 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS4 capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using MST.MaxAge_06FF and MST.MaxAge_0700 in Steps 2 and 4, respectively.
9. Repeat Steps 2 through 7, using MST.MaxAge_2800 and MST.MaxAge_2801 in Steps 2 and 4, respectively.

Part B: MST BPDU Containing Invalid Max Age Value

10. Ensure that the [Default Test Values](#) are configured on the DUT.
11. Continuously transmit, from TS1, MST.MaxAge_0500 frames at a rate of one every two seconds.
12. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
13. Continuously transmit, from TS3, MST.MaxAge_0501 frames at a rate of one every two seconds.
14. Start capture on TS1, TS2, TS3 and TS4.
15. Wait until TS2 and TS4 capture 2 MST BPDUs.
16. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
17. Repeat Steps 11 through 15, using MST.MaxAge_FFFE and MST.MaxAge_FFFF in Steps 11 and 13, respectively.

Observable results:

- In Part A, during step 7 and the repetitions of step 7, TS2 and TS4 must capture properly formatted MST BPDUs with Max Age equal to that in frames transmitted by TS1.
- In Parts A and B, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Part B, during step 16 and the repetitions of step 16, TS2 and TS4 must capture properly formatted MST BPDUs with Max Age equal to that in frames transmitted by TS1.

Possible Problems:

- The DUT may ignore the least two significant bits of the Max Age field, and/or set them to zero on transmission. If this is the case, the packets must be adjusted accordingly.

Test MSTP.op.1.11 – Hello Time Field Verification

Purpose: To verify that the DUT properly processes MST BPDUs containing various Hello Time values, and does not propagate the Hello Time contained in received BPDUs.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine

Resource Requirements:

- 4 Test Stations

Discussion:

xST Bridge Version:	802.1D-1998	802.1t-2001	802.1D-2004	802.1Q-2005
Hello Time Value Range:	1 – 10	1 – 10	1 – 2	1 – 2
Recommended Hello Time Value:	2	2	2	2

Table 1.4 – xSTP Hello Time Range

The Hello Time field conveyed in xST BPDUs is not directly used by the Spanning Tree Algorithm of ST Bridges, but is conveyed to facilitate the monitoring of protocol performance by management functions. The Spanning Tree Algorithm does not use the Hello Time value during xST Bridge algorithm state operations; rather the Hello Time value is used to determine the period of BPDU transmission. MST Bridges use the Hello Time value within the Port Transmit State Machine to determine when to transmit ST, TCN and MST BPDUs.

An MST Bridge may maintain a per-port Hello Time value for each Port on the Bridge. The per-port Hello Time value is used by the MST Bridge to determine the period of BPDU transmission on each Port and is conveyed in BPDUs transmitted by the Port. The per-port Hello Time value is configured via management, not via information in received BPDUs.

$2 \times (\text{Bridge_Forward_Delay} - 1.0 \text{ seconds}) \geq \text{Bridge_Max_Age} \geq 2 \times (\text{Bridge_Hello_Time} + 1.0 \text{ seconds})$

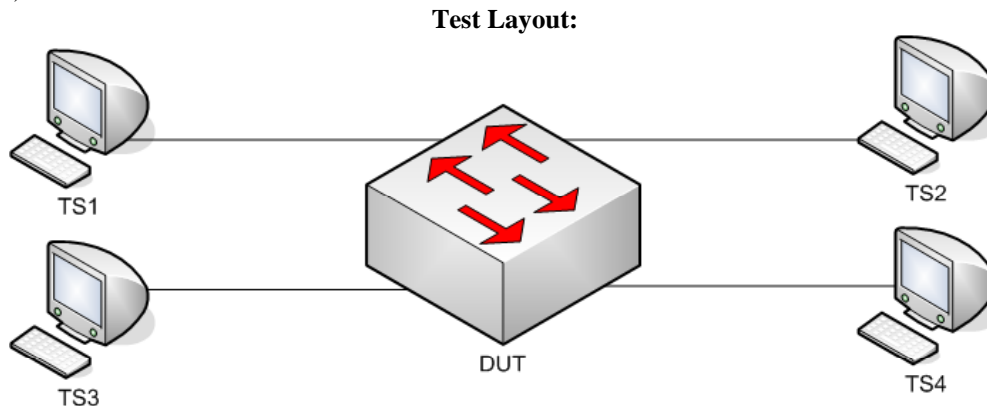


Figure 1.11 – Hello Time Field Verification

Procedure:

Part A: MST BPDU Containing Various Hello Time Values

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.Hello_0100 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, MST.Hello_0101 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS4 capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames .
8. Repeat Steps 2 through 7, using MST.Hello_0A00 and MST.Hello_0A01 in Steps 2 and 4, respectively.
9. Repeat Steps 2 through 7, using MST.Hello_0F00 and MST.Hello_0F01 in Steps 2 and 4, respectively.

Part B: Hello Time of 0x0000

10. Ensure that the [Default Test Values](#) are configured on the DUT.
11. Continuously transmit, from TS1, MST.Hello_0000 frames at a rate of one every two seconds.
12. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
13. Continuously transmit, from TS3, MST.Hello_0001 frames at a rate of one every two seconds.
14. Start capture on TS1, TS2, TS3 and TS4.
15. Wait until TS2 and TS4 capture 2 MST BPDUs.
16. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames .

Observable results:

- In Parts A and B, the DUT must set DUT.TS3's Port State to Alternate Port, and Port State to Discarding State.
- In Parts A and B, TS2 and TS4 must capture properly formatted MST BPDUs at a rate of one every two seconds, with Hello Time equal to the Port Hello Time configured on DUT.TS2 and DUT.TS4 respectively.

Possible Problems:

- None

Test MSTP.op.1.12 – Forward Delay Field Verification

Purpose: To verify that the DUT properly processes MST BPDUs containing various Forward Delay values and propagates the Forward Delay contained in received BPDUs.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine

Resource Requirements:

- 4 Test Stations

Discussion:

xST Bridge Version:	802.1D-1998	802.1t-2001	802.1D-2004	802.1Q-2005
Forward Delay Value Range:	4 – 30	4 – 30	4 – 30	4 – 30
Recommend Forward Delay Value:	15	15	15	15

Table 1.5 – xSTP Forward Delay Range

The Forward Delay is a Bridge-wide parameter that is conveyed in ST, RST and MST BPDUs to ensure that all Bridges in a Bridged LAN uses a consistent value for the Forward Delay Timer.

$2 \times (\text{Bridge_Forward_Delay} - 1.0 \text{ seconds}) \geq \text{Bridge_Max_Age} \geq 2 \times (\text{Bridge_Hello_Time} + 1.0 \text{ seconds})$

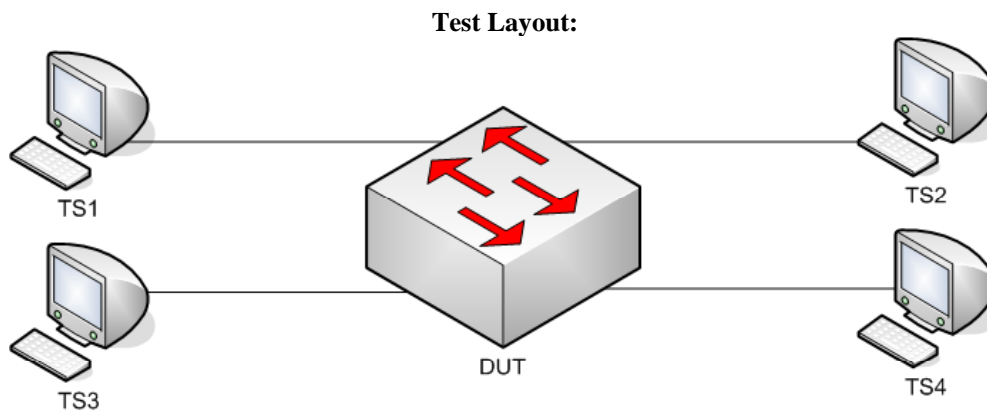


Figure 1.12 – Forward Delay Field Verification

Procedure:

Part A: Valid Forward Delay Value Configured

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Configure the DUT's Bridge Max Age to 6 seconds.
3. Configure the DUT's Bridge Forward Delay to 4 seconds.
4. Continuously transmit, from TS1, MST.WorseRootIDthanDUT frames at a rate of one every two seconds.
5. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
6. Start capture on TS1, TS2, TS3 and TS4.
7. Wait until TS1, TS2 and TS3 capture 2 MST BPDUs.
8. Stop capture on TS1, TS2 and TS3, and observe the captured frames.
9. Repeat Steps 2 through 8, using 40 seconds and 30 seconds in Steps 2 and 3, respectively.

Part B: Recommended Range Forward Delay Value Propagation

10. Ensure that the [Default Test Values](#) are configured on the DUT.
11. Continuously transmit, from TS1, MST.FwdDelay_0400 frames at a rate of one every two seconds.
12. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
13. Continuously transmit, from TS3, MST.FwdDelay_0401 frames at a rate of one every two seconds.
14. Start capture on TS1, TS2, TS3 and TS4.
15. Wait until TS2 and TS4 capture 2 MST BPDUs.
16. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
17. Repeat Steps 12 through 16, using MST.FwdDelay_1DFF and MST.FwdDelay_1E00 in Steps 11 and 13, respectively.

Part C: Large Forward Delay Value Propagation

18. Ensure that the [Default Test Values](#) are configured on the DUT.
19. Continuously transmit, from TS1, MST.FwdDelay_1E01 frames at a rate of one every two seconds.
20. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
21. Continuously transmit, from TS3, MST.FwdDelay_1E02 frames at a rate of one every two seconds.
22. Start capture on TS1, TS2, TS3 and TS4.
23. Wait until TS2 and TS4 each capture 2 MST BPDUs.
24. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
25. Repeat Steps 20 through 25, using MST.FwdDelay_FFFE and MST.FwdDelay_FFFF in Steps 19 and 21, respectively.

Observable results:

- In Part A, during step 7 and the repetitions of step 7, TS1, TS2 and TS3 must capture properly formatted MST BPDUs with Forward Delay equal the DUT's configured Forward Delay.
- In Parts B and C, TS2 and TS4 must capture properly formatted MST BPDUs with Forward Delay equal to that in frames transmitted from TS1.
- In Parts B and C, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.

Possible Problems:

- The DUT may ignore the least two significant bits of the Forward Delay field, and/or setting them to zero upon transmission. If this is the case, the packets must be adjusted accordingly.

Test MSTP.op.1.13 – Large BPDU Message Times

Purpose: To verify that the DUT properly processes MST BPDUs containing large CIST message times and propagates the Max Age and Forward Delay values contained in received BPDUs.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine

Resource Requirements:

- 4 Test Stations

Discussion:

ST, RST and MST Bridges support a range of timer values (message times) and methods designed to age out old information in the Bridged LAN. MST Bridges must support the ability to process each of the information ageing methods, and operate in a network consisting of many different information-ageing elements (IEEE 802.1D-1998, IEEE 802.1t-2001, IEEE 802.1w-2001, IEEE 802.1Q-2003, IEEE 802.1D-2004 and IEEE 802.1Q-2005). This Test examines the DUT's behavior in various information-ageing scenarios.

$2 \times (\text{Bridge_Forward_Delay} - 1.0 \text{ seconds}) \geq \text{Bridge_Max_Age} \geq 2 \times (\text{Bridge_Hello_Time} + 1.0 \text{ seconds})$

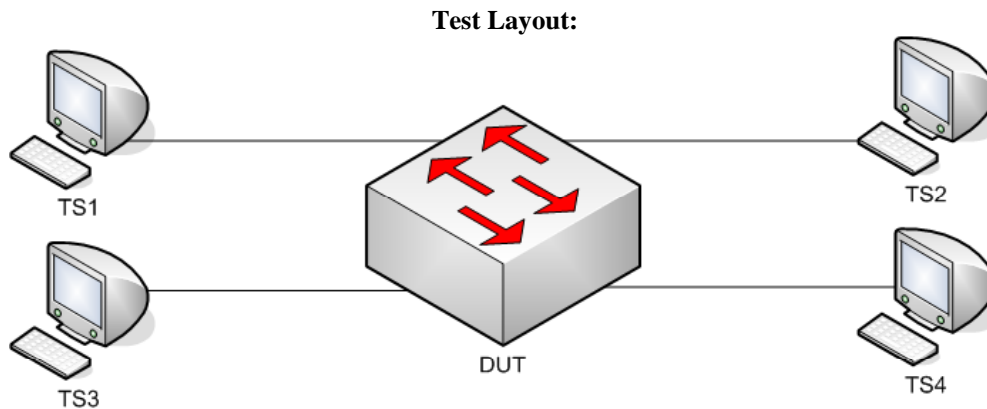


Figure 1.13 – Large BPDU Message Times

Procedure:

Part A: Valid Large Message Times

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.MakeRootPortBigMsgTimes1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, MST.MakeRootPortBigMsgTimes2 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS4 to capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Observable results:

- In Part A, during step 7, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Part A, TS2 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part A, TS2 and TS4 must capture properly formatted MST BPDUs with Max Age and Forward Delay equal to those in frames transmitted by TS1.
- In Part A, TS2 and TS4 must capture properly formatted MST BPDUs with Hello Time equal to the Port Hello Time configured on DUT.TS2 and DUT.TS4 respectively.

Possible Problems:

- None.

Test MSTP.op.1.14 – BPDU Length Verification

Purpose: To verify that the DUT properly processes MST BPDUs containing various Length field values and propagates the information contained in received BPDUs.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine

Resource Requirements:

- 4 Test Stations

Discussion:

The requirements for validation of received BPDUs depend on BPDU type: ST BPDU, RST BPDU, MST BPDU, and TCN BPDU. A BPDU shall be considered invalid, and shall not be processed, if it does not contain the minimum number of octets specified for a particular BPDU type: 35, 36, 35 and 4, respectively. Additionally, a minimum BPDU size equal to 102 octets is defined for MST BPDUs. By default, all BPDUs transmitted in valid Ethernet frames must contain at least 48 octets between the Length field and the FCS. Therefore, all BPDUs transmitted in valid Ethernet frames satisfy the minimum BPDU size requirements.

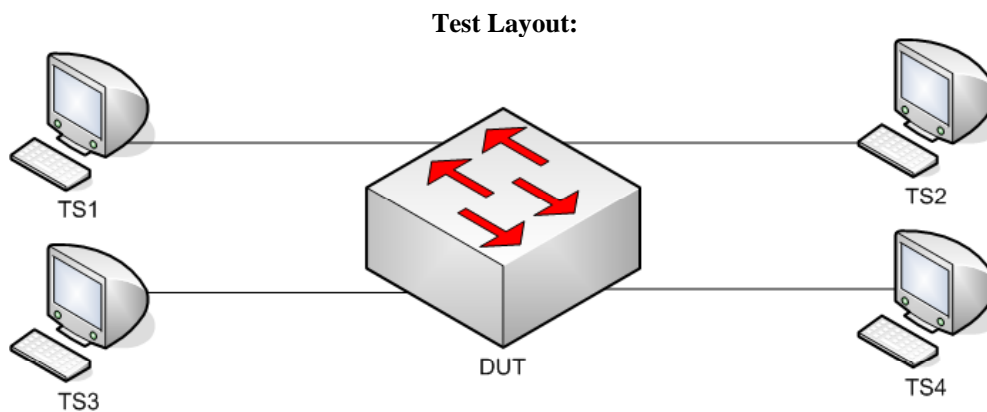


Figure 1.14 – Length/Type Field Verification

Procedure:

Part A: Invalid BPDU Lengths

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.MakeRootPortLength1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, MST.WorseRootIDthanDUT frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2, TS3 and TS4 to capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using MST.MakeRootPortLength2 frame in Step 2.
9. Repeat Steps 2 through 7, using MST.MakeRootPortLength3 frame in Step 2.

Part B: Valid BPDU Lengths

10. Ensure that the [Default Test Values](#) are configured on the DUT.
11. Continuously transmit, from TS1, MST.MakeRootPortBPDULength1 frames at a rate of one every two seconds.
12. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
13. Continuously transmit, from TS3, MST.WorseRootIDthanDUT frames at a rate of one every two seconds.
14. Start capture on TS1, TS2, TS3 and TS4.
15. Wait until TS2, TS3 and TS4 to capture 2 MST BPDUs.
16. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
17. Repeat Steps 11 through 16, using MST.MakeRootPortBPDULength2 frame in Step 11.
18. Repeat Steps 11 through 16, using MST.MakeRootPortBPDULength3 frame in Step 11.
19. Repeat Steps 11 through 16, using MST.MakeRootPortBPDULength4 frame in Step 11.
20. Repeat Steps 11 through 16, using MST.MakeRootPortBPDULength5 frame in Step 11.

Observable results:

- In Part A, TS2 and TS4 must capture properly formatted MST BPDUs with the correct Length/Type field, and CIST Root ID equal to the CIST Bridge ID configured on the DUT.
- In Part B, during step 16 and the repetitions of step 16, TS2 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted from TS1.

Possible Problems:

- None.

Test MSTP.op.1.15 – Receive Identical MST BPDUs On Two Different Ports

Purpose: To verify that the DUT properly processes MST BPDUs when receiving identical BPDUs on two different Ports.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTePropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine

Resource Requirements:

- 4 Test Stations

Discussion:

When a Bridge receives two identical MST BPDUs on two different Bridge Ports, it indicates there is a strong possibility of a network loop. To address this issue MST Bridges must place one of the two Ports in the Blocking State. The Port with a lesser CIST Port ID, must be placed in the Blocking State.

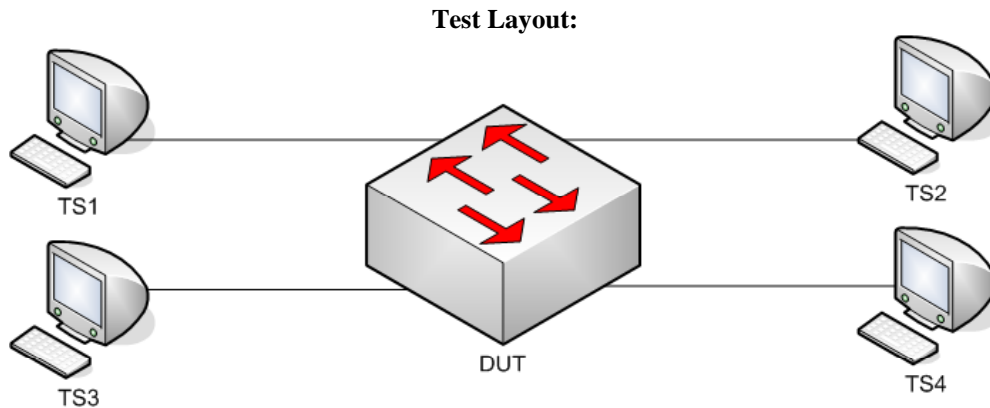


Figure 1.15 – Receive Identical ST BPDUs On Two Different Ports

Procedure:

Part A: Receive Identical MST BPDUs On Two Different Ports. DUT Is Not Root.

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.IdenticalBPDU1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, MST.IdenticalBPDU1 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS4 to capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Part B: Receive Identical MST BPDUs On Two Different Ports. DUT Is Root.

8. Ensure that the [Default Test Values](#) are configured on the DUT.
9. Continuously transmit, from TS1, MST.IdenticalBPDU2 frames at a rate of one every two seconds.
10. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
11. Continuously transmit, from TS3, MST.IdenticalBPDU2 frames at a rate of one every two seconds.
12. Start capture on TS1, TS2, TS3 and TS4.
13. Wait until TS1, TS2, TS3 and TS4 to capture 2 MST BPDUs.
14. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Observable results:

- In Part A, the DUT must set DUT.TS3 to a Port Role of Alternate Port, and Port State of Discarding State.
- In Part A, during step 7, TS2 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part B, TS1, TS2, TS3 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to the DUT's CIST Bridge ID.

Possible Problems:

- None.

Test MSTP.op.1.16 – CIST Internal Path Cost Field Verification

Purpose: To verify that the DUT processes MST BPDUs with varying CIST Internal Path Cost field values and transmits properly formatted ST and MST BPDUs.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 13.29 – Port Protocol Migration state machine
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-21 – Topology Change state machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

The CIST Internal Root Path Cost for an MST bridge is the cost of the CIST network path from the Root port of the MST Regional Root Bridge to the CIST Regional Root Bridge. The CIST Internal Root Path Cost field for all other bridges is the sum of the *IntRootPathCost* portion of the Root Port's *port priority* vector and the Path Cost parameter value configured on the CIST Regional Root Port.

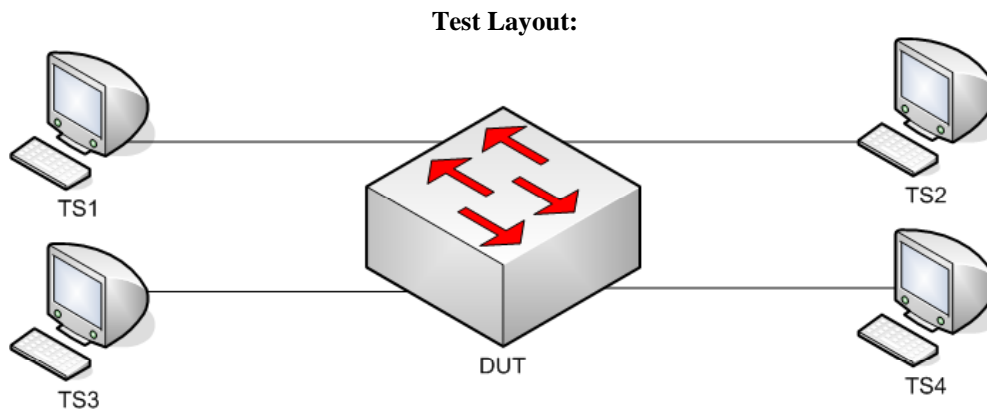


Figure 1.16 – CIST Internal Path Cost Field Verification

Procedure:

Part A: Various CIST Internal Path Cost values – Intra-Region BPDU

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.IntraCISTIntPathCost_00000001 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, MST.IntraCISTIntPathCost_00000002 frames at a rate of one every two seconds.
5. Continuously transmit, from TS4, ST.WorseRootIDthanDUT frames at a rate of one every two seconds.
6. Start capture on TS1, TS2, TS3 and TS4.
7. Wait until TS2 and TS4 capture 2 MST BPDUs.
8. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
9. Repeat Steps 2 through 8, using MST.IntraCISTIntPathCost_EEEEEEEE and MST.IntraCISTIntPathCost_EEEEEEEF in Steps 2 and 4, respectively.

Part B: Overflow CIST Internal Path Cost – Informational

10. Ensure that the [Default Test Values](#) are configured on the DUT.
11. Continuously transmit, from TS1, MST.IntraCISTIntPathCost_FFFFFFFE frames at a rate of one every two seconds.
12. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
13. Continuously transmit, from TS3, MST.IntraCISTIntPathCost_FFFFFFFF frames at a rate of one every two seconds.
14. Continuously transmit, from TS4, ST.WorseRootIDthanDUT frames at a rate of one every two seconds.
15. Start capture on TS1, TS2, TS3 and TS4.
16. Wait until TS2 and TS4 capture 2 MST BPDUs.
17. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Part C: Various CIST Internal Path Cost values – Inter-Region BPDU

18. Ensure that the [Default Test Values](#) are configured on the DUT.
19. Continuously transmit, from TS1, MST.InterCISTIntPathCost_00000001 frames at a rate of one every two seconds.
20. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
21. Continuously transmit, from TS3, MST.InterCISTIntPathCost_00000002 frames at a rate of one every two seconds.
22. Continuously transmit, from TS4, ST.WorseRootIDthanDUT frames at a rate of one every two seconds.
23. Start capture on TS1, TS2, TS3 and TS4.
24. Wait until TS2 and TS4 capture 2 MST BPDUs.
25. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
26. Repeat Steps 19 through 25, using MST.InterCISTIntPathCost_EEEEEEEE and MST.InterCISTIntPathCost_EEEEEEEF in Steps 19 and 21, respectively.
27. Repeat Steps 19 through 25, using MST.InterCISTIntPathCost_FFFFFFFE and MST.InterCISTIntPathCost_FFFFFFFF in Steps 19 and 21, respectively.

Observable results:

- In Part A, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Part A, during step 8 and the repetitions of step 8, TS2 must capture properly formatted MST BPDUs with an Internal Root Path Cost equal to that in frames transmitted by TS1, plus the Port Path Cost configured on DUT.TS1.
- In Part A, during step 8 and the repetitions of step 8, TS4 must capture properly formatted ST BPDUs with a Root Path Cost equal to the CIST External Root Path Cost in frames transmitted by TS1.
- In Part B, during step 17, record the value of Internal Root Path Cost set by the DUT in its MST BPDUs, and the value of Root Path Cost in its ST BPDUs.
- In Part B, during step 17, record the Port Role of DUT.TS3.
- In Part C, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Part C, during step 25 and the repetitions of step 25, TS2 must capture properly formatted MST BPDUs with an Internal Root Path Cost equal to 0x00000000.
- In Part C, during step 25 and the repetitions of step 25, TS2 must capture properly formatted MST BPDUs with a CIST Root ID equal to that in frames transmitted by TS1.
- In Part C, during step 25 and the repetitions of step 25, TS4 must capture properly formatted ST BPDUs with a Root Path Cost equal to the CIST External Root Path Cost in frames transmitted by TS1. plus the Port Path Cost configured on DUT.TS1.

Possible Problems:

- None.

Test MSTP.op.1.17 – Erroneous Version 3 Length Field

Purpose: To verify that the DUT validates the version 3 length field on receipt of BPDUs and properly discards those with incorrect or erroneous values.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 14.6 – Encoding and decoding of STP configuration, RST, and MST BPDUs

Resource Requirements:

- 3 Test Stations

Discussion:

When an MST Bridge receives an BPDU where the protocol version identifier is 3 or more, the BPDU type field is 2, the version 1 length field is 0 and the BPDU is 102 or more octets in length, the validation procedure will use the version 3 length field to determine if it should decode the message as a MSTP BPDU. The value of the version 3 length field represents the number of octets that follow in the BPDU. It shall not exceed 1088 octets which represent the length of the MST configuration message and 0 to 64 MSTI Configuration messages. The version 3 length must be at least 64 to accommodate the MST configuration message. Invalid version 3 length fields shall cause the validation procedure to decode the BPDU as an RST BPDU.

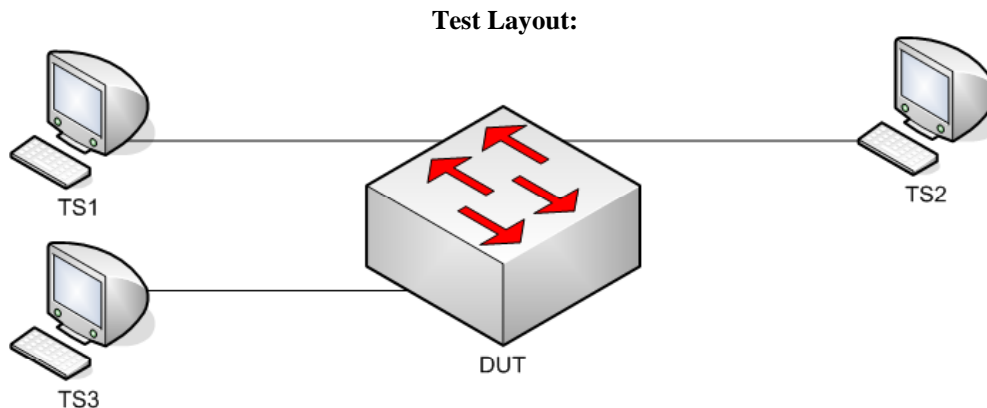


Figure 1.17 – Erroneous Version 3 Length Field

Procedure:

Part A: Large Version 3 Length Field

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.MakeRootPortBigV3Length frames at the rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at the rate of one every two seconds.
4. Start capture on TS1, TS2, and TS3.
5. Wait until TS2, and TS3 capture 2 MST BPDUs.
6. Stop capture on TS1, TS2, and TS3, and observe the captured frames.

Part B: Small Version 3 Length Field

7. Ensure that the [Default Test Values](#) are configured on the DUT.
8. Continuously transmit, from TS1, MST.MakeRootPortSmallV3Length frames at the rate of one every two seconds.
9. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at the rate of one every two seconds.
10. Start capture on TS1, TS2, and TS3.
11. Wait until TS2, and TS3 capture 2 MST BPDUs.
12. Stop capture on TS1, TS2, and TS3, and observe the captured frames.

Part C: Medium Version 3 Length Field

13. Ensure that the [Default Test Values](#) are configured on the DUT.
14. Continuously transmit, from TS1, MST.MakeRootPortInvalidV3Length frames at the rate of one every two seconds.
15. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at the rate of one every two seconds.
16. Start capture on TS1, TS2, and TS3.
17. Wait until TS2, and TS3 capture 2 MST BPDUs.
18. Stop capture on TS1, TS2, and TS3, and observe the captured frames.

Observable results:

- In Parts A, B, and C during Step 6, 12, 18, TS2 and TS3 must capture properly formatted MST BPDUs containing a CIST Regional Root Identifier of the DUT and a CIST Root Identifier equal to that used in BPDUs transmitted from TS1.

Possible Problems:

- None.

Test MSTP.op.1.18 – MSTI Regional Root Identifier Verification

Purpose: To verify that the DUT properly processes and encodes regional root identifiers in MSTI configuration messages.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDUs parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 14.6 – Encoding and decoding of STP configuration, RST, and MST BPDUs

Resource Requirements:

- 3 Test Stations

Discussion:

The txMstp() procedure transmits a MST BPDUs on a port including the parameters of each MSTI message encoded in MSTID order. The regional root identifier constitutes the most significant portion of the MSTI bridge priority vector for a given MSTI. The most significant 4 bits of the MSTI regional root identifier constitute the manageable priority component while octets 3 through 8 represent the unique bridge identifier.

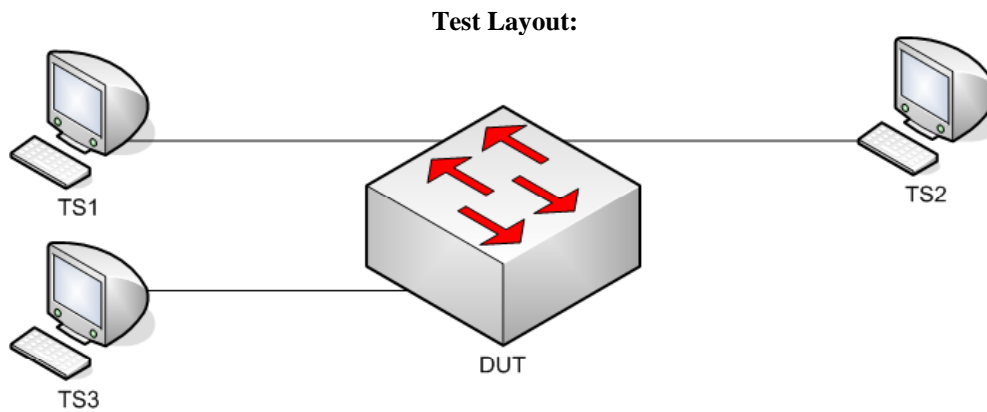


Figure 1.18 – MSTI Regional Root Identifier Verification

Procedure:

Part A: MSTI Regional Root ID Verification - No Bridge Partner

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Start capture on TS1.
3. Wait until TS1 captures 2 MST BPDUs.
4. Stop capture on TS1 and observe the captured frames.

Part B: MSTI Regional Root ID Verification - Intra-Region BPDU

5. Ensure that the [Default Test Values](#) are configured on the DUT.
6. Continuously transmit, from TS1, MST.IntraMSTIRootID001 frames at the rate of one every two seconds.
7. Continuously transmit, from TS2, MST.WorseRootIDthanDUT frames at the rate of one every two seconds.
8. Start capture on TS1 , TS2 and TS3.
9. Wait until TS1 and TS2 capture 2 MST BPDUs.
10. Stop capture on TS1 and TS2, and observe the captured frames.

Part C: MSTI Regional Root ID Verification - Inter-Region BPDU

11. Ensure that the [Default Test Values](#) are configured on the DUT.
12. Continuously transmit, from TS1, MST.InterMSTIRootID001 frames at the rate of one every two seconds.
13. Continuously transmit, from TS2, MST.WorseRootIDthanDUT frames at the rate of one every two seconds.
14. Start capture on TS1 , TS2 and TS3.
15. Wait until TS1 and TS2 capture 2 MST BPDUs.
16. Stop capture on TS1 and TS2, and observe the captured frames.

Observable results:

- In Part A, during step 4, TS1 must capture properly formatted MST BPDUs with Regional Root Identifiers for MSTIs 0x001 and 0x002 equal to the Bridge Identifier of the DUT for those MSTIs.
- In Part B, during step 10, TS1, TS2 and TS3 must capture properly formatted MST BPDUs with a Regional Root Identifier for MSTI 0x001 equal to that sent in frames transmitted by TS1.
- In Part C, during step 16, TS1 , TS2 and TS3 must capture properly formatted MST BPDUs with a Regional Root Identifiers for MSTIs 0x001 and 0x002 equal to the Bridge Identifier of the DUT for those MSTIs.

Possible Problems:

- None.

Test MSTP.op.1.19 - MSTI Priority Fields Verification

Purpose: To verify that the DUT properly processes and encodes the root and bridge manageable bridge priority fields.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 14.6 – Encoding and decoding of STP configuration, RST, and MST BPDUs

Resource Requirements:

- 3 Test Stations

Discussion:

The txMstp() procedure transmit a MST BPDU on a port including the parameters of each MSTI message encoded in MSTID order. The most significant 4 bits of octet 2 in a MSTI configuration message constitute the manageable priority component of the regional root for a certain MSTI. The 4 most significant bits of Octet 14 conveys the value of the bridge identifier priority for the same MSTI.

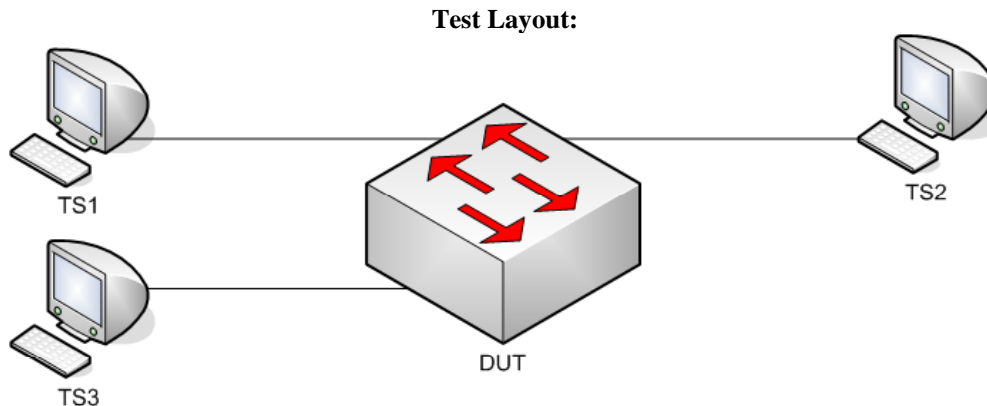


Figure 1.19 – MSTI Priority Fields Verification

Procedure:

Part A: MSTI Regional Root Priority - No Bridge Partner

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Start capture on TS1.
3. Wait until TS1 captures 2 MST BPDUs.
4. Stop capture on TS1 and observe the captured frames.

Part B: MSTI Regional Root Priority - Intra-Region BPDU

5. Ensure that the [Default Test Values](#) are configured on the DUT.
6. Continuously transmit, from TS1, MST.IntraMSTIRootID001 frames at the rate of one every two seconds.
7. Continuously transmit, from TS2, MST.WorseRootIDthanDUT frames at the rate of one every two seconds.
8. Start capture on TS1 and TS2.
9. Wait until TS1 and TS2 capture 2 MST BPDUs.
10. Stop capture on TS1 and TS2, and observe the captured frames.

Observable results:

- In Part A, TS1 must capture properly formatted MST BPDUs with a Regional Root Priority and Bridge Identifier Priority for MSTIs 0x001 and 0x002 of 0x9 and 0xA respectively.
- In Part B, TS1 and TS2 must capture properly formatted MST BPDUs with a Regional Root Priority of 0x6 and a Bridge Identifier Priority of 0x9 for MSTI 0x001.

Possible Problems:

- None.

Test MSTP.op.1.20 - MSTI Internal Root Path Cost Verification

Purpose: To verify that the DUT properly encodes the internal root path cost for each MSTI configuration message.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 14.6 – Encoding and decoding of STP configuration, RST, and MST BPDUs

Resource Requirements:

- 3 Test Stations

Discussion:

The txMstp() procedure transmits a MST BPDU on a port including the parameters of each MSTI message encoded in MSTID order. Octets 10 through 13 of each message encode the internal root path cost for that MSTI. The MSTI internal root path cost conveys the path cost to the MSTI regional root within a MST region.

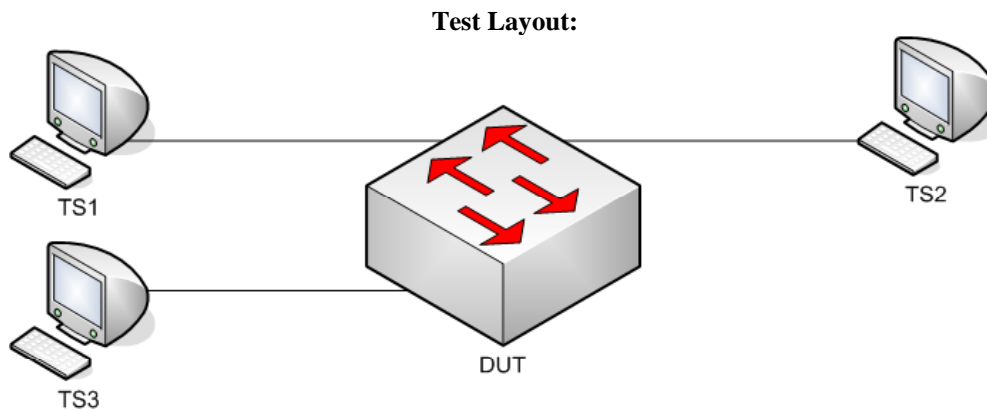


Figure 1.20 – MSTI Internal Root Path Cost Verification

Procedure:

Part A: MSTI Internal Root Path Cost

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.IntraMSTI001PathCost_00030D40 frames at the rate of one every two seconds.
3. Continuously transmit, from TS2, MST.WorseRootIDthanDUT frames at the rate of one every two seconds.
4. Start capture on TS2 and TS3.
5. Wait until TS2 and TS3 capture 2 MST BPDUs.
6. Stop capture on TS2 and TS3, and observe the captured frames.

Observable results:

- In Part A, TS2 and TS3 must capture properly formatted MST BPDUs with an internal root path cost for MSTI 0x001 of 0x00061A80.

Possible Problems:

None.

Test MSTP.op.1.21 - MSTI Remaining Hops Field Verification

Purpose: To verify that the DUT properly verifies and encodes the remaining hops field in each MSTI configuration message.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: sub-clause 13.26.22 – updtRcvdInfoWhile()
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 14.6 – Encoding and decoding of STP configuration, RST, and MST BPDUs

Resource Requirements:

- 3 Test Stations

Discussion:

The txMstp() procedure transmit a MST BPDU on a port including the parameters of each MSTI message encoded in MSTID order. Octet 16 of each message encodes the remaining hops for each MSTI message. On receipt of a superior MSTI priority vector remainingHops is decremented and used in the updtRcvdInfoWhileMsti() procedure to determine the value of the rcvdInfoWhile timer. If the value decremented remainingHops value is less than or equal to 0 the information is aged out.

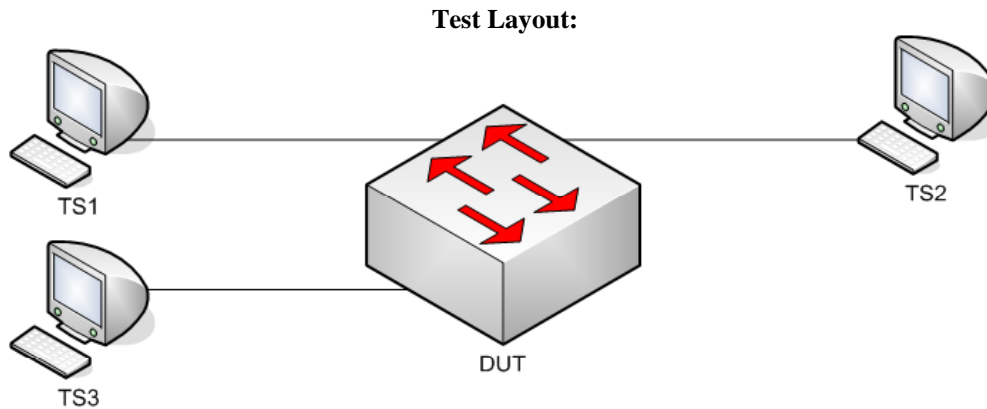


Figure 1.21 – MSTI Remaining Hops Field Verification

Procedure:

Part A: MSTI Remaining Hops Decrement

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.IntraMSTI001RemainingHops_13 frames at the rate of one every two seconds.
3. Continuously transmit, from TS2, MST.IntraMSTI002RemainingHops_02 frames at the rate of one every two seconds.
4. Start capture on TS3 and TS4.
5. Wait until TS3 and TS4 capture 2 MST BPDUs.
6. Stop capture on TS3 and TS4, and observe the captured frames.

Part B: MSTI Remaining Hops Age Out

7. Ensure that the [Default Test Values](#) are configured on the DUT.
8. Continuously transmit, from TS1, MST.IntraMSTI001RemainingHops_01 frames at the rate of one every two seconds.
9. Continuously transmit, from TS2, MST.WorseRootIDthanDUT frames at the rate of one every two seconds.
10. Start capture on TS2 and TS3.
11. Wait until TS2 and TS3 capture 2 MST BPDUs.
12. Stop capture on TS2 and TS3, and observe the captured frames.

Observable results:

- In Part A, TS3 and TS4 must capture properly formatted MST BPDUs with a Remaining Hops field of 0x12 for MSTI 0x001.
- In Part A, TS3 and TS4 must capture properly formatted MST BPDUs with a Remaining Hops field of 0x01 for MSTI 0x002.
- In Part B, TS2 and TS3 must capture properly formatted MST BPDUs with a Remaining Hops field of 0x14 for MSTI 0x001.
- In Part B, TS2 and TS3 must capture properly formatted MST BPDUs with a Regional Root Identifier for MSTI 0x001 of the DUT.

Possible Problems:

- None.

Test MSTP.op.1.22 – VLAN Tagged BPDUs

Purpose: To verify that the DUT does not process tagged MST BPDUs.

References:

- IEEE Std. 802.1Q-2005: sub-clause 8.13.10 – VLAN attachment and connectivity for Higher Layer Entities

Resource Requirements:

- 3 Test Stations

Discussion:

- Spanning Tree BPDUs transmitted by the Bridge Protocol Entity are not forwarded by Bridges, and must be visible to all other Bridge Protocol Entities attached to the same LAN segment. Such frames shall be transmitted Untagged; any BPDUs that carry a tag header are not recognized as well-formed BPDUs and are not forwarded by the Bridge.

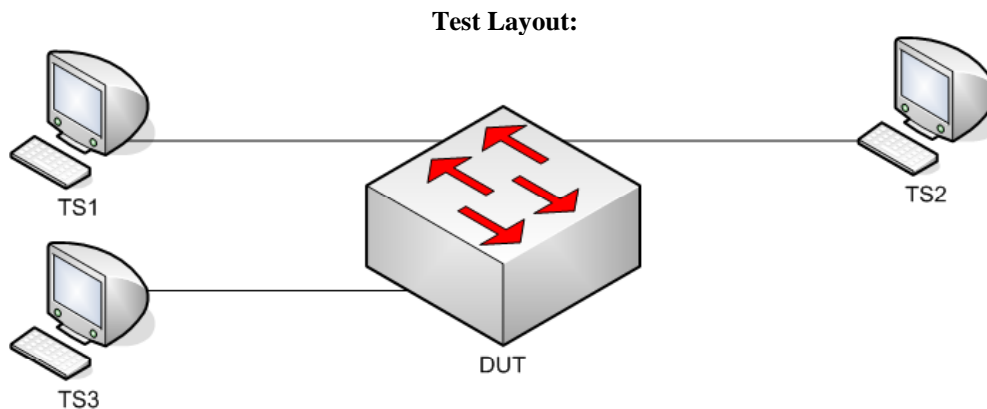


Figure 1.22 – VLAN tagged BPDUs

Procedure:

Part A: VLAN tagged BPDUs

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, MST.IntraMakeRootPortVLANtagged frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Start capture on TS1, TS2 and TS3.
5. Wait until TS1, TS2 and TS3 capture 2 MST BPDUs.
6. Stop capture on TS1, TS2 and TS3, and observe the captured frames.
7. Repeat Steps 2 through 6, using MST.InterMakeRootPortVLANtagged frames in Step 2.

Observable results:

- In Part A, during Step 6, and the repetitions of Step 6, TS1, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to the DUT's CIST Bridge ID.

Possible Problems:

- None.

GROUP 2: RST BPDU Format and Processing

Scope

This Group of tests examines the DUT's RST BPDU processing and validation procedure, and ensures the DUT does not transmit RST BPDUs.

Overview

This Group tests the Frame Format of the following:

BPDU Types:

MST BPDUs

BPDU Parameters:

Protocol ID
Protocol Version ID
BPDU Type
CIST Flags
CIST Root ID
CIST External Path Cost
CIST Regional Root ID
CIST Port ID
Message Age
Max Age
Forward Delay
Version One Length
Version Three Length
MST Configuration ID
CIST Internal Root Path Cost
CIST Bridge ID
CIST Remaining Hops
MSTI Configuration Messages

Validation of BPDUs based on the following criteria:

Protocol ID
Message Age

Test MSTP.op.2.1 – Basic RST BPDU Verification

Purpose: To verify that the DUT properly processes basic RST BPDUs with valid field values, and transmits properly formatted MST BPDUs.

References:

- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.29 – Port Protocol Migration state machine
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 3 Test Stations

Discussion:

IEEE Std 802.1D-2004 Figure 9-3, in addition to sub-clause 9.3.3, specifies the proper format and encoding of RST BPDUs. To ensure cross-vendor interoperability and backward compatibility an MST Bridge must accept and process RST BPDUs meeting the basic validation requirements of IEEE Std. 802.1Q-2005 sub-clause 14.4. An MST Bridge shall transmit MST BPDUs on any Port that has not been placed in ST BPDU transmission mode by the Port Protocol Migration state machine. MST BPDU format is designed to be processed by RST Bridges, although containing additional information beyond RST BPDU fields.

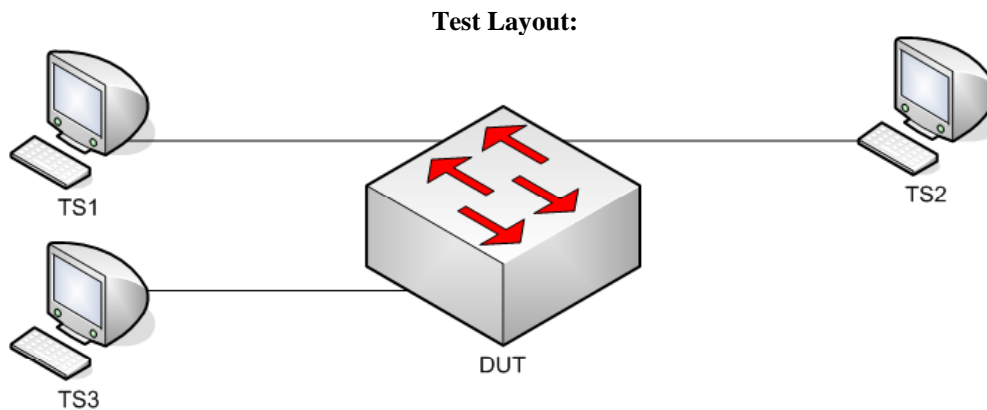


Figure 2.1 – Basic RST BPDU Verification

*The University of New Hampshire
InterOperability Laboratory*

Procedure:

Part A: Valid BPDU Transmission

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, RST.MakeRootPort frames at a rate of one every two seconds.
3. Continuously transmit, from TS3, RST.WorseRootIDThanDUT frames at a rate of one every two seconds.
4. Start capture on TS1, TS2 and TS3.
5. Wait until TS2 and TS3 capture two MST BPDUs.
6. Stop capture on TS1, TS2 and TS3, and observe the captured frames.

Observable results:

- In Part A, during Step 6, TS2 and TS3 must capture properly formatted MST BPDUs containing the following fields and values:

BPDU Field Name	Field Value
Protocol ID / Protocol Version ID	0x0000 / 0x03
BPDU Type	0x02
CIST Flags	Designated Port and Discarding (TS3) Designated Port and Forwarding (TS2)
CIST Root ID	Root Bridge ID contained in RST.MakeRootPort
CIST External Path Cost	Root Path Cost contained in RST.MakeRootPort + DUT.TS1's Port Path Cost
CIST Regional Root ID	DUT's CIST Bridge ID
CIST Port ID	DUT.TS2 and DUT.TS3's CIST Port ID, respectively
Message Age	Message Age contained in RST.MakeRootPort + 1 second.
Max Age	Max Age contained in RST.MakeRootPort
Hello Time	DUT.TS2 and DUT.TS3's Port Hello Time, respectively
Forward Delay	Forward Delay contained in RST.MakeRootPort
Version 1 Length	0x00
CIST Internal Root Path Cost	0x00000000
CIST Bridge ID	DUT's CIST Bridge ID
CIST Remaining Hops	DUT's MaxHops

- In Part A, each port on the DUT must use a unique source MAC address.
- In Part A, the BPDUs captured by TS2 and TS3 must be untagged.

Possible Problems:

- None.

Test MSTP.op.2.2 – Protocol ID Verification

Purpose: To verify that the DUT does not process RST BPDUs with a Protocol ID not equal to 0x0000.

References:

- IEEE Std. 802.1D-2004: sub-clause 9.1 – Structure
- IEEE Std. 802.1D-2004: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-2004: sub-clause 9.3 – BPDU formats and parameters
- IEEE Std. 802.1D-2004: Figure 9-3 – RST BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 13.29 – Port Protocol Migration state machine
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 3 Test Stations

Discussion:

The Protocol ID is encoded in the first and second octets of an RST BPDU. A Protocol ID of 0x0000 identifies the frame as a BPDU. Frames containing a Protocol ID not equal to 0x0000 are not BPDUs and shall not be processed by an MST Bridge's MSTP entity.

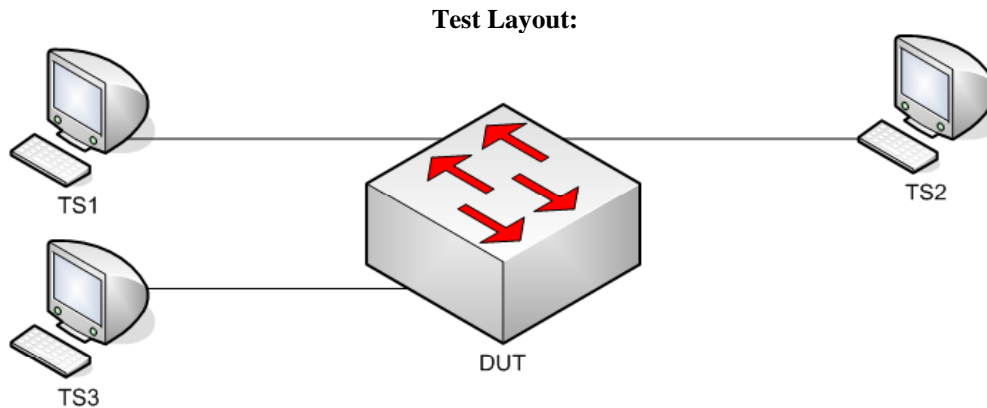


Figure 2.2 – Protocol ID Verification

*The University of New Hampshire
InterOperability Laboratory*

Procedure:

Part A: Invalid Protocol ID

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, RST.MakeRootPortBadProtoID1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS3, RST.WorseRootThanDUT frames at a rate of one every two seconds.
4. Start capture on TS1, TS2 and TS3.
5. Wait until TS1, TS2 and TS3 capture 2 MST BPDUs.
6. Stop capture on TS1, TS2 and TS3, and observe the captured frames.
7. Repeat Steps 2 through 6, using RST.MakeRootPortBadProtoID2 in Step 2.
8. Repeat Steps 2 through 6, using RST.MakeRootPortBadProtoID3 in Step 2.

Observable results:

- In Part A, during Step 6, and repetitions of Step 6, TS1, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to the DUT's CIST Bridge ID.

Possible Problems:

- None.

Test MSTP.op.2.3 – Protocol Version ID Verification

Purpose: To verify that the DUT processes RST BPDUs containing varying Protocol Version ID values.

References:

- IEEE Std. 802.1D-2004: sub-clause 9.1 – Structure
- IEEE Std. 802.1D-2004: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-2004: sub-clause 9.3 – BPDU formats and parameters
- IEEE Std. 802.1D-2004: Figure 9-3 – RST BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 13.29 – Port Protocol Migration state machine
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 3 Test Stations

Discussion:

The Protocol Version ID is encoded in the third octet of an RST BPDU. A compliant device must not validate an RST BPDU based on the value encoded in the Protocol Version ID field. This allows future versions of the Spanning Tree Protocol to use this field while providing support for legacy versions.

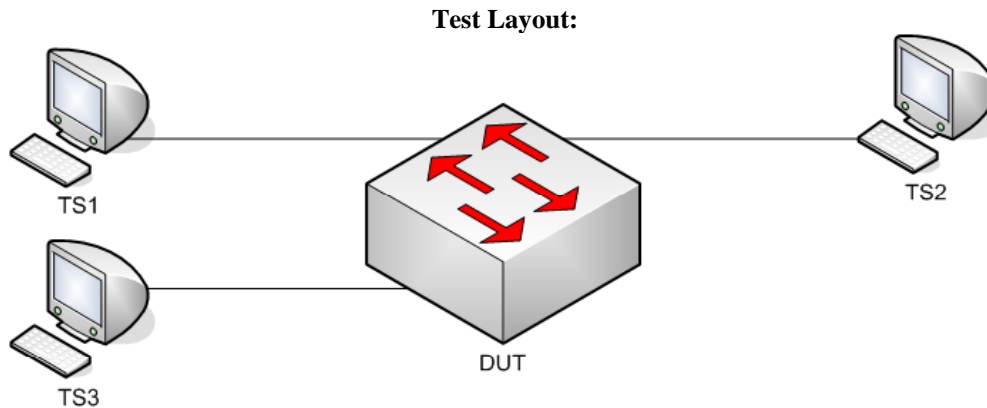


Figure 2.3 – Protocol Version ID Verification

Procedure:

Part A: Future Protocol Version ID

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, RST.MakeRootPortProtoVerID1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS3, RST.WorseRootThanDUT frames at a rate of one every two seconds.
4. Start capture on TS1, TS2 and TS3.
5. Wait until TS2 and TS3 capture 2 MST BPDUs.
6. Stop capture on TS1, TS2 and TS3, and observe the captured frames.
7. Repeat Steps 2 through 6, using RST.MakeRootPortProtoVerID2 in Step 2.
8. Repeat Steps 2 through 6, using RST.MakeRootPortProtoVerID3 in Step 2.

Observable results:

- In Part A, during Step 6, and repetitions of Step 6, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.

Possible Problems:

- None.

Test MSTP.op.2.4 – BPDU Type Field Verification

Purpose: To verify that the DUT does not process RST BPDUs containing invalid BPDU Type values.

References:

- IEEE Std. 802.1D-2004: sub-clause 9.1 – Structure
- IEEE Std. 802.1D-2004: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-2004: sub-clause 9.3 – BPDU formats and parameters
- IEEE Std. 802.1D-2004: Figure 9-3 – RST BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 13.29 – Port Protocol Migration state machine
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-21 – Topology Change state machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 3 Test Stations

Discussion:

Each version of STP defines one or more valid BPDU types, encoded in the fourth octet of transmitted BPDUs. For Protocol Version 0x03 of STP, the BPDU Type field is encoded with a value equal to 0x02. For Protocol Version 0x02, any other value in the BPDU Type field denotes an invalid BPDU Type and must not be processed.

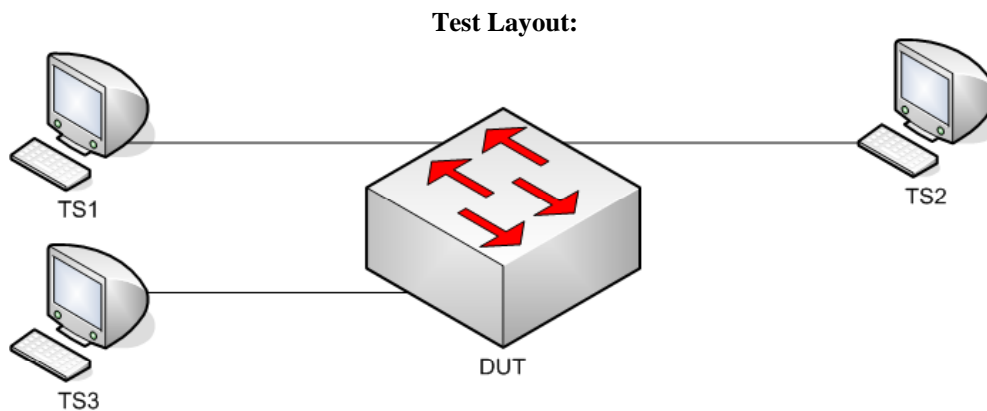


Figure 2.4 – BPDU Type Field Verification

Procedure:

Part A: Invalid BPDU Types

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, RST.MakeRootPortBadBPDUType1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS3, RST.WorseRootThanDUT frames at a rate of one every two seconds.
4. Start capture on TS1, TS2 and TS3.
5. Wait until TS1, TS2 and TS3 capture 2 MST BPDUs.
6. Stop capture on TS1, TS2 and TS3, and observe the captured frames.
7. Repeat Steps 2 through 6, using RST.MakeRootPortBadBPDUType2 in Step 2.
8. Repeat Steps 2 through 6, using RST.MakeRootPortBadBPDUType3 in Step 2.

Observable results:

- In Part A, during Step 6, and repetitions of Step 6, TS1, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to the DUT's CIST Bridge ID.

Possible Problems:

- None.

Test MSTP.op.2.5 – CIST Root/CIST Regional Root ID Field Verification

Purpose: To verify that the DUT processes RST BPDUs with varying CIST Root ID, CIST External Path Cost and CIST Regional Root Identifier field values.

References:

- IEEE Std. 802.1D-2004: sub-clause 9.1 – Structure
- IEEE Std. 802.1D-2004: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-2004: sub-clause 9.3 – BPDU formats and parameters
- IEEE Std. 802.1D-2004: Figure 9-3 – RST BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.18 – syncMaster()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.19 – txConfig()
- IEEE Std. 802.1Q-2005: sub-clause 13.29 – Port Protocol Migration state machine
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-21 – Topology Change state machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

The CIST Root ID contained in MST BPDUs transmitted by an MST Bridge is a result of the CIST Priority Vector Calculation process. If an MST Bridge has not received a BPDU from a Bridge within the Region it participates in containing a CIST Root ID better than the Bridge's CIST Bridge ID, then the Bridge considers itself the CIST Regional Root and will transmit MST BPDUs containing a CIST Regional Root ID equal to its own CIST Bridge ID, and ST BPDUs containing a Bridge ID equal to its own CIST Bridge ID. Otherwise, the Bridge will appoint the Port receiving the best CIST Internal Path Cost as the CIST Root Port and transmit BPDUs containing the CIST Root Port's *port priority vector* on all of its Designated Ports. If an MST Bridge that is the CIST Regional Root for the has not received a BPDU from outside the Region it participates in containing a CIST Root ID (MST BPDUs), or Root Bridge ID (ST BPDUs), better than the Bridge's CIST Bridge ID, then it will consider itself the CIST Root Bridge and will transmit MST BPDUs containing a CIST Root ID equal its own CIST Bridge ID, and ST BPDUs containing a Root Bridge ID equal to its own CIST Bridge ID. Otherwise, the Bridge will appoint the Port receiving the best CIST Root ID as the CIST Root Port and transmit BPDUs containing the CIST Root Port's *port priority vector* on all of its Designated Ports.

The Bridge ID or Root Bridge ID, or CIST Root ID, is the concatenation of a 2-byte Bridge Priority and a 6-byte Bridge MAC address. MST Bridges allow Bridge Priority value configuration of only the four most significant bits, thereby supporting a range of Bridge Priority values from 0 to 61440, in increments of 4096. However, IEEE Std 802.1D-1998 ST Bridges allow Bridge Priority value configuration to any value between 0 and 65535. Therefore, MST Bridges must support processing a full range of Bridge Priority values.

Test Layout:

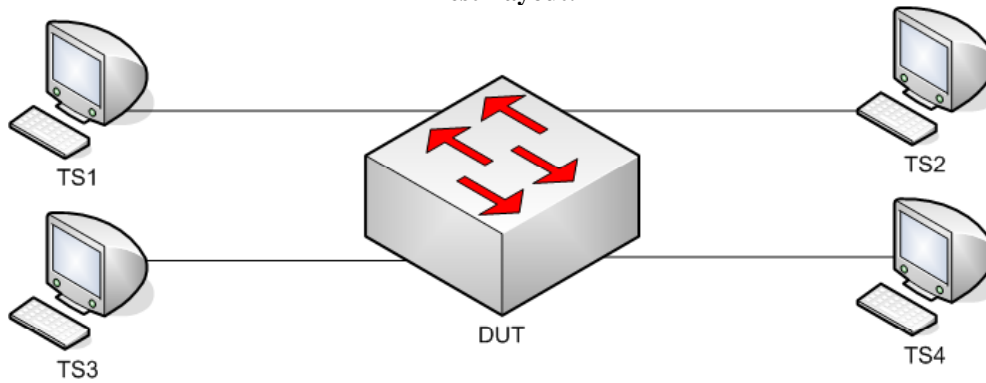


Figure 2.5 – CIST Root/CIST Regional Root ID Field Verification

Procedure:

Part A: RST BPDU CIST Root ID Verification – Priority Portion

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, RST.RootID0000_000000000000 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, RST.RootID0001_000000000000 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2, TS3 and TS4 capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7 using RST.RootID7776_777777777777 and RST.RootID7777_777777777777 in Steps 2 and 4, respectively.

Part B: RST BPDU CIST Root ID Verification – MAC Address Portion

9. Ensure that the [Default Test Values](#) are configured on the DUT.
10. Continuously transmit, from TS1, RST.RootID0000_000000000000 frames at a rate of one every two seconds.
11. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
12. Continuously transmit, from TS3, RST.RootID0000_000000000001 frames at a rate of one every two seconds.
13. Start capture on TS1, TS2, TS3 and TS4.
14. Wait until TS2, TS3 and TS4 capture 2 MST BPDUs.
15. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
16. Repeat Steps 10 through 15 using RST.RootID7777_777777777776 and RST.RootID7777_777777777777 in Steps 10 and 12, respectively.

Observable results:

- In Part A, during Step 7, and repetitions of Step 7, TS2, TS3 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part B, during Step 15, and repetitions of Step 15, TS2, TS3 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.

Possible Problems:

- None.

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

Purpose: To verify that the DUT processes RST BPDUs with varying Root Path Cost field values.

References:

- IEEE Std. 802.1D-2004: sub-clause 9.1 – Structure
- IEEE Std. 802.1D-2004: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-2004: sub-clause 9.3 – BPDU formats and parameters
- IEEE Std. 802.1D-2004: Figure 9-3 – RST BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 13.29 – Port Protocol Migration state machine
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-21 – Topology Change state machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

The External Root Path Cost for an MST Bridge is the cost of the CIST network path from the Root Port of the MST Regional Root Bridge to the CIST Root Bridge. The External Root Path Cost is not modified within an MST Region; therefore, the CIST External Path Cost value on all MST Bridges within an MST Region is equal. The CIST External Path Cost value is transmitted in BPDUs and may be used to determine the active topology. An MST Bridge encodes the CIST External Path Cost in the Root Path Cost field of ST BPDUs and the CIST External Path Cost field of MST BPDUs. The CIST External Path Cost for the CIST Root Bridge is zero. The CIST External Path Cost for all other Bridges is the sum of the *ExtRootPathCost* portion of the Root Port's *port priority* vector and Path Cost parameter value configured on the CIST Root Port.

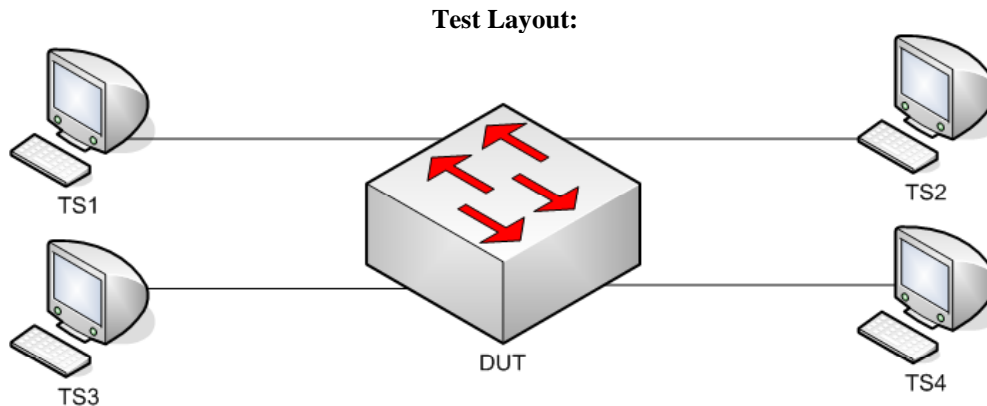


Figure 2.6 – Root Path Cost Field Verification

Procedure:

Part A: Root Path Cost equal to 0x00000000 – RST sourced

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, RST.CISTRRootPath00000000 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, RST.CISTRRootPath00000001 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS4 capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Part B: Root Path Cost equal to 0xFFFFFFFFE – RST sourced – Informational

8. Ensure that the [Default Test Values](#) are configured on the DUT.
9. Continuously transmit, from TS1, RST.CISTRRootPathFFFFFFFFE frames at a rate of one every two seconds.
10. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
11. Continuously transmit, from TS3, RST.CISTRRootPathFFFFFFFFF frames at a rate of one every two seconds.
12. Start capture on TS1, TS2, TS3 and TS4.
13. Wait until TS2, TS3 and TS4 capture 2 MST BPDUs.
14. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Observable results:

- In Part A, during Step 7, TS2 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part A, during Step 7, TS2 and TS4 must capture properly formatted MST BPDUs with an External Root Path Cost equal to the Port Path Cost configured on DUT.TS1.
- In Part B, during step 14, record the behavior of the DUT with respect to External Root Path Cost as well as DUT.TS3's Port Role.

Possible Problems:

- None.

Test MSTP.op.2.7 – Bridge ID Field Verification

Purpose: To verify that the DUT processes MST BPDUs with varying CIST Bridge ID field values and properly determines the CIST Root Port based on Bridge ID.

References:

- IEEE Std. 802.1D-2004: sub-clause 9.1 – Structure
- IEEE Std. 802.1D-2004: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-2004: sub-clause 9.3 – BPDU formats and parameters
- IEEE Std. 802.1D-2004: Figure 9-3 – RST BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 13.29 – Port Protocol Migration state machine
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-21 – Topology Change state machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

MST BPDUs contain a CIST Bridge ID field consisting of the concatenation of a 2-byte Bridge Priority and a 6-byte Bridge MAC address. RST and MST Bridges allow Bridge Priority value configuration of only the four most significant bits, thereby supporting a range of Bridge Priority values from 0 to 61440, in increments of 4096. However, IEEE Std 802.1D-1998 ST Bridges support Bridge Priority value configuration of any value between 0 and 65535. Therefore, MST Bridges must support processing of a full range of Bridge Priority values. The 6-byte Bridge MAC address component of the CIST Bridge ID ensures that the Bridge will be distinguished from all other Bridges on the LAN. Generally, the Bridge MAC address is the MAC address of the Bridge STP entity, and is different than the MAC address(es) of the Bridge Port(s). The CIST Bridge ID contained in an MST BPDU is always equal to the CIST Bridge ID of the transmitting Bridge.

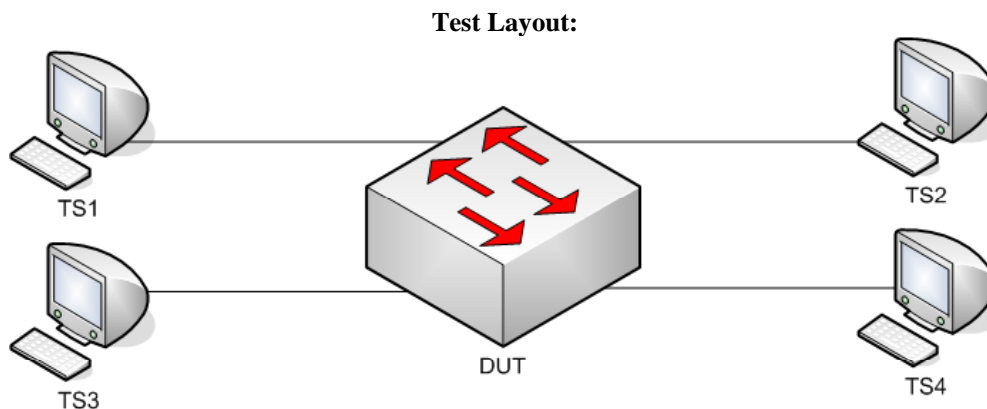


Figure 2.7 – Bridge ID Field Verification

Procedure:

Part A: Priority portion of the Bridge ID

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, RST.CISTBridgeID0000_000000000000 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, RST.CISTBridgeID0001_000000000000 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS4 capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using RST.CISTBridgeID7776_777777777777 and RST.CISTBridgeID7777_777777777777 in Steps 2 and 4, respectively.
9. Repeat Steps 2 through 7, using RST.CISTBridgeIDFFFFE_FFFFFFFF and RST.CISTBridgeIDFFFF_FFFFFFFF in Steps 2 and 4, respectively.

Part B: MAC Address portion of the Bridge ID

10. Ensure that the [Default Test Values](#) are configured on the DUT.
11. Continuously transmit, from TS1, RST.CISTBridgeID0000_000000000000 frames at a rate of one every two seconds.
12. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
13. Continuously transmit, from TS3, RST.CISTBridgeID0000_000000000001 frames at a rate of one every two seconds.
14. Start capture on TS1, TS2, TS3 and TS4.
15. Wait until TS2 and TS4 capture 2 MST BPDUs.
16. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
17. Repeat Steps 11 through 16, using RST.CISTBridgeID7777_777777777776 and RST.CISTBridgeID7777_777777777777 in Steps 11 and 13, respectively.
18. Repeat Steps 10 through 15, using RST.CISTBridgeIDFFFF_FFFFFFFF and RST.CISTBridgeIDFFFF_FFFFFFFF in Steps 11 and 13, respectively.

Observable results:

- In Part A, during Step 7, and repetitions of Step 7, TS2 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Parts A and B, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Part B, during Step 16, and repetitions of Step 16, TS2 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.

Possible Problems:

- None.

Test MSTP.op.2.8 – Port ID Field Verification

Purpose: To verify that the DUT processes RST BPDUs with varying Port ID field values, and to examine the DUT’s Port ID configuration mechanism.

References:

- IEEE Std. 802.1D-2004: sub-clause 9.1 – Structure
- IEEE Std. 802.1D-2004: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-2004: sub-clause 9.3 – BPDU formats and parameters
- IEEE Std. 802.1D-2004: Figure 9-3 – RST BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 13.29 – Port Protocol Migration state machine
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-21 – Topology Change state machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

xST Bridge Version:	802.1D-1998	802.1t-2001	802.1D-2004	802.1Q-2005
Required Port Number Range:	1 – 255	1 – 4095	1 – 4095	1 – 4095
Required Port Priority Range:	0 – 255	0 – 240*	0 – 240*	0 – 240*

* = Increments of 16 (IEEE 802.1t-2001 updated IEEE 802.1D-1998)

Table 2.1 – xSTP Port ID Support

IEEE 802.1D-1998 ST BPDUs contain a Port ID field consisting of the concatenation of an 8-bit Port Priority value and an 8-bit Port Number value. IEEE 802.1t-2001 ST BPDUs, RST BPDUs and MST BPDUs contain a Port ID field consisting of the concatenation of the four most significant bits of the Port Priority value and a 12-bit Port Number value.

The CIST Port ID distinguishes the Port from all other Ports on the Bridge and allows the network administrator one additional method to administratively control selection of the Root and Root Port. The CIST Port ID may be used as a tiebreaker when two Bridges are directly connected with more than one link, and when a Bridge is directly connected to itself. The CIST Port ID contained in a BPDU is always that of the Port from which it was transmitted.

Test Layout:

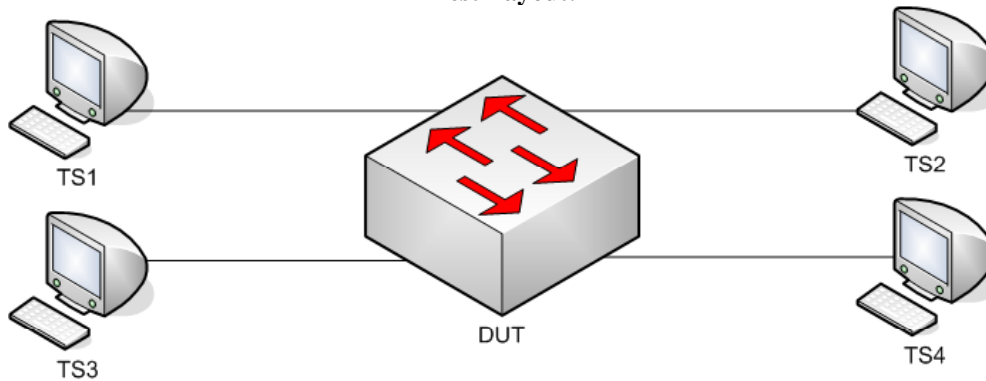


Figure 2.8 – Port ID Field Verification

Procedure:

Part A: Various CIST Port ID values

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, RST.PortID0000 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, RST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, RST.PortID0001 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS4 capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using RST.PortID0100 and RST.PortID0101 in Steps 2 and 4, respectively.
9. Repeat Steps 2 through 7, using RST.PortIDF000 and RST.PortIDF001 in Steps 2 and 4, respectively.
10. Repeat Steps 2 through 7, using RST.PortIDFFFE and RST.PortIDFFFF in Steps 2 and 4, respectively.

Observable results:

- In Part A, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Part A, during Step 7, and repetitions of Step 7, TS2 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.

Possible Problems:

- None.

Test MSTP.op.2.9 – Message Age Field Verification

Purpose: To verify that the DUT only processes RST BPDUs containing a Message Age less than the Max Age , and that the Message Age is incremented properly in MST BPDUs transmitted by the DUT (when it is not the Root).

References:

- IEEE Std. 802.1D-2004: sub-clause 9.1 – Structure
- IEEE Std. 802.1D-2004: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-2004: sub-clause 9.3 – BPDU formats and parameters
- IEEE Std. 802.1D-2004: Figure 9-3 – RST BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

xST Bridge Version:	802.1D-1998	802.1t-2001	802.1D-2004	802.1Q-2005
Message Age Increment Range:	1 – 4	1 – 4	1	1
Recommended Message Age Increment:	1	1	1	1

Table 2.2 – xSTP Message Age Range

The Message Age field represents a decimal number of seconds encoded in hex. The first byte of the Message Age field represents integer seconds in the range 0 to 255. The Message Age field marks the age of the CIST information contained in an MST BPDU relative to the information’s origination at the CIST Root Bridge. When a Port receives an MST BPDU containing better information than that which is currently held for the Port, the information is recorded, and the Port’s Message Age Timer is set to the Message Age contained in the received MST BPDU. The Message Age Timer is started – it will increment at regular intervals until new or same information is received or Message Age Timer Expiry occurs.

When an MST Bridge is the CIST Root, it transmits MST BPDUs containing a Message Age of zero. MST Bridges that are the CIST Regional Root transmit MST BPDUs containing a Message Age value equal to the current value of the Message Age Timer for the CIST Root Port of the MST Region it participates in incremented by 1. MST Bridges that are not the CIST Regional Root transmit MST BPDUs containing a Message Age value equal to the Message Age Timer of the Bridge’s CIST Root Port. MST BPDUs containing a Message Age that is greater than or equal to their Max Age are immediately aged by the updRcvdInfoWhileCist() procedure.

$2 \times (\text{Bridge_Forward_Delay} - 1.0 \text{ seconds}) \geq \text{Bridge_Max_Age} \geq 2 \times (\text{Bridge_Hello_Time} + 1.0 \text{ seconds})$

Test Layout:

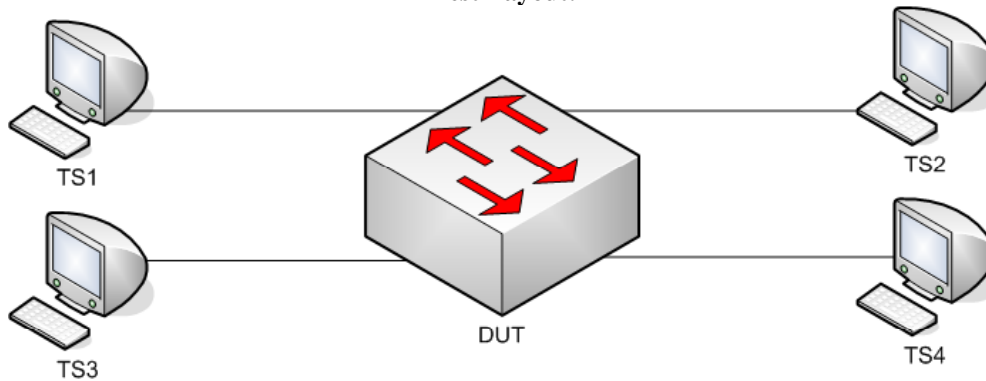


Figure 2.9 – Message Age Field Verification

Procedure:

Part A: Various Message Age Values

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, RST.MessageAge0000 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, RST.MessageAge0001 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS4 capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using RST.MessageAge1100 and RST.MessageAge1200 in Steps 2 and 4, respectively.

Part B: Valid Message Age Value > DUT's Max Age

9. Ensure that the [Default Test Values](#) are configured on the DUT.
10. Continuously transmit, from TS1, RST.MessageAge2000 frames at a rate of one every two seconds.
11. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
12. Continuously transmit, from TS3, RST.MessageAge2001 frames at a rate of one every two seconds.
13. Start capture on TS1, TS2, TS3 and TS4.
14. Wait until TS2, TS3 and TS4 capture 2 MST BPDUs.
15. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
16. Repeat Steps 10 through 15, using RST.MessageAgeFFFE and RST.MessageAgeFFFF in Steps 10 and 12, respectively.

Part C: BPDUs Containing Message Age Value == BPDUs's Max Age Value

17. Ensure that the [Default Test Values](#) are configured on the DUT.
18. Continuously transmit, from TS1, RST.MessageAge1400 frames at a rate of one every two seconds.
19. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
20. Continuously transmit, from TS3, RST.MessageAge1400 frames at a rate of one every two seconds.
21. Start capture on TS1, TS2, TS3 and TS4.
22. Wait until TS2, TS3 and TS4 capture 2 MST BPDUs.
23. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

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InterOperability Laboratory*

Part D: rcvdInfoWhile timer timeout

24. Ensure that the [Default Test Values](#) are configured on the DUT.
25. Continuously transmit, from TS1, RST.MessageAge_1300 frames at a rate of one every two seconds.
26. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
27. Start capture on TS1, TS2, TS3 and TS4.
28. Wait until TS2, TS3 and TS4 capture 2 BPDUs.
29. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Observable results:

- In Part A, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Part A, during Step 7, and repetitions of Step 7, TS2 and TS4 must capture properly formatted MST BPDUs with Message Age equal to that in frames transmitted by TS1, plus one second.
- In Part A, TS2 and TS4 must capture properly formatted MST BPDUs with a CIST Root ID equal to that in frames transmitted by TS1.
- In Parts B and C TS1, TS2, TS3 and TS4 must capture properly formatted MST BPDUs with Message Age equal to 0x0000.
- In Parts B and C TS1, TS2, TS3 and TS4 must capture properly formatted MST BPDUs with a CIST Root ID equal to the DUT's CIST Bridge ID.
- In Part D, during Step 29, TS1, TS2, TS3, and TS4 must capture properly formatted MST BPDUs with Message Age equal to 0x1400, and CIST Root ID equal to that in frames transmitted by TS1.

Possible Problems:

- None.

Test MSTP.op.2.10 – Max Age Field Verification

Purpose: To verify that the DUT only accepts RST BPDUs containing a valid Max Age value greater than the Message Age value, and that the Max Age value is properly encoded in RST BPDUs transmitted by the DUT.

References:

- IEEE Std. 802.1D-2004: sub-clause 9.1 – Structure
- IEEE Std. 802.1D-2004: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-2004: sub-clause 9.3 – BPDU formats and parameters
- IEEE Std. 802.1D-2004: Figure 9-3 – RST BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

xST Bridge Version:	802.1D-1998	802.1t-2001	802.1D-2004	802.1Q-2005
Max Age Value Range:	6 – 40	6 – 40	6 – 40	6 – 40
Recommended Max Age Value:	20	20	20	20

Table 2.3 – xSTP Max Age Range

The Max Age field represents a decimal number of seconds encoded in hex. The first byte of the Max Age field represents integer seconds in the range 0 to 255; the second byte represents the decimal value in seconds in the range 0 to 255/256 in increments of 1/256.

The Max Age field provides all xST Bridges in a LAN a value with which to determine if received information is valid or too old. The age of information contained in an xST BPDU is increased at each hop from the information’s origination at the Root Bridge. Information that transverse more hops than desired by the network administrator will be considered old, as the xST BPDU will contain a Message Age value greater than, or equal to, the Max Age value.

When an MST Bridge is the Root, it transmits xST BPDUs containing a Message Age value equal to zero and a Max Age value equal to the Bridge’s configured Max Age value. Non-Root MST Bridges transmit xST BPDUs containing a Message Age value equal to the current value of the Message Age Timer for the CIST Root Port on the MST Region incremented by a value greater than zero plus any transmission delay, but less than the maximum allowed Message Age Increment Overestimate, and a Max Age value equal to the Max Age value received in xST BPDUs on the Bridge’s Root Port. xST BPDUs containing a Message Age that is greater than or equal to their Max Age are immediately aged by the updRcvdInfoWhileCist() procedure.

$2 \times (\text{Bridge_Forward_Delay} - 1.0 \text{ seconds}) \geq \text{Bridge_Max_Age} \geq 2 \times (\text{Bridge_Hello_Time} + 1.0 \text{ seconds})$

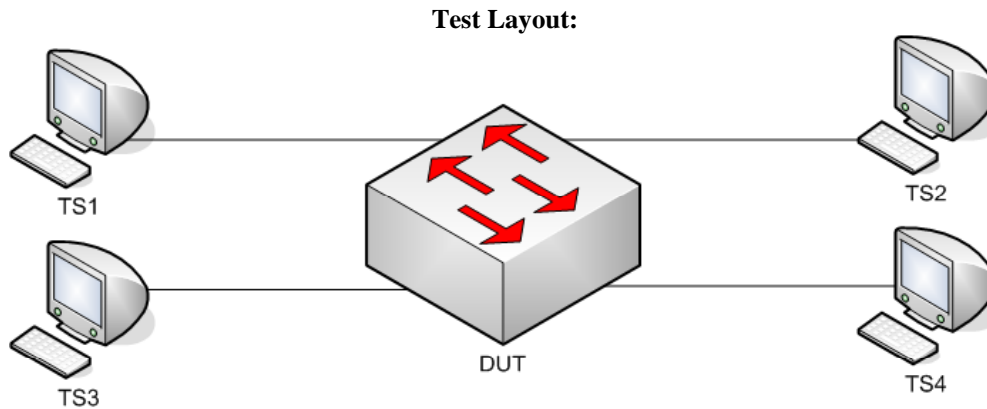


Figure 2.10 – Max Age Field Verification

Procedure:

Part A: RST BPDUs Containing Small, Valid Max Age Value

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, RST.MaxAge0600 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, RST.MaxAge0601 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS4 capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using RST.MaxAge06FF and RST.MaxAge0700 in Steps 2 and 4, respectively.

Part B: RST BPDUs Containing Invalid Max Age Value

9. Ensure that the [Default Test Values](#) are configured on the DUT.
10. Continuously transmit, from TS1, RST.MaxAge0500 frames at a rate of one every two seconds.
11. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
12. Continuously transmit, from TS3, RST.MaxAge0501 frames at a rate of one every two seconds.
13. Start capture on TS1, TS2, TS3 and TS4.
14. Wait until TS2 and TS4 capture 2 MST BPDUs.
15. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
16. Repeat Steps 10 through 15, using RST.MaxAgeFFFE and RST.MaxAgeFFFF in Steps 10 and 12, respectively.

Observable results:

- In Parts A and B, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Parts A and B TS2 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted from TS1.
- In Parts A and B TS2 and TS4 must capture properly formatted MST BPDUs with Max Age equal to that in frames transmitted from TS1.

Possible Problems:

- The DUT may ignore the least two significant bits of the Max Age field, and/or set them to zero on transmission. If this is the case, packets must be adjusted accordingly.

Test MSTP.op.2.11 – Hello Time Field Verification

Purpose: To verify that the DUT properly processes RST BPDUs containing various Hello Time values, and does not propagate the Hello Time contained in received BPDUs.

References:

- IEEE Std. 802.1D-2004: sub-clause 9.1 – Structure
- IEEE Std. 802.1D-2004: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-2004: sub-clause 9.3 – BPDU formats and parameters
- IEEE Std. 802.1D-2004: Figure 9-3 – RST BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

xST Bridge Version:	802.1D-1998	802.1t-2001	802.1D-2004	802.1Q-2005
Hello Time Value Range:	1 – 10	1 – 10	2	2
Recommended Hello Time Value:	2	2	2	2

Table 2.4 – xSTP Hello Time Range

The Hello Time field conveyed in xST BPDUs is not directly used by the Spanning Tree Algorithm of ST Bridges, but is conveyed to facilitate the monitoring of protocol performance by management functions. The Spanning Tree Algorithm does not use the Hello Time value during xST Bridge algorithm state operations; rather the Hello Time value is used to determine the period of BPDU transmission. MST Bridges use the Hello Time value within the Port Transmit State Machine to determine when to transmit ST, TCN and MST BPDUs.

An MST Bridge maintains a per-port Hello Time value for each Port on the Bridge. The per-port Hello Time value is used by the MST Bridge to determine the period of BPDU transmission on each Port and is conveyed in BPDUs transmitted by the Port. The per-port Hello Time value is configured via management, not via information in received BPDUs.

$2 \times (\text{Bridge_Forward_Delay} - 1.0 \text{ seconds}) \geq \text{Bridge_Max_Age} \geq 2 \times (\text{Bridge_Hello_Time} + 1.0 \text{ seconds})$

Test Layout:

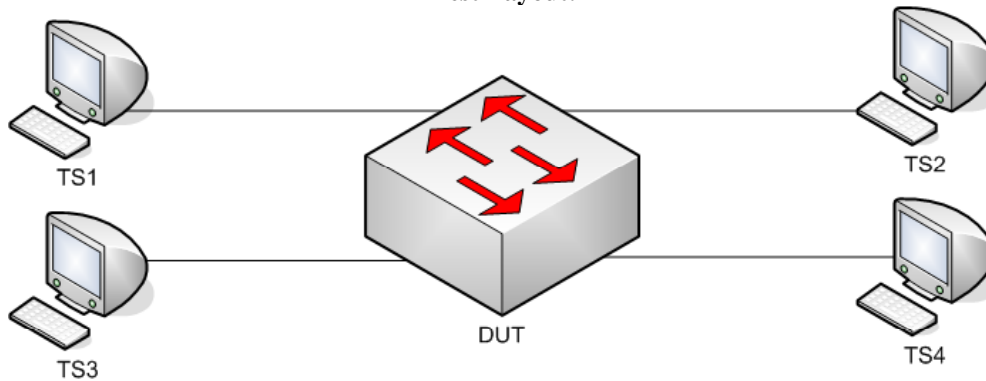


Figure 2.11 – Hello Time Field Verification

Procedure:

Part A: RST BPDUs Containing Various Hello Time Values

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, RST.Hello_0100 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, RST.Hello_0101 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS4 capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using RST.Hello_0A00 and RST.Hello_0A01 in Steps 2 and 4, respectively.
9. Repeat Steps 2 through 7, using RST.Hello_0F00 and RST.Hello_0F01 in Steps 2 and 4, respectively.

Part B: Hello Time of 0x0000

10. Ensure that the [Default Test Values](#) are configured on the DUT.
11. Continuously transmit, from TS1, RST.Hello_0000 frames at a rate of one every two seconds.
12. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
13. Continuously transmit, from TS3, RST.Hello_0001 frames at a rate of one every two seconds.
14. Start capture on TS1, TS2, TS3 and TS4.
15. Wait until TS2 and TS4 capture 2 MST BPDUs.
16. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Observable results:

- In Parts A and B, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Parts A and B TS2 and TS4 must capture MST BPDUs with a Hello Time equal to the Port Hello Time configured on DUT.TS2 and DUT.TS4 respectively.

Possible Problems:

- None

Test MSTP.op.2.12 – Forward Delay Field Verification

Purpose: To verify that the DUT properly processes RST BPDUs containing various Forward Delay values and propagates the Forward Delay contained in received BPDUs.

References:

- IEEE Std. 802.1D-2004: sub-clause 9.1 – Structure
- IEEE Std. 802.1D-2004: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-2004: sub-clause 9.3 – BPDU formats and parameters
- IEEE Std. 802.1D-2004: Figure 9-3 – RST BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

xST Bridge Version:	802.1D-1998	802.1t-2001	802.1D-2004	802.1Q-2005
Forward Delay Value Range:	4 – 30	4 – 30	4 – 30	4 – 30
Recommend Forward Delay Value:	15	15	15	15

Table 2.5 – xSTP Forward Delay Range

The Forward Delay is a Bridge-wide parameter that is conveyed in ST, RST and MST BPDUs to ensure that all Bridges in a Bridged LAN uses a consistent value for the Forward Delay Timer.

$2 \times (\text{Bridge_Forward_Delay} - 1.0 \text{ seconds}) \geq \text{Bridge_Max_Age} \geq 2 \times (\text{Bridge_Hello_Time} + 1.0 \text{ seconds})$

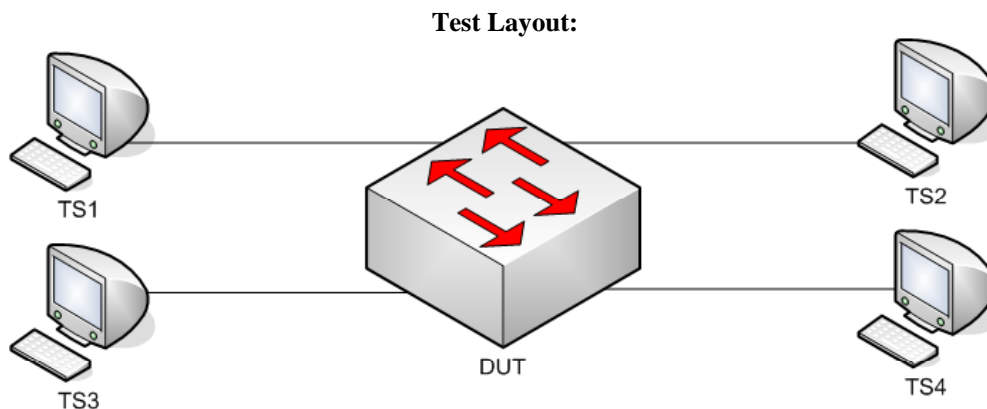


Figure 2.12 – Forward Delay Field Verification

Procedure:

Part A: Valid Forward Delay Value Configured

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Configure the DUT's Bridge Max Age to 6 seconds.
3. Configure the DUT's Bridge Forward Delay to 4 seconds.
4. Continuously transmit, from TS1, RST.WorseRootThanDUT frames at a rate of one every two seconds.
5. Start capture on TS1 and TS2.
6. Wait until TS1 and TS2 capture 2 MST BPDUs.
7. Stop capture on TS1 and TS2, and observe the captured frames.
8. Repeat Steps 2 through 7, using 2 seconds, 40 seconds and 30 seconds in Steps 2 and 3, respectively.

Part B: Recommended Range Forward Delay Value Propagation

9. Ensure that the [Default Test Values](#) are configured on the DUT.
10. Continuously transmit, from TS1, RST.FwdDelay_0400 frames at a rate of one every two seconds.
11. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
12. Continuously transmit, from TS3, RST.FwdDelay_0401 frames at a rate of one every two seconds.
13. Start capture on TS1, TS2, TS3 and TS4.
14. Wait until TS2 and TS4 capture 2 MST BPDUs.
15. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
16. Repeat Steps 10 through 15, using RST.FwdDelay_1DFF and RST.FwdDelay_1E00 in Steps 10 and 12, respectively.

Part C: Large Forward Delay Value Propagation

17. Ensure that the [Default Test Values](#) are configured on the DUT.
18. Continuously transmit, from TS1, RST.FwdDelay_1E01 frames at a rate of one every two seconds.
19. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
20. Continuously transmit, from TS3, RST.FwdDelay_1E02 frames at a rate of one every two seconds.
21. Start capture on TS1, TS2, TS3 and TS4.
22. Wait until TS2 and TS4 capture 2 MST BPDUs.
23. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
24. Repeat Steps 18 through 23, using RST.FwdDelay_FFFE and RST.FwdDelay_FFFF in Steps 18 and 20, respectively.

Observable results:

- In Part A, during Step 7 TS1 and TS2 must capture properly formatted MST BPDUs with Forward Delay equal to the DUT's configured Forward Delay.
- In Part A, during Step 7, and repetitions of Step 7, TS1 and TS2 must capture properly formatted MST BPDUs with CIST Root ID equal to the DUT's CIST Bridge ID.
- In Parts B and C, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Parts B and C TS2 and TS4 must capture properly formatted MST BPDUs with Forward Delay equal to that in frames transmitted by TS1.
- In Parts B and C, and repetitions of B and C, TS2 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.

Possible Problems:

- The DUT may ignore the least two significant bits of the Forward Delay field, and/or set them to zero on transmission. In this case, the frames must be modified.

Test MSTP.op.2.13 – Large BPDU Message Times

Purpose: To verify that the DUT properly processes RST BPDUs containing large CIST message times and propagates the Max Age and Forward Delay values contained in received BPDUs.

References:

- IEEE Std. 802.1D-2004: sub-clause 9.1 – Structure
- IEEE Std. 802.1D-2004: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-2004: sub-clause 9.3 – BPDU formats and parameters
- IEEE Std. 802.1D-2004: Figure 9-3 – RST BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

ST, RST and MST Bridges support a range of timer values and methods designed to age out old information in the Bridged LAN. MST Bridges must support the ability to process each of the information ageing methods, and operate in a network consisting of many different information-ageing elements (IEEE 802.1D-1998, IEEE 802.1t-2001, IEEE 802.1w-2001, IEEE 802.1Q-2005, IEEE 802.1D-2004 and IEEE 802.1Q-2005). This Test examines the DUT's behavior in various information-ageing scenarios.

$2 \times (\text{Bridge_Forward_Delay} - 1.0 \text{ seconds}) \geq \text{Bridge_Max_Age} \geq 2 \times (\text{Bridge_Hello_Time} + 1.0 \text{ seconds})$

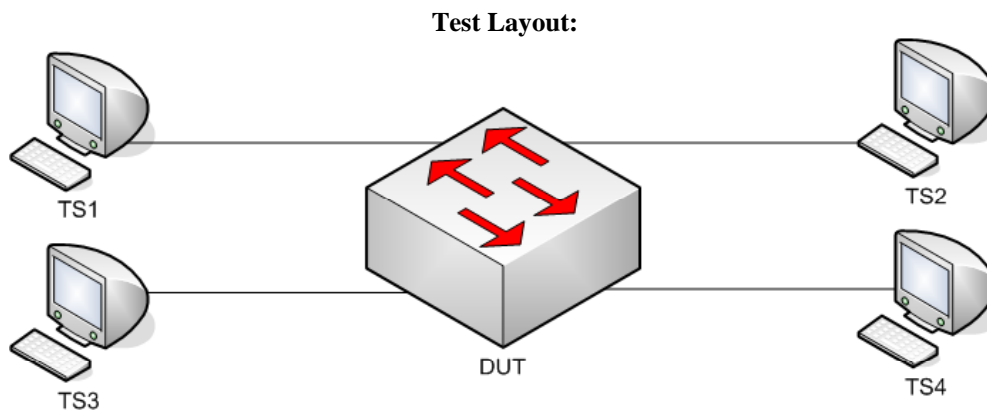


Figure 2.13 – Large BPDU Message Times

Procedure:

Part A: Valid Large Message Times

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, RST.MakeRootPortBigMsgTimes1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, RST.MakeRootPortBigMsgTimes2 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS4 to capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Observable results:

- In Part A, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Part A, during Step 7, TS2 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part A, during Step 7, TS2 and TS4 must capture properly formatted MST BPDUs with Max Age and Forward Delay equal to that in frames transmitted by TS1.
- In Part A, during Step 7, TS2 and TS4 must capture properly formatted MST BPDUs with Hello Time equal to the Port Hello Time configured on DUT.TS2 and DUT.TS4 respectively.

Possible Problems:

- None.

Test MSTP.op.2.14 – BPDU Length Verification

Purpose: To verify that the DUT properly processes RST BPDUs of various lengths and propagates the information contained in valid received BPDUs.

References:

- IEEE Std. 802.1D-2004: sub-clause 9.1 – Structure
- IEEE Std. 802.1D-2004: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-2004: sub-clause 9.3 – BPDU formats and parameters
- IEEE Std. 802.1D-2004: Figure 9-3 – RST BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 3 Test Stations

Discussion:

The requirements for validation of received BPDUs depend on BPDU type: ST BPDU, RST BPDU, MST BPDU, and TCN BPDU. A BPDU shall be considered invalid, and shall not be processed, if it does not contain the minimum number of octets specified for a particular BPDU type: 35, 36, 35 and 4, respectively. Additionally, a minimum BPDU size equal to 102 octets is defined for MST BPDUs. By default, all BPDUs transmitted in valid Ethernet frames must contain at least 48 octets between the Length field and the FCS. Therefore, all BPDUs transmitted in valid Ethernet frames satisfy the minimum BPDU size requirements.

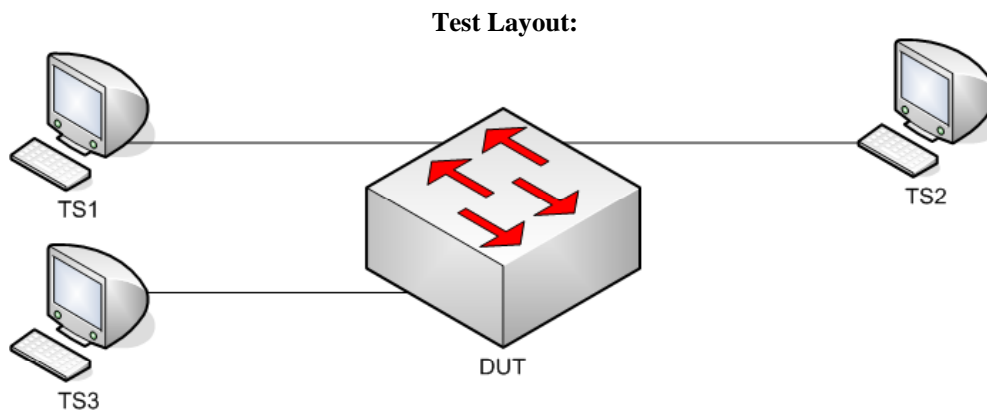


Figure 2.14 – Length/Type Field Verification

Procedure:

Part A: Invalid BPDU Lengths

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, RST.MakeRootPortLength1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Start capture on TS1, TS2 and TS3.
5. Wait until TS2 and TS3 to capture 2 MST BPDUs.
6. Stop capture on TS1, TS2 and TS3, and observe the captured frames.
7. Repeat Steps 2 through 6, using RST.MakeRootPortLength2 frame in Step 2.
8. Repeat Steps 2 through 6, using RST.MakeRootPortLength3 frame in Step 2.

Part B: Valid BPDU Lengths

9. Ensure that the [Default Test Values](#) are configured on the DUT.
10. Continuously transmit, from TS1, RST.MakeRootPortBPDULength1 frames at a rate of one every two seconds.
11. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
12. Start capture on TS1, TS2 and TS3.
13. Wait until TS2 and TS3 to capture 2 MST BPDUs.
14. Stop capture on TS1, TS2 and TS3, and observe the captured frames.
15. Repeat Steps 10 through 14, using RST.MakeRootPortBPDULength2 frame in Step 10.
16. Repeat Steps 10 through 14, using RST.MakeRootPortBPDULength3 frame in Step 10.
17. Repeat Steps 10 through 14, using RST.MakeRootPortBPDULength4 frame in Step 10.
18. Repeat Steps 10 through 14, using RST.MakeRootPortBPDULength5 frame in Step 10.

Observable results:

- In Part A, during Step 6, and repetitions of Step 6, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to the CIST Root ID configured on the DUT.
- In Part B, during Step 14, and repetitions of Step 14, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.

Possible Problems:

- None.

Test MSTP.op.2.15 – Receive Identical RST BPDUs On Two Different Ports

Purpose: To verify that the DUT properly processes RST BPDUs when receiving identical BPDUs on two different Ports.

References:

- IEEE Std. 802.1D-2004: sub-clause 9.1 – Structure
- IEEE Std. 802.1D-2004: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-2004: sub-clause 9.3 – BPDU formats and parameters
- IEEE Std. 802.1D-2004: Figure 9-3 – RST BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

When a Bridge receives two identical RST BPDUs on two different Bridge Ports, it indicates there is a strong possibility of a network loop. To address this issue MST Bridges must place one of the two Ports in the Blocking State. The Port with a lesser CIST Port ID, must be placed in the Blocking State.

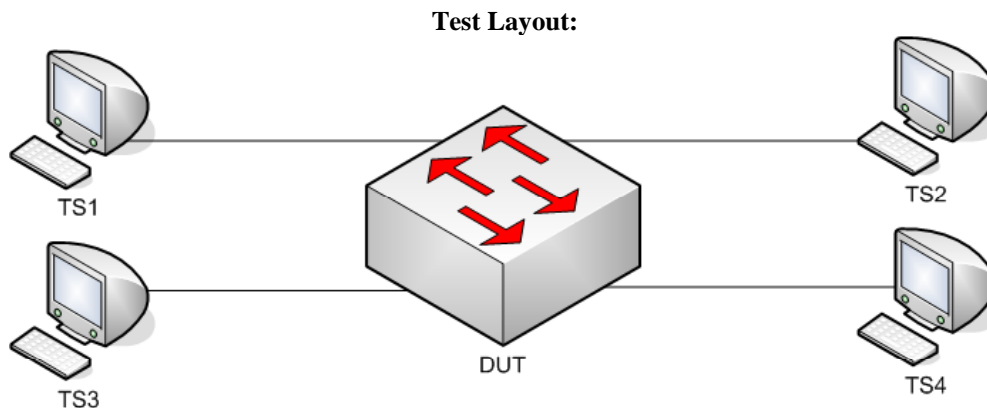


Figure 2.15 – Receive Identical RST BPDUs On Two Different Ports

Procedure:

Part A: Receive Identical RST BPDUs On Two Different Ports. DUT Is Not Root.

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, RST.IdenticalBPDU1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, RST.IdenticalBPDU1 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS4 to capture 2 MST BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Part B: Receive Identical RST BPDUs On Two Different Ports

8. Ensure that the [Default Test Values](#) are configured on the DUT. DUT Is Root.
9. Continuously transmit, from TS1, RST.IdenticalBPDU2 frames at a rate of one every two seconds.
10. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
11. Continuously transmit, from TS3, RST.IdenticalBPDU2 frames at a rate of one every two seconds.
12. Start capture on TS1, TS2, TS3 and TS4.
13. Wait until TS1, TS2, TS3 and TS4 to capture 2 MST BPDUs.
14. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Observable results:

- In Part A, the DUT must set DUT.TS3's Port Role to Alternate Port, and Port State to Discarding State.
- In Part A, during Step 7, TS2 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part B, during Step 14, TS1, TS2, TS3 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to the DUT's CIST Bridge ID.

Possible Problems:

- None.

Test MSTP.op.2.16 – VLAN Tagged BPDUs

Purpose: To verify that the DUT does not process tagged MST BPDUs.

References:

- IEEE Std. 802.1Q-2005: sub-clause 8.13.10 – VLAN attachment and connectivity for Higher Layer Entities

Resource Requirements:

- 3 Test Stations

Discussion:

Spanning Tree BPDUs transmitted by the Bridge Protocol Entity are not forwarded by Bridges, and must be visible to all other Bridge Protocol Entities attached to the same LAN segment. Such frames shall be transmitted Untagged; any BPDUs that carry a tag header are not recognized as well-formed BPDUs and are not forwarded by the Bridge.

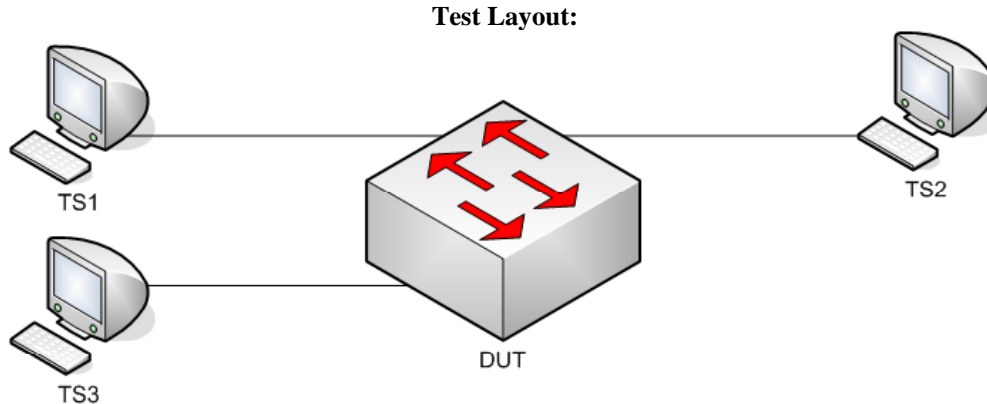


Figure 2.16 – VLAN tagged BPDUs

Procedure:

Part A: VLAN tagged BPDU

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, RST.MakeRootPortVLANTagged frames at a rate of one every two seconds.
3. Start capture on TS1, TS2 and TS3.
4. Wait until TS1, TS2 and TS3 capture 2 MST BPDUs.
5. Stop capture on TS1, TS2 and TS3, and observe the captured frames.

Observable results:

- In Part A, during Step 5, TS1, TS2 and TS3 must capture properly formatted MST BPDUs with a CIST Root ID equal to the DUT's Bridge ID.

Possible Problems:

- None.

GROUP 3: ST BPDU Format and Processing

Scope

This Group of tests examines the DUT's ST BPDU Frame Formats and Parameter Encoding behavior and ST BPDU validation procedure.

Overview

This Group tests the Frame Format of the following:

BPDU Types:

- ST BPDUs
- TCN BPDUs

BPDU Parameters:

- Protocol ID
- Protocol Version ID
- BPDU Type
- Flags
- Root Bridge ID
- Root Path Cost
- Bridge ID
- Port ID
- Message Age
- Max Age
- Forward Delay

Validation of BPDUs based on the following criteria:

- Protocol ID
- Message Age

Test MSTP.op.3.1 – Basic ST BPDU Verification

Purpose: To verify that the DUT properly processes basic ST BPDUs with valid field values, and transmits properly formatted ST BPDUs on Ports that have received an ST BPDU within the past 3 seconds.

References:

- IEEE Std. 802.1D-1998: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-1998: sub-clause 9.3.1 – Configuration BPDUs
- IEEE Std. 802.1D-1998: sub-clause 9.3.3 – Validation of received BPDUs
- IEEE Std. 802.1D-1998: Figure 9-1 – Configuration BPDU parameters and format
- IEEE Std. 802.1D-2004: sub-clause 17.17.4 – mdelayWhile
- IEEE Std. 802.1D-2004: sub-clause 17.24 – Port Protocol Migration state machine
- IEEE Std. 802.1D-2004: Figure 17-15 – Port protocol migration state machine
- IEEE Std. 802.1D-2004: Table 17-1 – RSTP Timer and Transmit Hold Count parameter values
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.29 – Port Protocol Migration state machine
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs

Resource Requirements:

- 4 Test Stations

Discussion:

IEEE Std 802.1D-1998 Figure 9-1 and sub-clauses 9.2, 9.3.1 specify the proper format and encoding of ST BPDUs. To ensure full legacy support and cross-vendor interoperability, an ST BPDU transmitted by an MST Bridge must adhere to the specified rules for format and encoding. An MST Bridge shall transmit ST BPDUs on any Port that has received an ST BPDU within 3 seconds (default Migrate Time value), as specified by the Port Protocol Migration state machine.

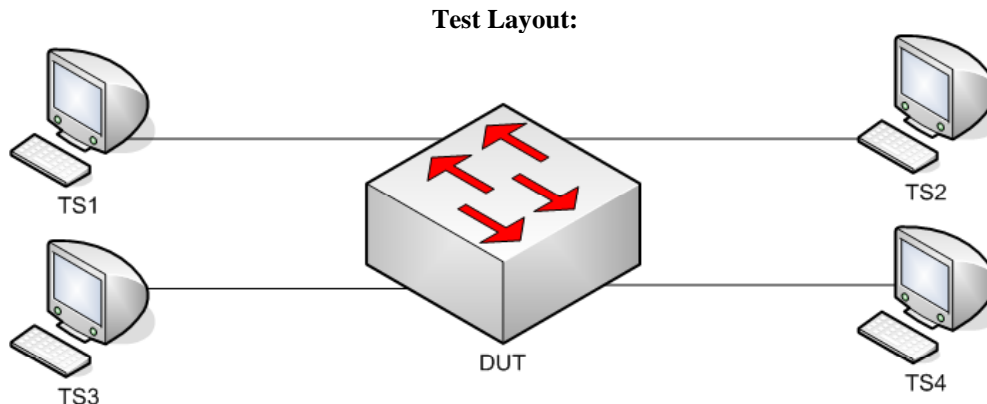


Figure 3.1 – Basic ST BPDU Verification

Procedure:

Part A: Valid BPDU Transmission – DUT is Root

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.WorseRootIDthanDUT frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Start capture on TS1 and TS2.
5. Wait until TS1 and TS2 capture two BPDUs.
6. Stop capture on TS1 and TS2, and observe the captured frames.

Part B: Valid BPDU Transmission – DUT is not Root

7. Ensure that the [Default Test Values](#) are configured on the DUT.
8. Continuously transmit, from TS1, ST.MakeRootPort frames at a rate of one every two seconds.
9. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
10. Continuously transmit, from TS4, ST.WorseRootIDthanDUT frames at a rate of one every two seconds.
11. Start capture on TS1, TS2, TS3 and TS4.
12. Wait until TS2, TS3 and TS4 capture two BPDUs.
13. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Part C: Valid TCN BPDU Transmission – TCN BPDUs

14. Ensure that the [Default Test Values](#) are configured on the DUT.
15. Continuously transmit, from TS1, ST.MakeRootPort frames at a rate of one every two seconds.
16. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
17. Start capture on TS1, TS2, TS3 and TS4.
18. Transmit, from TS4 a ST.TCN frame.
19. Wait until TS2, TS3 and TS4 capture two BPDUs.
20. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

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Observable results:

- In Part A, during Step 6, TS1 must capture properly formatted ST BPDUs containing the following fields and values:

BPDU Field Name	Field Value
Protocol ID / Protocol Version ID	0x0000 / 0x00
BPDU Type	0x00
Flags	0x00
Root Bridge ID	DUT's CIST Bridge ID
Root Path Cost	0x00000000
Designated Bridge ID	DUT's CIST Bridge ID
Designated Port ID	DUT.TS1's CIST Port ID
Message Age	0x0000
Max Age	DUT's Max Age
Hello Time	DUT.TS1's Port Hello Time
Forward Delay	DUT's Forward Delay

- In Part A, during Step 6, TS2 must capture properly formatted MST BPDUs containing the following fields and values:

BPDU Field Name	Field Value
Protocol ID / Protocol Version ID	0x0000 / 0x03
BPDU Type	0x02
CIST Flags	Designated Port and Discarding
CIST Root ID	DUT's CIST Bridge ID
CIST External Path Cost	0x00000000
CIST Regional Root ID	DUT's CIST Bridge ID
CIST Port ID	DUT.TS2's CIST Port ID
Message Age	0x0000
Max Age	DUT's Max Age
Hello Time	DUT.TS2's Port Hello Time
Forward Delay	DUT's Forward Delay
Version 1 Length	0x00
CIST Internal Root Path Cost	0x00000000
CIST Bridge ID	DUT's CIST Bridge ID
CIST Remaining Hops	DUT's Max Hops

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- In Part B, during Step 13, TS2 and TS3 must capture properly formatted MST BPDUs containing the following fields and values:

BPDU Field Name	Field Value
Protocol ID / Protocol Version ID	0x0000 / 0x03
BPDU Type	0x02
CIST Flags	Designated Port and Discarding (TS2) Designated Port and Forwarding (TS3)
CIST Root ID	Root ID contained in ST.MakeRootPort
CIST External Path Cost	Path Cost contained in ST.MakeRootPort incremented by DUT.TS1's Port Path Cost
CIST Regional Root ID	DUT's CIST Bridge ID
CIST Port ID	DUT.TS2 and DUT.TS3's CIST Port ID, respectively
Message Age	Message Age contained in ST.MakeRootPort incremented by 1.
Max Age	Max Age Contained in ST.MakeRootPort
Hello Time	DUT.TS2 and DUT.TS3's Port Hello Time, respectively
Forward Delay	Forward Delay contained in ST.MakeRootPort
Version 1 Length	0x00
CIST Internal Root Path Cost	0x00000000
CIST Bridge ID	DUT's CIST Bridge ID
CIST Remaining Hops	DUT's Max Hops

- In Part B, during Step 13, TS4 must capture properly formatted ST BPDUs containing the following fields and values:

BPDU Field Name	Field Value
Protocol ID / Protocol Version ID	0x0000 / 0x00
BPDU Type	0x00
Flags	0x00
Root Bridge ID	Root ID contained in ST.MakeRootPort
Root Path Cost	Path Cost contained in ST.MakeRootPort incremented by DUT.TS1's Port Path Cost
Designated Bridge ID	DUT's CIST Bridge ID
Designated Port ID	DUT.TS4's CIST Port ID
Message Age	Message Age contained in ST.MakeRootPort incremented by 1.
Max Age	Max Age contained in ST.MakeRootPort
Hello Time	DUT.TS4's Port Hello Time
Forward Delay	Forward Delay contained in ST.MakeRootPort

- In Part C, during Step 20, TS1 must capture a TCN BPDU.

BPDU Field Name	Field Value
Protocol ID / Protocol Version ID	0x0000 / 0x00
BPDU Type	0x80

- In Parts A, B and C, each port on the DUT must use a unique source MAC address.
- In Parts A, B and C, the BPDUs captured by TS1, TS2, TS3 and TS4 must be untagged.

Possible Problems:

- None.

Test MSTP.op.3.2 – Protocol ID Verification

Purpose: To verify that the DUT does not process ST BPDUs with a Protocol ID not equal to 0x0000.

References:

- IEEE Std. 802.1D-1998: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-1998: sub-clause 9.3.1 – Configuration BPDUs
- IEEE Std. 802.1D-1998: sub-clause 9.3.3 – Validation of received BPDUs
- IEEE Std. 802.1D-1998: Figure 9-1 – Configuration BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.19 – txConfig()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs

Resource Requirements:

- 4 Test Stations

Discussion:

The Protocol ID is encoded in the first and second octets of an ST BPDU. A Protocol ID of 0x0000 identifies the frame as a BPDU. Frames containing a Protocol ID not equal to 0x0000 are not BPDUs and shall not be processed by an MST Bridge's MSTP entity.

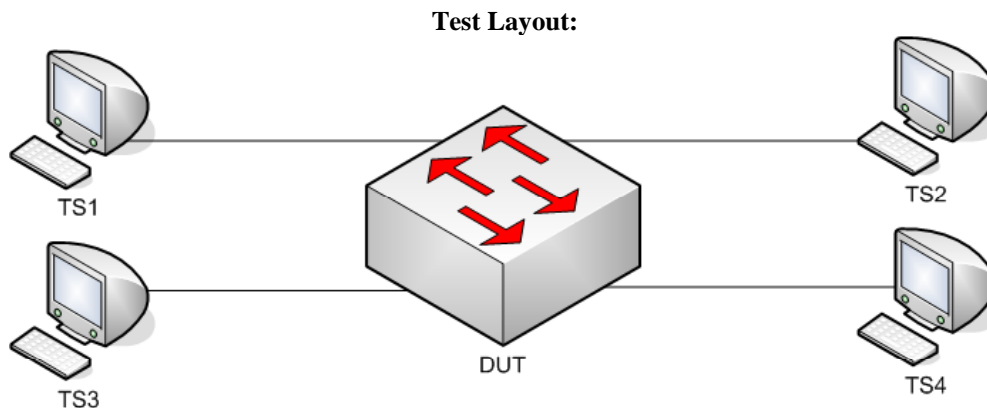


Figure 3.2 – Protocol ID Verification

Procedure:

Part A: Invalid Protocol ID

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.MakeRootPortBadProtoID1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS4, ST.WorseRootIDthanDUT frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS1, TS2, TS3 and TS4 capture 2 BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using ST.MakeRootPortBadProtoID2 in Step 2.
9. Repeat Steps 2 through 7, using ST.MakeRootPortBadProtoID3 in Step 2.
10. Repeat Steps 2 through 7, using ST.TCN_BadProtoID in Step 2.

Observable results:

- In Part A, during Step 7, and repetitions of Step 7, TS1, TS2, TS3 and TS4 must capture properly formatted MST BPDUs with CIST Root ID equal to the DUT's CIST Bridge ID. None of the frames captured should contain topology change information.

Possible Problems:

- None.

Test MSTP.op.3.3 – Protocol Version ID Verification

Purpose: To verify that the DUT processes ST BPDUs containing varying Protocol Version ID values.

References:

- IEEE Std. 802.1D-1998: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-1998: sub-clause 9.3.1 – Configuration BPDUs
- IEEE Std. 802.1D-1998: sub-clause 9.3.3 – Validation of received BPDUs
- IEEE Std. 802.1D-1998: Figure 9-1 – Configuration BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.19 – txConfig()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs

Resource Requirements:

- 4 Test Stations

Discussion:

The Protocol Version ID is encoded in the third octet of an ST BPDU. A compliant device must not validate an ST BPDU based on the value encoded in the Protocol Version ID field. This allows future versions of the Spanning Tree Protocol to use this field while providing legacy support for STP.

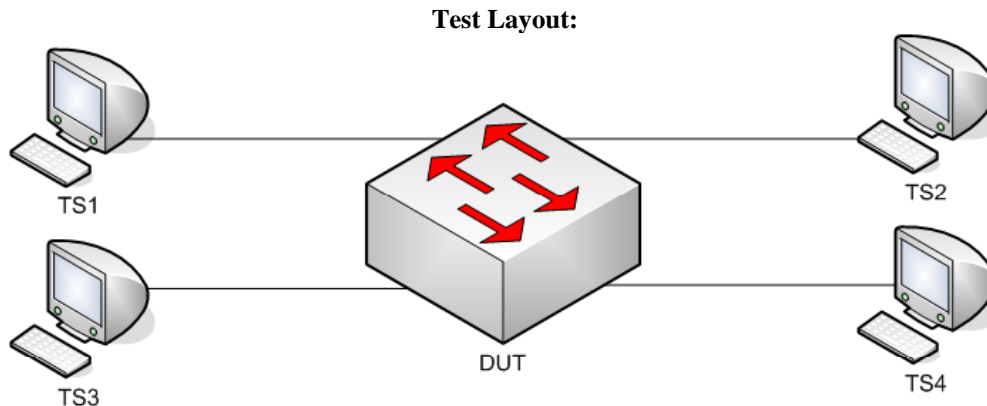


Figure 3.3 – Protocol Version ID Verification

Procedure:

Part A: Future Protocol Version ID – ST BPDU

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.MakeRootPortProtoVerID1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS4, ST.WorseRootIDthanDUT frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2, TS3 and TS4 capture 2 BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using ST.MakeRootPortProtoVerID2 in Step 2.
9. Repeat Steps 2 through 7, using ST.MakeRootPortProtoVerID3 in Step 2.

Part B: Future Protocol Version ID – TCN BPDU

10. Ensure that the [Default Test Values](#) are configured on the DUT.
11. Continuously transmit, from TS1, ST.MakeRootPortProtoVerID1 frames at a rate of one every two seconds.
12. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
13. Continuously transmit, from TS4, ST.WorseRootIDthanDUT frames at a rate of one every two seconds.
14. Start capture on TS1, TS2, TS3 and TS4.
15. Transmit, from TS4, one TCN_ProtoVerID frame.
16. Wait until TS2, TS3 and TS4 capture 2 BPDUs.
17. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Observable results:

- In Part A, during Step 7, and repetitions of Step 7, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part A, during Step 7, and repetitions of Step 7, TS4 must capture properly formatted ST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part B, during Step 17, TS1 must capture one TCN BPDU.

Possible Problems:

- None.

Test MSTP.op.3.4 – BPDU Type Field Verification

Purpose: To verify that the DUT does not process ST BPDUs containing an invalid BPDU Type field value.

References:

- IEEE Std. 802.1D-1998: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-1998: sub-clause 9.3.1 – Configuration BPDUs
- IEEE Std. 802.1D-1998: sub-clause 9.3.3 – Validation of received BPDUs
- IEEE Std. 802.1D-1998: Figure 9-1 – Configuration BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.19 – txConfig()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs

Resource Requirements:

- 4 Test Stations

Discussion:

Each version of STP defines one or more valid BPDU types. For version 0x00 of STP, the BPDU Type field allows a device to distinguish between an ST BPDU and a TCN BPDU. A BPDU Type field value of 0x00 denotes an ST BPDU and a BPDU Type field value of 0x80 denotes a TCN BPDU. For Protocol Version 0x00, any other value in the BPDU Type field denotes an invalid BPDU Type and must not be processed. The BPDU Type field is encoded in the fourth octet of a BPDU.

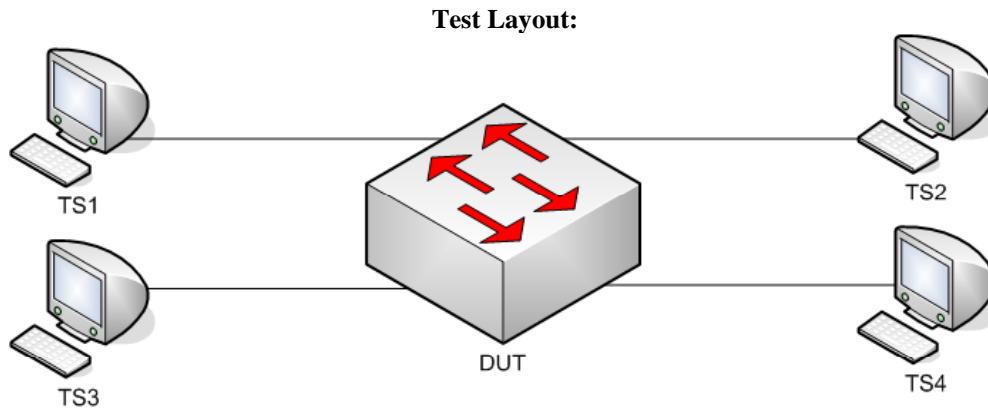


Figure 3.4 – BPDU Type Field Verification

Procedure:

Part A: BPDU Type – TCN BPDUs

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.MakeRootPort frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS4, ST.WorseRootIDthanDUT frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Transmit, from TS4, one ST.TCN_BPDU frame.
7. Wait until TS2, TS3 and TS4 capture 2 BPDUs.
8. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Part B: Invalid BPDU Types

9. Ensure that the [Default Test Values](#) are configured on the DUT.
10. Continuously transmit, from TS1, ST.MakeRootPortBadBPDUType1 frames at a rate of one every two seconds.
11. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
12. Continuously transmit, from TS4, ST.WorseRootIDthanDUT frames at a rate of one every two seconds.
13. Start capture on TS1, TS2, TS3 and TS4.
14. Wait until TS1, TS2, TS3 and TS4 capture 2 BPDUs.
15. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
16. Repeat Steps 10 through 15, using ST.MakeRootPortBadBPDUType2 in Step 10.
17. Repeat Steps 10 through 15, using ST.MakeRootPortBadBPDUType3 in Step 10.
18. Repeat Steps 10 through 15, using TCN_BadBPDUType in Step 10.

Observable results:

- In Part A, during Step 8 TS1 must capture one TCN BPDU with a Type field containing 0x80.
- In Part A, during Step 8 TS2 and TS3 must capture properly formatted MST BPDUs with the Topology Change Flag set to TRUE.
- In Part A, during Step 8 TS4 must capture ST BPDUs with the BPDU Flags set to 0x81.
- In Part B, during Step 15, and repetitions of Step 15, TS1, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to the DUT's CIST Bridge ID.
- In Part B, during Step 15, and repetitions of Step 15, TS4 must capture properly formatted ST BPDUs with CIST Root ID equal to the DUT's CIST Bridge ID.

Possible Problems:

- None.

Test MSTP.op.3.5 – BPDU Flags Field Verification

Purpose: To verify that the DUT processes ST BPDUs with varying valid BPDU Flags field values.

References:

- IEEE Std. 802.1D-1998: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-1998: sub-clause 9.3.1 – Configuration BPDUs
- IEEE Std. 802.1D-1998: sub-clause 9.3.3 – Validation of received BPDUs
- IEEE Std. 802.1D-1998: Figure 9-1 – Configuration BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.19 – txConfig()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit state machine
- IEEE Std. 802.1Q-2005: Figure 13-21 – Topology Change state machine

Resource Requirements:

- 4 Test Stations

Discussion:

Each version of Spanning Tree defines one or more flags, encoded using one or more bits within the BPDU Flags field. ST Version 0x00 defines 2 flags, each encoded in a single bit. The least significant bit in the BPDU flags field is the Topology Change Flag. The most significant bit in the BPDU flags field is the Topology Change Acknowledgement flag. Each flag is encoded with “1” indicating that the flag is set, a value of TRUE, or “0” indicating that the flag is not set, a value of FALSE. The Topology Change Flag notifies Bridges throughout the LAN that a change has occurred in the topology of the LAN. Each ST Bridge that receives such a notification sets the ageing time for its Filtering Database equal to Forward Delay. As a result, all dynamic filtering entries that are not updated during the next Forward Delay interval are flushed. Each RST or MST Bridge that receives such a notification flushes its Filtering Database entries on all Ports other than the receiving Port. ST, RST and MST Bridges respond to Topology Change Notification BPDUs by setting the Topology Change Acknowledgement Flag in the next ST BPDU transmitted on the Port that received the TCN BPDU. This will cause the Bridge transmitting TCN BPDU to stop transmission of TCN BPDUs (until another Topology Change is detected). Bits 2-7 of the Flags field are reserved for future use and are not checked upon reception of a ST BPDU.

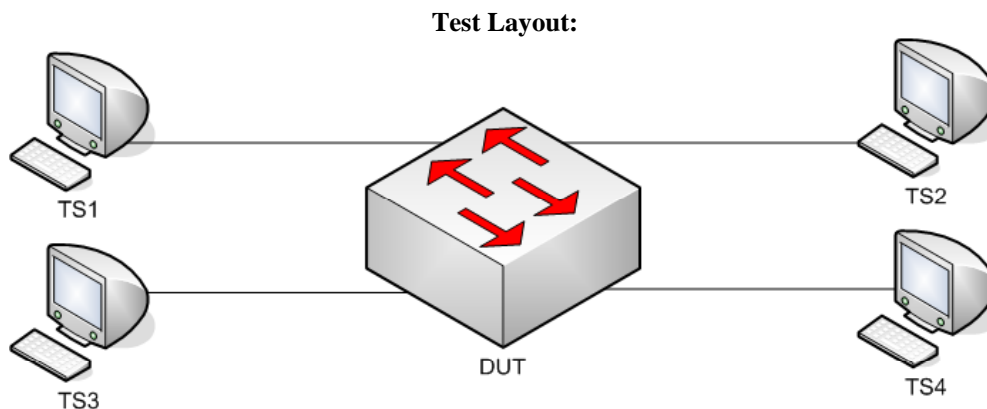


Figure 3.5 – BPDU Flags Field Verification

Procedure:

Part A: BPDU Flags Field of 0x81

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.MakeRootPort frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS4, ST.WorseRootIDthanDUT frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Transmit, from TS4, one TCN_BPDU frame.
7. Wait until TS1, TS2, TS3 and TS4 capture 1 BPDU.
8. Stop transmitting, from TS1, ST.MakeRootPort frames.
9. Transmit, from TS1, one ST.TC_TcackBPDU frame.
10. Wait until TS2, TS3 and TS4 capture 1 BPDU.
11. Continuously transmit, from TS1, ST.MakeRootPort frames at a rate of one every two seconds.
12. Wait until TS2, TS3 and TS4 capture 25 MST, MST and MST BPDUs, respectively.
13. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Observable results:

- In Part A, during Step 7, TS1 must capture one properly formatted TCN BPDU.
- In Part A, during Step 7, TS2 and TS3 must capture one properly formatted MST BPDU with the Topology Change Flag set to TRUE.
- In Part A, during Step 7, TS4 must capture one properly formatted ST BPDU with the Topology Change Flags Field set to 0x81.
- In Part A, during Step 10, TS1 must not capture any BPDUs.
- In Part A, during Step 12, TS1 must not capture any BPDUs.
- In Part A, during steps 7, 10, and 12, TS2 and TS3 should receive MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part A, during steps 7, 10, and 12, TS4 should receive ST BPDUs with Root ID equal to that in frames transmitted by TS1.

Possible Problems:

- None.

Test MSTP.op.3.6 – Root ID Field Verification

Purpose: To verify that the DUT processes ST BPDUs with varying Root Bridge ID, Bridge ID and Root Path Cost field values.

References:

- IEEE Std. 802.1D-1998: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-1998: sub-clause 9.3.1 – Configuration BPDUs
- IEEE Std. 802.1D-1998: sub-clause 9.3.3 – Validation of received BPDUs
- IEEE Std. 802.1D-1998: Figure 9-1 – Configuration BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.19 – txConfig()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp(),
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit state machine

Resource Requirements:

- 4 Test Stations

Discussion:

The Root ID contained in ST BPDUs transmitted by an MST Bridge is a result of the CIST Priority Vector Calculation process. If an MST Bridge has not received a BPDU from a Bridge within the Region it participates in containing a Root ID, CIST Root ID, better than the Bridge's CIST Bridge ID, then the Bridge considers itself the CIST Regional Root and will transmit MST BPDUs containing a CIST Regional Root ID equal to its own CIST Bridge ID, and ST BPDUs containing a Bridge ID equal to its own CIST Bridge ID. Otherwise, the Bridge will appoint the Port receiving the best CIST Internal Path Cost as the CIST Root Port and transmit BPDUs containing the CIST Root Port's *port priority vector* on all of its Designated Ports. If an MST Bridge that is the CIST Regional Root and has not received a BPDU from outside the Region it participates in containing a CIST Root ID (MST BPDUs), or Root Bridge ID (ST BPDUs), better than the Bridge's CIST Bridge ID, then it will consider itself the CIST Root Bridge and will transmit MST BPDUs containing a CIST Root ID equal its own CIST Bridge ID, and ST BPDUs containing a Root Bridge ID equal to its own CIST Bridge ID. Otherwise, the Bridge will appoint the Port receiving the best CIST Root ID as the CIST Root Port and transmit BPDUs containing the CIST Root Port's *port priority vector* on all of its Designated Ports.

The Bridge ID or Root Bridge ID, or CIST Root ID, is the concatenation of a 2-byte Bridge Priority and a 6-byte Bridge MAC address. MST Bridges allow Bridge Priority value configuration of only the four most significant bits, thereby supporting a range of Bridge Priority values from 0 to 61440, in increments of 4090. However, IEEE Std 802.1D-1998 ST Bridges allow Bridge Priority value configuration to any value between 0 and 65535. Therefore, MST Bridges must support processing a full range of Bridge Priority values.

Test Layout:

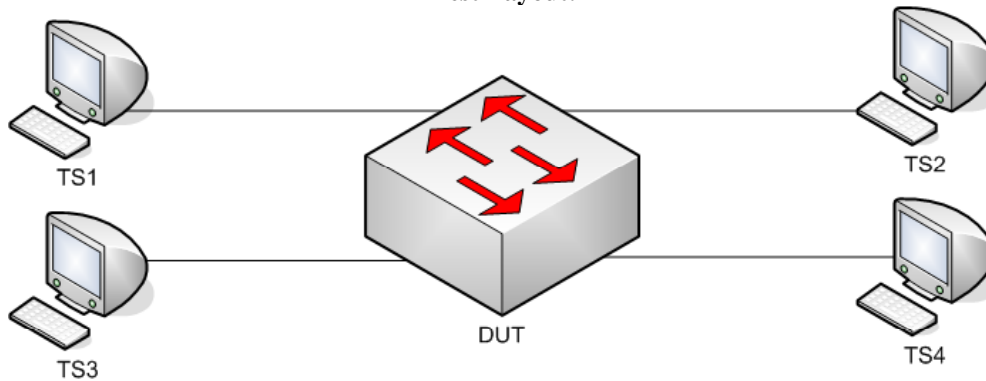


Figure 3.6 – Root ID Field Verification

Procedure:

Part A: ST BPDU Root ID Verification – Priority Portion

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.RootID0000_000000000000 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS4, ST.RootID0001_000000000000 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS4 and TS3 capture 2 BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using ST.RootID7776_777777777777 and ST.RootID7777_777777777777 frames in Steps 2 and 4, respectively.

Part B: ST BPDU Root ID Verification – MAC Address Portion

9. Ensure that the [Default Test Values](#) are configured on the DUT.
10. Continuously transmit, from TS1, ST.RootID0000_000000000000 frames at a rate of one every two seconds.
11. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
12. Continuously transmit, from TS4, ST.RootID0000_000000000001 frames at a rate of one every two seconds.
13. Start capture on TS1, TS2, TS3 and TS4.
14. Wait until TS4 and TS3 capture 2 BPDUs.
15. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
16. Repeat Steps 10 through 15, using ST.RootID7777_777777777776 and ST.RootID7777_777777777777 frames in Steps 10 and 12, respectively.

Observable results:

- In Part A, during Step 7, and repetitions of Step 7, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part A, during Step 7, and repetitions of Step 7, TS4 must capture properly formatted ST BPDUs with Root ID equal to that in frames transmitted by TS1.
- In Part B, during Step 15, and repetitions of Step 15, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part B, during Step 15, and repetitions of Step 15, TS4 must capture properly formatted ST BPDUs with Root ID equal to that in frames transmitted by TS1.

Possible Problems:

- None.

Test MSTP.op.3.7 – Root Path Cost Field Verification

Purpose: To verify that the DUT processes ST BPDUs with varying Root Path Cost field values.

References:

- IEEE Std. 802.1D-1998: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-1998: sub-clause 9.3.1 – Configuration BPDUs
- IEEE Std. 802.1D-1998: sub-clause 9.3.3 – Validation of received BPDUs
- IEEE Std. 802.1D-1998: Figure 9-1 – Configuration BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.19 – txConfig()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp(),
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit state machine

Resource Requirements:

- 4 Test Stations

Discussion:

The External Root Path Cost for an MST Bridge is the cost of the CIST network path from the Root Port of the MST Regional Root Bridge to the CIST Root Bridge. The External Root Path Cost is not modified within an MST Region; therefore, the CIST External Path Cost value on all MST Bridges within an MST Region is equal. The CIST External Path Cost value is transmitted in BPDUs and may be used to determine the active topology. An MST Bridge encodes the CIST External Path Cost in the Root Path Cost field of ST BPDUs and the CIST External Path Cost field of MST BPDUs. The CIST External Path Cost for the CIST Root Bridge is zero. The CIST External Path Cost for all other Bridges is the sum of the *ExtRootPathCost* portion of the Root Port's *port priority vector* and Path Cost parameter value configured on the CIST Root Port.

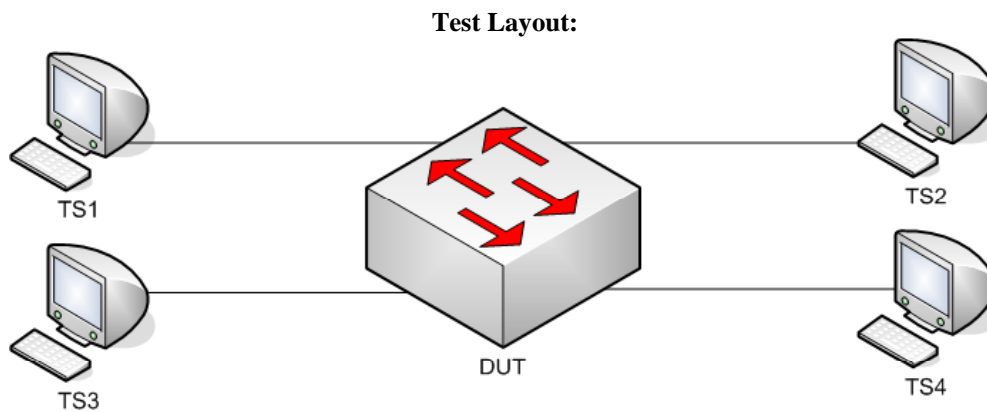


Figure 3.7 – Root Path Cost Field Verification

Procedure:

Part A: Root Path Cost of 0x00000000 – ST sourced

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.CISTRRootPath00000000 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS3, ST.WorseRootIDThanDUT frames at a rate of one every two seconds.
5. Continuously transmit, from TS4, ST.CISTRRootPath00000001 frames at a rate of one every two seconds.
6. Start capture on TS1, TS2, TS3 and TS4.
7. Wait until TS2 and TS3 capture 2 BPDUs.
8. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Part B: Root Path Cost of 0xFFFFFFFF – ST sourced – Informational

9. Ensure that the [Default Test Values](#) are configured on the DUT.
10. Continuously transmit, from TS1 ST.CISTRRootPathFFFFFFFFE frames at a rate of one every two seconds.
11. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
12. Continuously transmit, from TS4, ST.CISTRRootPathFFFFFFFFF frames at a rate of one every two seconds.
13. Start capture on TS1, TS2, TS3 and TS4.
14. Wait until TS2 and TS3 and TS4 capture 2 BPDUs.
15. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Observable results:

- In Part A, TS2 and TS3 must capture properly formatted MST BPDUs with External Root Path Cost equal to that in frames transmitted by TS1. plus DUT.TS1's Port Path Cost.
- In Part A, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part A, the DUT must set DUT.TS4's Port Role to Alternate Port, and Port State to Discarding State.
- In Part B, record the DUT's behavior with respect to Root Path Cost, as well as DUT.TS4's Port Role.

Possible Problems:

- None.

Test MSTP.op.3.8 – Bridge ID Field Verification

Purpose: To verify that the DUT processes ST BPDUs with varying Bridge ID field values; allows configuration of, and propagates valid Bridge Priority values; denies configuration of, and does not propagate invalid Bridge Priority values; and properly determines the CIST Root Port based on Bridge ID.

References:

- IEEE Std. 802.1D-1998: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-1998: sub-clause 9.3.1 – Configuration BPDUs
- IEEE Std. 802.1D-1998: sub-clause 9.3.3 – Validation of received BPDUs
- IEEE Std. 802.1D-1998: Figure 9-1 – Configuration BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.19 – txConfig()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp(),
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit state machine

Resource Requirements:

- 4 Test Stations

Discussion:

ST BPDUs contain a Bridge ID field consisting of the concatenation of a 2-byte Bridge Priority and a 6-byte Bridge MAC address. RST and MST Bridges allow Bridge Priority value configuration of only the four most significant bits, thereby supporting a range of Bridge Priority values from 0 to 61440, in increments of 4090. However, IEEE Std 802.1D-1998 ST Bridges support Bridge Priority value configuration of any value between 0 and 65535. Therefore, RST and MST Bridges must support processing of a full range of Bridge Priority values. The 6-byte Bridge MAC address component of the Bridge ID ensures that the Bridge will be distinguished from all other Bridges on the LAN. Generally, the Bridge MAC address is the MAC address of the Bridge STP entity, and is different than the MAC address(es) of the Bridge Port(s). The Bridge ID contained in an ST BPDU is always equal to the Bridge ID of the transmitting Bridge.

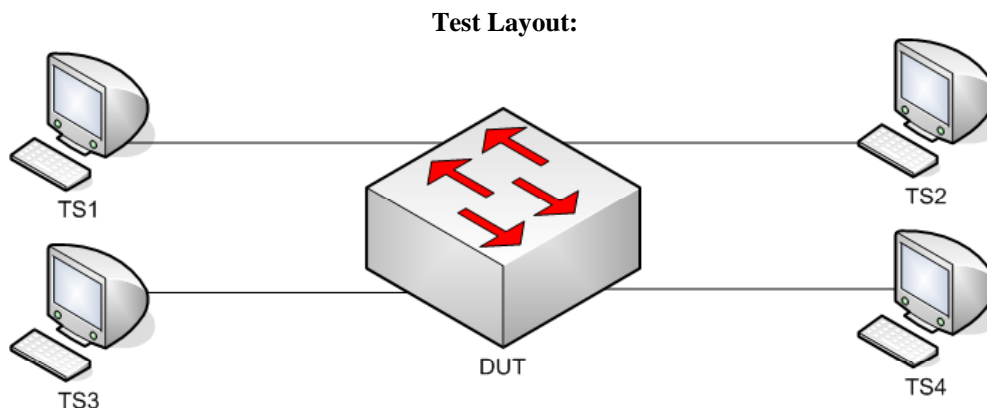


Figure 3.8 – Bridge ID Field Verification

Procedure:

Part A: Priority portion of the Bridge ID

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.CISTBridgeID0000_000000000000 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS4, ST.CISTBridgeID0001_000000000000 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS3 capture 2 BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using ST.CISTBridgeID7776_777777777777 and ST.CISTBridgeID7777_777777777777 in Steps 2 and 4, respectively.
9. Repeat Steps 2 through 7, using ST.CISTBridgeIDFFFE_FFFFFFFF and ST.CISTBridgeIDFFFF_FFFFFFFF in Steps 2 and 4, respectively.

Part B: MAC Address portion of the Bridge ID

10. Ensure that the [Default Test Values](#) are configured on the DUT.
11. Continuously transmit, from TS1, ST.CISTBridgeID0000_000000000000 frames at a rate of one every two seconds.
12. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
13. Continuously transmit, from TS4, ST.CISTBridgeID0000_000000000001 frames at a rate of one every two seconds.
14. Start capture on TS1, TS2, TS3 and TS4.
15. Wait until TS2 and TS3 capture 2 BPDUs.
16. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
17. Repeat Steps 11 through 16, using ST.CISTBridgeID7777_777777777776 and ST.CISTBridgeID7777_777777777777 in Steps 11 and 13, respectively.
18. Repeat Steps 11 through 16, using ST.CISTBridgeIDFFFF_FFFFFFFF and ST.CISTBridgeIDFFFF_FFFFFFFF in Steps 11 and 13, respectively.

Observable results:

- In Parts A and B, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted from TS1.
- In Parts A and B, the DUT must set DUT.TS4's Port Role to Alternate Port, and Port State to Discarding State.

Possible Problems:

- None.

Test MSTP.op.3.9 – Port ID Field Verification

Purpose: To verify that the DUT processes ST BPDUs with varying Port ID field values, and to examine the DUT's Port ID configuration mechanism.

References:

- IEEE Std. 802.1D-1998: sub-clause 8.5.1.4 – Port Identifier
- IEEE Std. 802.1D-1998: sub-clause 8.6.1.3.2 – Step 2
- IEEE Std. 802.1D-1998: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-1998: sub-clause 9.3.1 – Configuration BPDUs
- IEEE Std. 802.1D-1998: sub-clause 9.3.3 – Validation of received BPDUs
- IEEE Std. 802.1D-1998: Figure 9-1 – Configuration BPDU parameters and format
- IEEE Std. 802.1t-2001: sub-clause 9.2.7 – Encoding of Port Identifiers
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.19 – txConfig()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.20 – txMstp(),
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs

Resource Requirements:

- 4 Test Stations

Discussion:

xST Bridge Version:	802.1D-1998	802.1t-2001	802.1D-2004	802.1Q-2005
Required Port Number Range:	1 – 255	1 – 4095	1 – 4095	1 – 4095
Required Port Priority Range:	0 – 255	0 – 240*	0 – 240*	0 – 240*

* = Increments of 16 (IEEE 802.1t-2001 updated IEEE 802.1D-1998)

Table 3.1 – xSTP Port ID Range

IEEE 802.1D-1998 ST BPDUs contain a Port ID field consisting of the concatenation of an 8-bit Port Priority value and an 8-bit Port Number value. IEEE 802.1t-2001 ST BPDUs, RST BPDUs and MST BPDUs contain a Port ID field consisting of the concatenation of the four most significant bits of the Port Priority value and a 12-bit Port Number value.

The Port ID distinguishes the Port from all other Ports on the Bridge and allows the network administrator one additional method to administratively control selection of the Root and Root Port. The Port ID may be used as a tiebreaker when two Bridges are directly connected with more than one link, and when a Bridge is directly connected to itself. The Port ID contained in a BPDU is always that of the Port from which it was transmitted.

Test Layout:

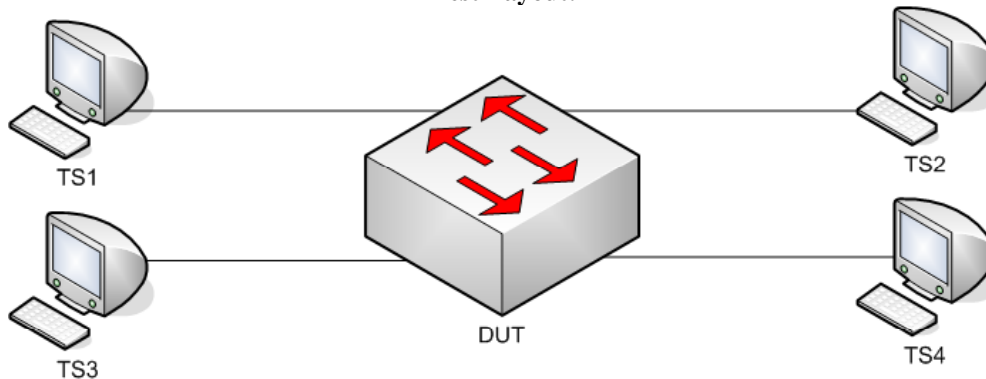


Figure 3.9 – Port ID Field Verification

Procedure:

Part A: Various Port ID Values

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.PortID_0000 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS4, ST.PortID_0001 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS3 capture 2 BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using ST.PortID_0100 and ST.PortID_0101 in Steps 2 and 4, respectively.
9. Repeat Steps 2 through 7, using ST.PortID_F000 and ST.PortID_F001 in Steps 2 and 4, respectively.
10. Repeat Steps 2 through 7, using ST.PortID_FFFE and ST.PortID_FFFF in Steps 2 and 4, respectively.

Observable results:

- In Part A, during Step 7, and repetitions of Step 7, the DUT must set DUT.TS4's Port Role to Alternate Port, and Port State to Discarding State.
- In Part A, during Step 7, and repetitions of Step 7, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1

Possible Problems:

- None.

Test MSTP.op.3.10 – Message Age Field Verification

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

References:

- IEEE Std. 802.1D-1998: sub-clause 8.5.1.5 – Message Age
- IEEE Std. 802.1D-1998: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-1998: sub-clause 9.2.8 – Encoding of Timer Values
- IEEE Std. 802.1D-1998: sub-clause 9.3.1 – Configuration BPDUs
- IEEE Std. 802.1D-1998: sub-clause 9.3.3 – Validation of received BPDUs
- IEEE Std. 802.1D-1998: Figure 9-1 – Configuration BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

xST Bridge Version:	802.1D-1998	802.1t-2001	802.1D-2004	802.1Q-2005
Message Age Increment Range:	1 – 4	1 – 4	1	1
Recommended Message Age Increment:	1	1	1	1

Table 3.2 – xSTP Message Age Range

The Message Age field represents a decimal number of seconds encoded in hex. The first byte of the Message Age field represents integer seconds in the range 0 to 255.

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

When an MST Bridge is the CIST Root, it transmits ST and MST BPDUs containing a Message Age of zero. MST Bridges that are the CIST Regional Root transmit ST and MST BPDUs containing a Message Age value equal to the current value of the Message Age Timer for the CIST Root Port of the MST Region it participates in incremented by 1. MST Bridges that are not the CIST Regional Root transmit ST and MST BPDUs containing a Message Age value equal to the Message Age Timer of the Bridge’s CIST Root Port. ST BPDUs containing a Message Age that is greater than or equal to their Max Age are not valid BPDUs, and the information they contain shall not be processed.

Test Layout:

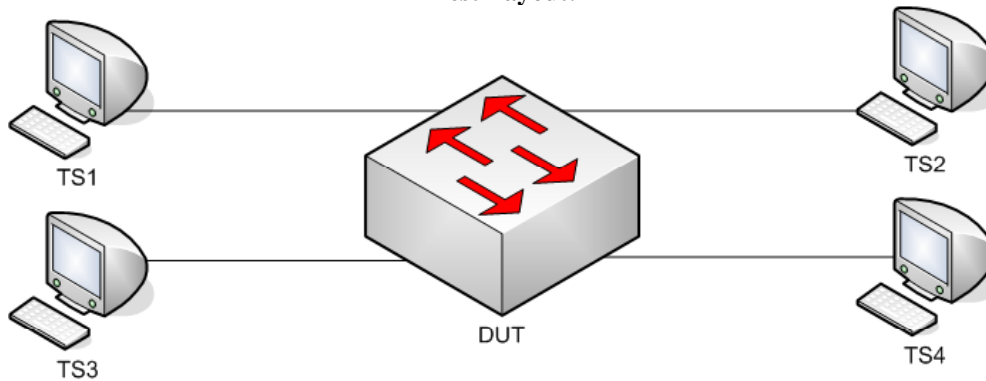


Figure 3.10 – Message Age Field Verification

Procedure:

Part A: Valid message Age Value < DUT's Max Age

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.MessageAge_0000 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS4, ST.MessageAge_0001 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS3 capture 2 BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using ST.MessageAge_1200 and ST.MessageAge_1201 in Steps 2 and 4, respectively.

Part B: Valid Message Age Value > DUT's Max Age

9. Ensure that the [Default Test Values](#) are configured on the DUT.
10. Continuously transmit, from TS1, ST.MessageAge_2000 frames at a rate of one every two seconds.
11. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
12. Continuously transmit, from TS4, ST.MessageAge_2001 frames at a rate of one every two seconds.
13. Start capture on TS1, TS2, TS3 and TS4.
14. Wait until TS2, TS3 and TS4 capture 2 BPDUs.
15. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
16. Repeat Steps 10 through 15, using ST.MessageAge_FFFE and ST.MessageAge_FFFF in Steps 10 and 12, respectively.

Part C: BPDUs Containing Message Age Value == BPDUs's Max Age Value

17. Ensure that the [Default Test Values](#) are configured on the DUT.
18. Continuously transmit, from TS1, ST.MessageAge_1400 frames at a rate of one every two seconds.
19. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
20. Continuously transmit, from TS4, ST.MessageAge_1400 frames at a rate of one every two seconds.
21. Start capture on TS1, TS2, TS3 and TS4.
22. Wait until TS2, TS3 and TS4 capture 2 BPDUs.
23. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

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Part D: rcvdInfoWhile timer timeout

24. Ensure that the [Default Test Values](#) are configured on the DUT.
25. Continuously transmit, from TS1, ST.MessageAge_1300 frames at a rate of one every two seconds.
26. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
27. Start capture on TS1, TS2, TS3 and TS4.
28. Wait until TS2, TS3 and TS4 capture 2 BPDUs.
29. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Observable results:

- In Part A, during Step 7, and repetitions of Step 7, the DUT must set DUT.TS4's Port Role to Alternate Port, and Port State to Discarding State.
- In Part A, during Step 7, and repetitions of Step 7, TS2 and TS3 must capture properly formatted MST BPDUs with Message Age equal to that in frames transmitted by TS1 plus 1 second.
- In Part A, during Step 7, and repetitions of Step 7, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Parts B and C TS1 and TS4 must capture properly formatted ST BPDUs with Message Age equal to 0x0000.
- In Parts B and C TS1 and TS4 must capture properly formatted ST BPDUs with CIST Root ID equal to the DUT's CIST Bridge ID.
- In Parts B and C TS2 and TS3 must capture properly formatted MST BPDUs with Message Age equal to 0x0000.
- In Parts B and C TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to the DUT's CIST Bridge ID.
- In Part D, during Step 29 TS2 and TS3 must capture properly formatted MST BPDUs with Message Age equal to that in frames transmitted by TS1 plus 1 second.
- In Part D, during Step 29 TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part D, during Step 29 TS4 must capture properly formatted ST BPDUs with Message Age equal to that in frames transmitted by TS1 plus 1 second.
- In Part D, during Step 29 TS4 must capture properly formatted ST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.

Possible Problems:

- None.

Test MSTP.op.3.11 – Max Age Field Verification

Purpose: To verify that the DUT only accepts ST BPDUs containing a valid Max Age value greater than the Message Age value, and that the Max Age value is properly encoded in ST BPDUs transmitted by the DUT.

References:

- IEEE Std. 802.1D-1998: sub-clause 8.5.1.5 – Message Age
- IEEE Std. 802.1D-1998: sub-clause 8.5.1.6 – Max Age
- IEEE Std. 802.1D-1998: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-1998: sub-clause 9.2.8 – Encoding of Timer Values
- IEEE Std. 802.1D-1998: sub-clause 9.3.1 – Configuration BPDUs
- IEEE Std. 802.1D-1998: sub-clause 9.3.3 – Validation of received BPDUs
- IEEE Std. 802.1D-1998: Figure 9-1 – Configuration BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

xST Bridge Version:	802.1D-1998	802.1t-2001	802.1D-2004	802.1Q-2005
Max Age Value Range:	6 – 40	6 – 40	6 – 40	6 – 40
Recommended Max Age Value:	20	20	20	20

Table 3.3 – xSTP Max Age Range

The Max Age field represents a decimal number of seconds encoded in hex. The first byte of the Max Age field represents integer seconds in the range 0 to 255; the second byte represents the decimal value in seconds in the range 0 to 255/256 in increments of 1/256.

The Max Age field provides all ST Bridges in a LAN a value with which to determine if received information is valid or too old. The age of information contained in an ST BPDU is increased at each hop from the information’s origination at the Root Bridge. Information that traverse more hops than desired by the network administrator will be considered old, as the BPDU will contain a Message Age value greater than, or equal to, the Max Age value.

When an MST Bridge is the Root, it transmits ST BPDUs containing a Message Age value equal to zero and a Max Age value equal to the Bridge’s configured Max Age value. Non-Root MST Bridges transmit ST BPDUs containing a Message Age value equal to the current value of the Message Age Timer for the CIST Root Port on the MST Region incremented by a value greater than zero plus any transmission delay, but less than the maximum allowed Message Age Increment Overestimate, and a Max Age value equal to the Max Age value received in BPDUs on the Bridge’s Root Port.

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

Test Layout:

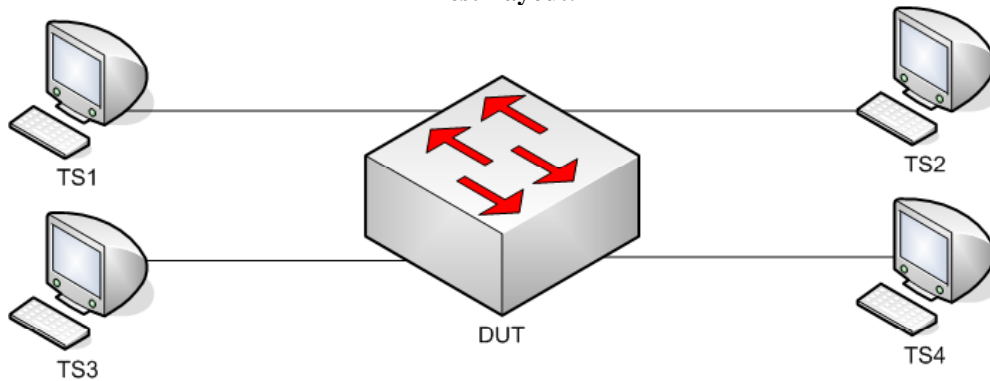


Figure 3.11 – Max Age Field Verification

Procedure:

Part A: ST BPDU Containing Small, Valid Max Age Value

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.MaxAge_0600 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS4, ST.MaxAge_0601 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS3 capture 2 BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using ST.MaxAge_06FF and ST.MaxAge_0700 in Steps 2 and 4, respectively.

Part B: ST BPDU Containing Invalid Max Age Value

9. Ensure that the [Default Test Values](#) are configured on the DUT.
10. Continuously transmit, from TS1, ST.MaxAge_0500 frames at a rate of one every two seconds.
11. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
12. Continuously transmit, from TS4, ST.MaxAge_0501 frames at a rate of one every two seconds.
13. Start capture on TS1, TS2, TS3 and TS4.
14. Wait until TS2 and TS3 capture 2 BPDUs.
15. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
16. Repeat Steps 10 through 15, using ST.MaxAge_FFFE and ST.MaxAge_FFFF in Steps 10 and 12, respectively.

Observable results:

- In Parts A and B the DUT must set DUT.TS4's Port Role to Alternate Port, and Port State to Discarding State.
- In Parts A and B TS2 and TS3 must capture properly formatted MST BPDUs with Max Age equal to that in frames transmitted by TS1.
- In Parts A and B TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.

Possible Problems:

- None.

Test MSTP.op.3.12 – Hello Time Field Verification

Purpose: To verify that the DUT properly processes ST BPDUs containing various Hello Time values, and does not propagate the Hello Time contained in received BPDUs.

References:

- IEEE Std. 802.1D-1998: sub-clause 8.5.1.7 – Hello Time
- IEEE Std. 802.1D-1998: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-1998: sub-clause 9.2.8 – Encoding of Timer Values
- IEEE Std. 802.1D-1998: sub-clause 9.3.1 – Configuration BPDUs
- IEEE Std. 802.1D-1998: sub-clause 9.3.3 – Validation of received BPDUs
- IEEE Std. 802.1D-1998: Figure 9-1 – Configuration BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

xST Bridge Version:	802.1D-1998	802.1t-2001	802.1D-2004	802.1Q-2005
Hello Time Value Range:	1 – 10	1 – 10	1 – 2	1 – 2
Recommended Hello Time Value:	2	2	2	2

Table 3.4 – xSTP Hello Time Range

The Hello Time field conveyed in ST BPDUs is not directly used by the Spanning Tree Algorithm of ST Bridges, but is conveyed to facilitate the monitoring of protocol performance by management functions. The Spanning Tree Algorithm does not use the Hello Time value during ST Bridge algorithm state operations; rather the Hello Time value is used to determine the period of BPDU transmission. MST Bridges use the Hello Time value within the Port Transmit State Machine to determine when to transmit ST, TCN and MST BPDUs.

An ST Bridge that is Root sets its Hello Timer to the value of Bridge Hello Time. An ST Bridge that is not Root uses its own Bridge Hello Time value to determine the rate at which TCN BPDUs should be transmitted (rather than the value conveyed in BPDUs). An MST Bridge maintains a per-port Hello Time value for each Port on the Bridge. The per-port Hello Time value is used by the MST Bridge to determine the period of BPDU transmission on each Port and is conveyed in BPDUs transmitted by the Port. The per-port Hello Time value is configured via management, not via information in received BPDUs.

Test Layout:

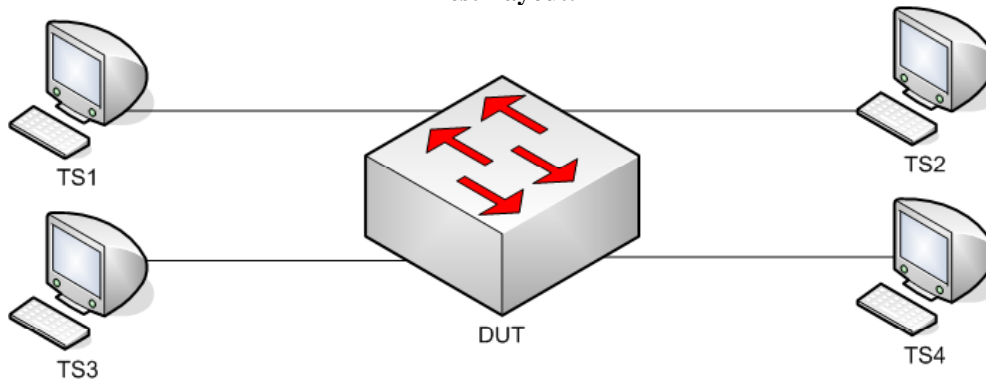


Figure 3.12 – Hello Time Field Verification

Procedure:

Part A: ST BPDU Containing Valid Hello Time Values

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.Hello_0000 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS4, ST.Hello_0001 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS3 capture 2 BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using ST.Hello_0A00 and ST.Hello_0A01 in Steps 2 and 4, respectively.
9. Repeat Steps 2 through 7, using ST.Hello_0F00 and ST.Hello_0F01 in Steps 2 and 4, respectively.

Part B: Hello Time of 0x0000

10. Ensure that the [Default Test Values](#) are configured on the DUT.
11. Continuously transmit, from TS1, ST.Hello_0000 frames at a rate of one every two seconds.
12. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
13. Continuously transmit, from TS3, ST.Hello_0001 frames at a rate of one every two seconds.
14. Start capture on TS1, TS2, TS3 and TS4.
15. Wait until TS2 and TS3 capture 2 BPDUs.
16. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Observable results:

- In Parts A and B the DUT must set DUT.TS4's Port Role to Alternate Port, and Port State to Discarding State.
- In Parts A and B TS2 and TS3 must capture properly formatted MST BPDUs at a rate of one every two seconds, with CIST Root ID equal to that in frames transmitted from TS1.
- In Parts A and B TS2 and TS3 must capture properly formatted MST BPDUs at a rate of one every two seconds, with a Hello Time equal to the Port Hello Time configured on DUT.TS2 and DUT.TS3 respectively.

Possible Problems:

- None

Test MSTP.op.3.13 – Forward Delay Field Verification

Purpose: To verify that the DUT properly processes ST BPDUs containing various Forward Delay values and propagates the Forward Delay contained in received BPDUs.

References:

- IEEE Std. 802.1D-1998: sub-clause 8.5.1.8 – Forward Delay
- IEEE Std. 802.1D-1998: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-1998: sub-clause 9.2.8 – Encoding of Timer Values
- IEEE Std. 802.1D-1998: sub-clause 9.3.1 – Configuration BPDUs
- IEEE Std. 802.1D-1998: sub-clause 9.3.3 – Validation of received BPDUs
- IEEE Std. 802.1D-1998: Figure 9-1 – Configuration BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

xST Bridge Version:	802.1D-1998	802.1t-2001	802.1D-2004	802.1Q-2005
Forward Delay Value Range:	4 – 30	4 – 30	4 – 30	4 – 30
Recommend Forward Delay Value:	15	15	15	15

Table 3.5 – xSTP Forward Delay Range

The Forward Delay is a Bridge-wide parameter that is conveyed in ST, RST and MST BPDUs to ensure that all Bridges in a Bridged LAN uses a consistent value for the Forward Delay Timer.

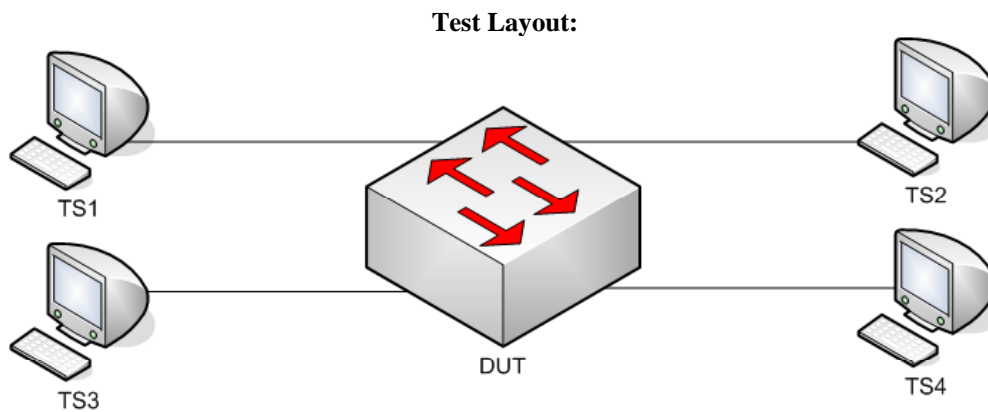


Figure 3.13 – Forward Delay Field Verification

Procedure:

Part A: Recommended Range Forward Delay Value Propagation

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.FwdDelay_0400 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS4, ST.FwdDelay_0401 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS3 capture 2 BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 11 through 16, using ST.FwdDelay_1DFF and ST.FwdDelay_1E00 in Steps 11 and 13, respectively.

Part B: Large Forward Delay Value Propagation

9. Ensure that the [Default Test Values](#) are configured on the DUT.
10. Continuously transmit, from TS1, ST.FwdDelay_1E01 frames at a rate of one every two seconds.
11. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
12. Continuously transmit, from TS4, ST.FwdDelay_1E02 frames at a rate of one every two seconds.
13. Start capture on TS1, TS2, TS3 and TS4.
14. Wait until TS2 and TS3 capture 2 BPDUs.
15. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
16. Repeat Steps 19 through 24, using ST.FwdDelay_FFFE and ST.FwdDelay_FFFF in Steps 19 and 21, respectively.

Observable results:

- In Parts A and B the DUT must set DUT.TS4's Port Role to Alternate Port, and Port State to Discarding State.
- In Parts A and B TS2 and TS3 must capture properly formatted MST BPDUs with Forward Delay equal to that in frames transmitted by TS1
- In Parts A and B TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.

Possible Problems:

- None.

Test MSTP.op.3.14 – Large BPDU Message Times

Purpose: To verify that the DUT properly processes ST BPDUs containing large CIST message times and propagates the Max Age and Forward Delay values contained in received BPDUs.

References:

- IEEE Std. 802.1D-1998: sub-clause 8.5.1.8 – Forward Delay
- IEEE Std. 802.1D-1998: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-1998: sub-clause 9.2.8 – Encoding of Timer Values
- IEEE Std. 802.1D-1998: sub-clause 9.3.1 – Configuration BPDUs
- IEEE Std. 802.1D-1998: sub-clause 9.3.3 – Validation of received BPDUs
- IEEE Std. 802.1D-1998: Figure 9-1 – Configuration BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

ST, RST and MST Bridges support a range of timer values and methods designed to age out old information in the Bridged LAN. MST Bridges must support the ability to process each of the information ageing methods, and operate in a network consisting of many different information-ageing elements (IEEE 802.1D-1998, IEEE 802.1t-2001, IEEE 802.1w-2001, IEEE 802.1Q-2005, IEEE 802.1D-2004 and IEEE 802.1Q-2005). This Test examines the DUT's behavior in various information-ageing scenarios.

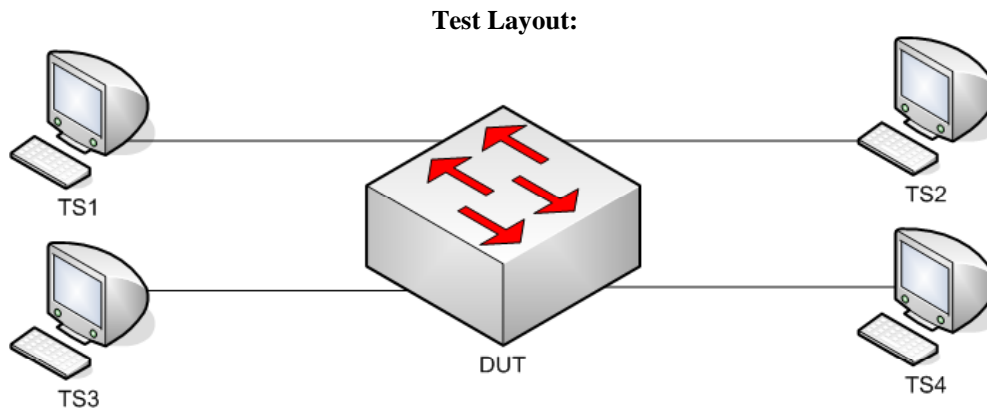


Figure 3.14 – Large BPDU Message Times

Procedure:

Part A: Valid Large Message Times

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.MakeRootPortBigMsgTimes1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS4, ST.MakeRootPortBigMsgTimes2 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2 and TS3.
6. Wait until TS2 and TS3 capture BPDUs
7. Stop capture on TS1, TS2 and TS3, and observe the captured frames.

Observable results:

- In Part A, during Step 7, the DUT must set DUT.TS4's Port Role to Alternate Port, and Port State to Discarding State.
- In Part A, during Step 7, TS2 and TS3 must capture properly formatted MST BPDUs with Max Age and Forward Delay equal to those in frames transmitted by TS1
- In Part A, during Step 7, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part A, during Step 7, TS2 and TS3 must capture properly formatted MST BPDUs with Hello Time equal to Port Hello Time configured for DUT.TS2 and DUT.TS3 respectively.

Possible Problems:

- None.

Test MSTP.op.3.15 – Length/Type Field Verification

Purpose: To verify that the DUT properly processes ST BPDUs containing a Length field other than 0x0026 and propagates the information contained in the BPDUs.

References:

- IEEE Std. 802.1D-1998: sub-clause 8.5.1.8 – Forward Delay
- IEEE Std. 802.1D-1998: sub-clause 9.2 – Encoding of parameter types
- IEEE Std. 802.1D-1998: sub-clause 9.2.8 – Encoding of Timer Values
- IEEE Std. 802.1D-1998: sub-clause 9.3.1 – Configuration BPDUs
- IEEE Std. 802.1D-1998: sub-clause 9.3.3 – Validation of received BPDUs
- IEEE Std. 802.1D-1998: Figure 9-1 – Configuration BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: sub-clause 13.26.15 – setSyncTree()
- IEEE Std. 802.1Q-2005: sub-clause 13.26.17 – setTcPropTree()
- IEEE Std. 802.1Q-2005: sub-clause 14.4 – Validation of received BPDUs
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

The requirements for validation of received BPDUs depend on BPDU type: ST BPDU, RST BPDU, MST BPDU, and TCN BPDU. A BPDU shall be considered invalid, and shall not be processed, if it does not contain the minimum number of octets specified for a particular BPDU type: 35, 36, 35 and 4, respectively. Additionally, a minimum BPDU size equal to 102 octets is defined for MST BPDUs. By default, all BPDUs transmitted in valid Ethernet frames must contain at least 48 octets between the Length field and the FCS. Therefore, all BPDUs transmitted in valid Ethernet frames satisfy the minimum BPDU size requirements.

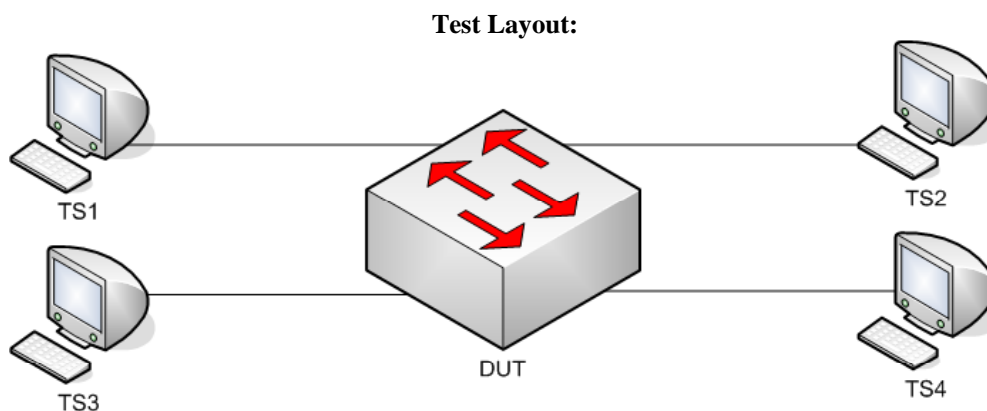


Figure 3.15 – Length/Type Field Verification

Procedure:

Part A: Length/Type Validation

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.MakeRootPortLength1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS4, ST.WorseRootIDthanDUT frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2, TS3 and TS4 capture 2 BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.
8. Repeat Steps 2 through 7, using ST.MakeRootPortLength2 frame in Step 2.
9. Repeat Steps 2 through 7, using ST.MakeRootPortLength3 frame in Step 2.

Observable results:

- In Part A, during Step 7, and repetitions of Step 7, TS2 and TS3 must capture properly formatted MST BPDUs with the correct Length/Type Field.
- In Part A, during Step 7, and repetitions of Step 7, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to the CIST Root ID configured on the DUT.

Possible Problems:

- None.

Test MSTP.op.3.16 – Receive Identical ST BPDUs On Two Different Ports

Purpose: To verify that the DUT properly processes ST BPDUs containing a Length field other than 0x0026 and propagates the information contained in the BPDUs.

References:

- IEEE Std. 802.1D-1998: sub-clause 9.3.1 – Configuration BPDUs
- IEEE Std. 802.1D-1998: sub-clause 9.3.3 – Validation of received BPDUs
- IEEE Std. 802.1D-1998: Figure 9-1 – Configuration BPDU parameters and format
- IEEE Std. 802.1Q-2005: sub-clause 13.5 – Modeling an MST Region as a single RSTP Bridge
- IEEE Std. 802.1Q-2005: sub-clause 13.6.1 – Designated Port Selection
- IEEE Std. 802.1Q-2005: Figure 13-12 – Port Transmit State Machine
- IEEE Std. 802.1Q-2005: Figure 14-1 – MST BPDU parameters and format
- IEEE Std. 802.1Q-2005: Figure 14-2 – MSTI Configuration Message parameters and format

Resource Requirements:

- 4 Test Stations

Discussion:

When a Bridge receives two identical ST BPDUs on two different Bridge Ports, it indicates there is a strong possibility of a network loop. To address this issue MST Bridges must place one of the two Ports in the Discarding State. If the two receiving Ports receive identical ST BPDUs with superior information, the Port with a greater CIST Port ID must be placed in the Discarding State.

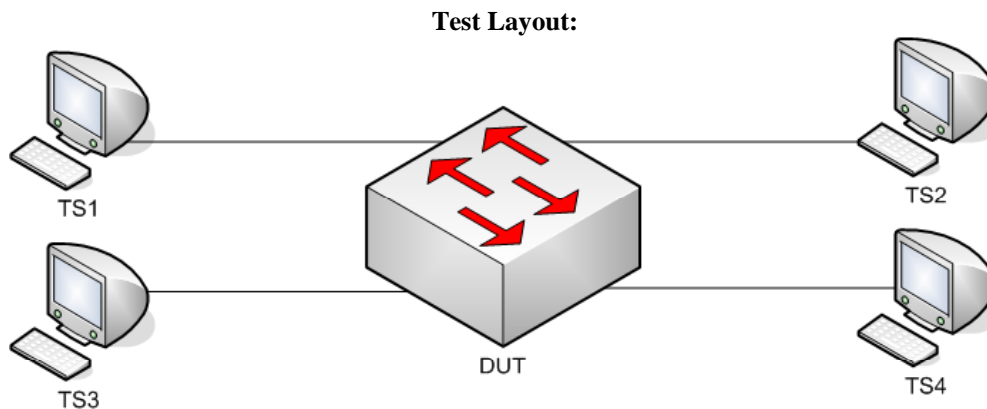


Figure 3.16 – Receive Identical ST BPDUs On Two Different Ports

Procedure:

Part A: Receive Identical ST BPDUs On Two Different Ports. DUT Is Not Root.

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.IdenticalBPDU1 frames at a rate of one every two seconds.
3. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
4. Continuously transmit, from TS4, ST.IdenticalBPDU1 frames at a rate of one every two seconds.
5. Start capture on TS1, TS2, TS3 and TS4.
6. Wait until TS2 and TS3 capture 2 BPDUs.
7. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Part B: Receive Identical ST BPDUs On Two Different Ports. DUT Is Root.

8. Ensure that the [Default Test Values](#) are configured on the DUT.
9. Continuously transmit, from TS1, ST.IdenticalBPDU2 frames at a rate of one every two seconds.
10. Continuously transmit, from TS2, MST.OtherRegionThanDUT frames at a rate of one every two seconds.
11. Continuously transmit, from TS4, ST.IdenticalBPDU2 frames at a rate of one every two seconds.
12. Start capture on TS1, TS2, TS3 and TS4.
13. Wait until TS1, TS2, TS3 and TS4 to capture 2 BPDUs.
14. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames.

Observable results:

- In Part A, during Step 7, the DUT must set DUT.TS4's Port Role to Alternate Port, and Port State to Discarding State.
- In Part A, during Step 7, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to that in frames transmitted by TS1.
- In Part B, during Step 14, TS1 and TS4 must capture properly formatted ST BPDUs with CIST Root ID equal to the DUT's CIST Bridge ID.
- In Part B, during Step 14, TS2 and TS3 must capture properly formatted MST BPDUs with CIST Root ID equal to the DUT's CIST Bridge ID.

Possible Problems:

- None.

Test MSTP.op.3.17 – VLAN Tagged BPDUs

Purpose: To verify that the DUT does not process tagged ST BPDUs.

References:

- IEEE Std. 802.1Q-2005: sub-clause 8.13.10 – VLAN attachment and connectivity for Higher Layer Entities

Resource Requirements:

- 3 Test Stations

Discussion:

Spanning Tree BPDUs transmitted by the Bridge Protocol Entity are not forwarded by Bridges, and must be visible to all other Bridge Protocol Entities attached to the same LAN segment. Such frames shall be transmitted Untagged; any BPDUs that carry a tag header are not recognized as well-formed BPDUs and are not forwarded by the Bridge.

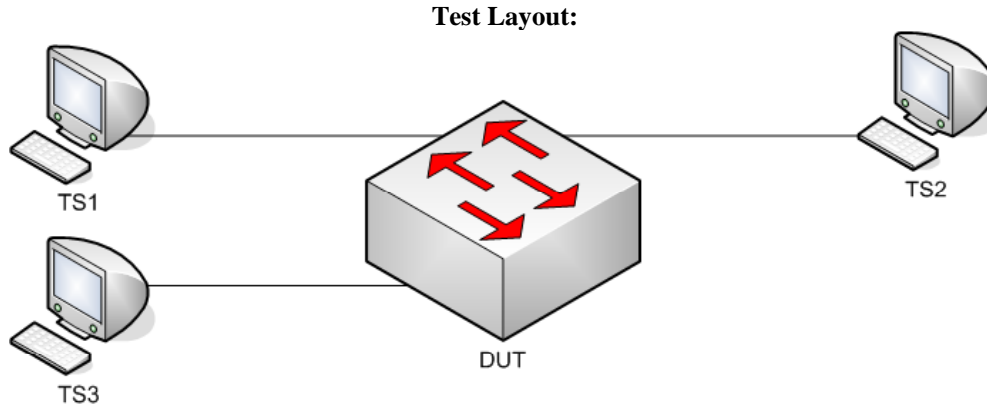


Figure 1.17 – VLAN tagged BPDUs

Procedure:

Part A: VLAN tagged BPDU

1. Ensure that the [Default Test Values](#) are configured on the DUT.
2. Continuously transmit, from TS1, ST.MakeRootPortVLANTagged frames at a rate of one every two seconds.
3. Start capture on TS1, TS2 and TS3.
4. Wait until TS1, TS2 and TS3 capture 2 BPDUs.
5. Stop capture on TS1, TS2 and TS3, and observe the captured frames.

Observable results:

- In Part A, during Step 5, TS1, TS2 and TS3 must capture properly formatted MST BPDUs with a Root ID equal to the DUT's Bridge ID.

Possible Problems:

- None.