Ethernet Switching Protocols

Filtering Database
Conformance Test Suite

Version 2.1

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Ethernet Switching Protocols
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Modification Record

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Introduction

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

The job of the Filtering Database (FDB) is to help ensure efficient usage of a Bridged LAN's resources by only forwarding received frames to those LAN segments on which they need to be. To this end, the FDB aggregates information used to make filtering and forwarding decisions for received MAC frames. The information may be statically configured, dynamically configured via control plane protocols, or dynamically learned based on observed traffic. Conceptually, the FDB is queried upon reception of each potentially forwarded frame, and the FDB provides the Forwarding Process with a set of potential transmission ports.

This test suite focuses primarily on those aspects of IEEE 802.1Q-2011 which have to do with learning, forwarding and filtering decisions made based upon the Source and Destination MAC addresses of received frames rather than those decisions made based upon port VLAN membership.

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

Abbreviations and Acronyms

IEEE 802.1

BPDU	Bridge Protocol Data Unit
CIST	Common Internal Spanning Tree
FCS	Frame Check Sequence(a.k.a Cyclic Redundancy Check)
ID	Identifier
LAN	Local Area Network
MAC	Media Access Control
MST	Multiple Spanning Tree
MSTI	Multiple Spanning Tree Instance
MSTP	Multiple Spanning Tree Protocol
PVID	Port VID
RSTP	Rapid Spanning Tree Protocol
SST	Single Spanning Tree
STP	Spanning Tree Protocol
VID	VLAN Identifier
VLAN	Virtual LAN

VLAN Conformance Test Suite

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

Test Organization

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

Test Label: The Test Label and title 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 label FDB.op.1.2 refers to the second test of the first group in the Filtering Database Conformance Test Suite.

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

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

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

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

Test Setup: The Default Test Setup section describes the configuration of the DUT prior to the start of the test. The procedure may involve configuration steps that deviate from what is given in the test setup. If a value is not provided for a protocol parameter, then the protocol's default is used for that parameter.

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 may also cues instruct the tester to make observations, which are interpreted in accordance with the observable results given for that test part.

Observable Results: This section lists observable results that can be examined by the tester to verify that the DUT is operating properly. When multiple observable results are possible, this section provides a short discussion on how to interpret them. The determination of a pass or fail for each test is usually based on how the behavior of the DUT compares to the results described in this section.

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

Group 1: Permanent Database

Scope: Functionality of the various aspects of the Permanent Database.

Test FDB.op.1.1 — Entry for Default PVID

Purpose: To verify that the DUT has a Static VLAN Registration Entry for the VLAN corresponding to the Default PVID in the Permanent Database.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 8.8.10
[2] IEEE Std. 802.1Q-2011: sub-clause 8.8.11
[3] IEEE Std. 802.1Q-2011: sub-clause 11.2.1.3
[4] IEEE Std. 802.1Q-2011: Table 9-1

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

Discussion: The initial state of the Permanent Database contains a Static VLAN Registration Entry for the VLAN corresponding to the Default PVID. The Port Map in this entry specifies Registration Fixed and forwarding untagged for all ports of the bridge. This entry may be modified or deleted through management. The Filtering Database must be initialized from the entries contained in the Permanent Database whenever initialization or re-initialization of the Filtering Database occurs.

This test is applicable if and only if the DUT is VLAN-aware.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Static VLAN Registration Entry Exists

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit 10 untagged frames.
3. Wait 2 seconds.

Part B: Static VLAN Registration Entry Specifies Forwarding Untagged

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit 10 untagged frames.
3. From TS1, transmit 10 priority-tagged frames.
4. From TS1, transmit 10 Default VLAN-tagged frames.
5. Wait 2 seconds.

Observable Results:

Part A:

- TS2 must receive all of the frames transmitted by TS1.

Part B:

- TS2 must receive all of the frames transmitted by TS1.
- All of the captured frames must be untagged.

Possible Problems: None.

Test FDB.op.1.2 — Entries for Reserved Multicast Addresses

Purpose: To verify that the DUT has a Static Filtering Entry in the Permanent Database for each of the reserved multicast addresses that cannot be forwarded.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 8.13.3
[2] IEEE Std. 802.1Q-2011: sub-clause 8.13.4
[3] IEEE Std. 802.1Q-2011: Table 8-1
[4] IEEE Std. 802.1Q-2011: Table 8-2

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

Discussion: The initial state of the Permanent Database must contain a Static Filtering Entry for each of the reserved addresses defined in Table 8-1 [3] for C-VLAN components and Table 8-2 [4] for S-VLAN components. Management on the DUT shall not provide the capability to modify or remove these Static Filtering Entries from the Filtering or Permanent Databases. The Filtering Database must be initialized from the entries contained in the Permanent Database whenever initialization or re-initialization of the Filtering Database occurs.

The list of reserved addresses for C-VLAN components is included in Table 8-1. The list of reserved addresses for S-VLAN components is included in Table 8-2.

If C-VLAN components are not supported, parts A and B cannot be completed. If S-VLAN components are not supported, parts C and D cannot be completed.

Table 8-1: C-VLAN component Reserved addresses

Bridge Group Address, Nearest Customer Bridge group address	01-80-C2-00-00-00
IEEE MAC-specific Control Protocols group address	01-80-C2-00-00-01
IEEE 802.3 Slow_Protocols_Multicast address	01-80-C2-00-00-02
Nearest non-TPMR Bridge group address	01-80-C2-00-00-03
IEEE MAC-specific Control Protocols group address	01-80-C2-00-00-04
Reserved for future standardization	01-80-C2-00-00-05
Reserved for future standardization	01-80-C2-00-00-06
Metro Ethernet Forum ELMI protocol group address	01-80-C2-00-00-07
Provider Bridge Group Address	01-80-C2-00-00-08
Reserved for future standardization	01-80-C2-00-00-09
Reserved for future standardization	01-80-C2-00-00-0A
Reserved for future standardization	01-80-C2-00-00-0B
Reserved for future standardization	01-80-C2-00-00-0C
Provider Bridge MVRP Address	01-80-C2-00-00-0D
Individual LAN Scope address, Nearest Bridge group address	01-80-C2-00-00-0E
Reserved for future standardization	01-80-C2-00-00-0F

Table 8-2: S-VLAN component Reserved addresses

IEEE MAC-specific Control Protocols group address	01-80-C2-00-00-01
IEEE 802.3 Slow_Protocols_Multicast address	01-80-C2-00-00-02
Nearest non-TPMR Bridge group address	01-80-C2-00-00-03
IEEE MAC-specific Control Protocols group address	01-80-C2-00-00-04
Reserved for future standardization	01-80-C2-00-00-05
Reserved for future standardization	01-80-C2-00-00-06
Metro Ethernet Forum ELMI protocol group address	01-80-C2-00-00-07
Provider Bridge Group Address	01-80-C2-00-00-08
Reserved for future standardization	01-80-C2-00-00-09
Reserved for future standardization	01-80-C2-00-00-0A
Individual LAN Scope address, Nearest Bridge group address	01-80-C2-00-00-0E

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Verifying the Static Filtering Entries Exist for C-VLAN Components

1. Ensure that the DUT is configured with the Test Setup.
2. Configure DUT.TS1 and DUT.TS2 for C-VLANs.
3. From TS1, transmit 10 untagged frames with a destination MAC address of 01-80-C2-00-00-00.
4. Wait 2 seconds.
5. Repeat steps 3 and 4 for each MAC address in Table 8-1.

Part B: Removal and Modification of the Static Filtering Entries for C-VLAN Components

1. Ensure that the DUT is configured with the Test Setup.
2. Configure DUT.TS1 and DUT.TS2 for C-VLANs.
3. Ensure that the DUT does not allow 01-80-C2-00-00-00 to be modified or removed from the FDB.[1]
4. Repeat step 3 for each MAC address in Table 8-1.

Part C: Verifying the Static Filtering Entries Exist for S-VLAN Components

1. Ensure that the DUT is configured with the Test Setup.
2. Configure DUT.TS1 and DUT.TS2 for S-VLANs.
3. From TS1, transmit 10 untagged frames with a destination MAC address of 01-80-C2-00-00-01.
4. Wait 2 seconds.
5. Repeat steps 3 and 4 for each MAC address in Table 8-2.

Part D: Removal and Modification of the Static Filtering Entries for S-VLAN Components

1. Ensure that the DUT is configured with the Test Setup.
2. Ensure that the DUT does not allow 01-80-C2-00-00-01 to be modified or removed from the FDB.[1]
3. Repeat step 2 for each MAC address in Table 8-2.

Observable Results:

Parts A and C:

- TS2 must not receive any of the frames transmitted by TS1.

Parts B and D:

- The removal or modification of any of the Static Filtering Entries must not be permitted.

Possible Problems: None.

[1] Because this step is essentially attempting to prove a negative, it is not possible to have 100% assurance that there is no way to do this on the DUT. In this step the tester is simply to make a best effort attempt.

Test FDB.op.1.3 — Entries for MRP Application Addresses

Purpose: To verify that the DUT cannot create, modify, or delete any MRP Application Addresses in either the Permanent or Filtering Databases.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 8.13.3
[2] IEEE Std. 802.1Q-2011: sub-clause 11.2.3.2.2
[3] IEEE Std. 802.1Q-2011: Table 10-1

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

Discussion: If the DUT supports Basic Filtering Services, the initial state of the Permanent Database must not contain a Static Filtering Entry for any of the MRP Application Addresses. If the DUT supports Extended Filtering Services, the initial state of the Permanent Database must contain a Static Filtering Entry for each supported MRP Application. The initial state of the Permanent Database must not contain a Static Filtering Entry for any unsupported MRP Application.

Management shall not provide the capability to create, delete, or modify entries in the Permanent or Filtering Databases for any MRP application address. The Filtering Database must be initialized from the entries contained in the Permanent Database whenever initialization or re-initialization of the Filtering Database occurs. The list of MRP Application addresses is as seen in Table 10-1 [3]:

Table 10-1: MRP application addresses

Assignment	Value
Customer and Provider Bridge MMRP address	01-80-C2-00-00-20
Customer Bridge MVRP address	01-80-C2-00-00-21
Reserved	01-80-C2-00-00-22
Reserved	01-80-C2-00-00-23
Reserved	01-80-C2-00-00-24
Reserved	01-80-C2-00-00-25
Reserved	01-80-C2-00-00-26
Reserved	01-80-C2-00-00-27
Reserved	01-80-C2-00-00-28
Reserved	01-80-C2-00-00-29
Reserved	01-80-C2-00-00-2A
Reserved	01-80-C2-00-00-2B
Reserved	01-80-C2-00-00-2C
Reserved	01-80-C2-00-00-2D
Reserved	01-80-C2-00-00-2E
Reserved	01-80-C2-00-00-2F

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Configuring Entries for MRP Application Addresses in Management

1. Ensure that the DUT is configured with the Test Setup.
2. If the DUT supports the MRP Application associated with 01-80-C2-00-00-20, ensure that the DUT does not allow the Static Filtering Entry associated with this address to be modified or removed.
3. If the DUT does not support the MRP Application associated with 01-80-C2-00-00-20, ensure that the DUT does not allow creation of a Static Filtering Entry for this MAC address.
4. Repeat steps 2 and 3 for each of the MAC addresses in Table 10-1.

Part B: Verifying Correctness of Filtering Database Entries for MRP Application Addresses

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit 10 untagged frames with a destination MAC address of 01-80-C2-00-00-20.
3. Wait 2 seconds.
4. Repeat step 2 for each of the MAC addresses in Table 10-1.

Observable Results:

Part A:

- None of the attempted creations, deletions, or modifications of the Static Filtering Entries in Table 10-1 should be permitted.

Part B:

- If the DUT supports a particular MRP Application, TS2 must not receive the frames transmitted by TS1 with the destination MAC address associated with that application.
- If the DUT does not support a particular MRP Application, TS2 must receive the frames transmitted by TS1 with the destination MAC address associated with that application.

Possible Problems: None.

Test FDB.op.1.4 — Entry Indicating Forward All Groups

Purpose: To verify that the DUT's default Group filtering behavior is Forward All Groups.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 8.8.6
[2] IEEE Std. 802.1Q-2011: sub-clause 8.8.9
[3] IEEE Std. 802.1Q-2011: sub-clause 10.12.2.3

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

Discussion: Forwarding and filtering of group-addressed frames may be managed by specifying defaults for each VID and outbound Port. The possible default Group filtering behaviors are forward All Groups, filter All Groups, forward Unregistered Groups, and filter Unregistered Groups. These all describe behavior on how to forward or filter a frame in absence of an explicit Static Filtering Entry.

In all Bridges, whether using Basic Filtering Services or Extended Filtering services, the default Group Filtering Behavior is Forward All Groups for all Ports of the Bridge, for all VIDs.

Forward All Groups indicates that a frame shall be forwarded unless there is a Static Filtering Entry that explicitly specifies filtering independent of any dynamic filtering information.

Test Setup: Perform a Factory Reset on the DUT. Refer to the Default Test Setup in Appendix A but do not explicitly configure a Static Filtering Entry for Forward All Groups.

Test Procedure:

Part A: Entry Indicating Forward All Groups Exists

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit 10 multicast frames using random multicast MAC addresses other than those in the Permanent Database.
3. Wait 2 seconds.

Observable Results:

Part A:

- TS2 must receive all of the frames transmitted by TS1.

Possible Problems: None.

Group 2: Learning Process

Scope: Functionality of the various aspects of the Learning Process.

Test FDB.op.2.1 — Learning Based on Port State

Purpose: To verify that the DUT learns source MAC addresses on a port based on its port state.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 8.4 [2] IEEE Std. 802.1Q-2011: sub-clause 8.7

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

Discussion: When a frame is received on a port and is not discarded by the ingress rules, that frame is passed to the Learning Process. The Learning Process creates a Dynamic Filtering Entry associated with the frame's VID in the Filtering Database if, and only if, each of the following is true:

- The port on which the frame was received is in a state that allows learning.
- The source MAC address in the frame denotes a specific end station.
- The resulting number of entries would not exceed the capacity of the Filtering Database.
- The Member set for the frame's VID includes at least one port.

This Dynamic Filtering Entry associates the reception port with the source MAC address for use in future forwarding/filtering decisions.

Port States are assigned by the Spanning Tree Protocol to prevent loops in the active topology. A port can be in the Discarding, Learning, or Forwarding state. Learning is disabled when the port is in the Discarding state and enabled when the port is in the Learning or Forwarding states.

This test is applicable if and only if the DUT supports the Spanning Tree Protocol.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Receiving Port in Discarding State

1. Ensure that the DUT is configured with the Test Setup.
2. From TS2, transmit a Configuration BPDU with a Root Priority better than the DUT's Bridge Priority and a Root Path Cost of 0x00000005.[1]
3. From TS1, transmit a Configuration BPDU containing the same Root Identifier used in step 1, a Root Path Cost of 0x0000000A, and a Message Age equal to 6 seconds less than Max Age.[1]
4. Wait 6 seconds.
5. Observe the port state of DUT.TS1.[2]
6. While the port on the DUT that is connected to TS1 is in the Discarding state, from TS1, transmit untagged frames with a source address of 00-02-01-AA-06-11.
7. From TS3, transmit 10 untagged frames with a destination address identical to the source address used in step 6.
8. Wait 2 seconds.

Part B: Receiving Port in Learning State

1. Ensure that the DUT is configured with the Test Setup.
2. From TS2, transmit a Configuration BPDU with a Root Priority better than the DUT's Bridge Priority and a Root Path Cost of 0x00000005.[1]
3. From TS1, transmit a Configuration BPDU containing the same Root Identifier used in step 1 and a Root Path Cost of 0x0000000A, and a Message Age equal to 6 seconds less than Max Age.[2]
4. Wait for DUT.TS1 to transition from the Discarding state to the Learning state.
5. While DUT.TS1 is in the Learning state, from TS1, transmit 10 untagged frames with a source address of 00-02-01-BB-05-11.

[1] The intention of steps 2 and 3 is to transition DUT.TS2 and DUT.TS1 to the Root and Alternate port roles respectively

[2] There are a number of ways this may be done. Notably, if the DUT provides management access via a CLI or GUI most devices provide visisbility into thie attribute.

6. Wait until DUT.TS1 has transitioned to the Forwarding state.
7. From TS3, transmit 10 untagged frames with a destination address identical to the source address used in step 5.
8. Wait 2 seconds.

Part C: Receiving Port in Forwarding State

1. Ensure that the DUT is configured with the Test Setup.
2. While DUT.TS1 is in the Forwarding state, from TS1, transmit 10 untagged frames with a source address of 00-02-01-CC-02-11.
3. From TS3, transmit 10 untagged frames with a destination address identical to the source address used in step 2.
4. Wait 2 seconds.

Observable Results:

Part A:

- TS2 and TS4 must receive all frames transmitted by TS3.
- TS1 must not receive the traffic transmitted by TS3.

Parts B and C:

- TS1 must receive all frames transmitted by TS3.
- TS2 and TS4 must not receive the frames transmitted by TS3.

Possible Problems: None.

Test FDB.op.2.2 — Learning Based on Source MAC Address

Purpose: To verify that the DUT learns source MAC addresses when they denote a specific end station and does not learn them when they denote a group MAC address.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 3.2.3
[2] IEEE Std. 802.1Q-2011: sub-clause 8.7
[3] IEEE Std. 802.1Q-2011: sub-clause 8.8

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

Discussion: When a frame is received on a port and is not discarded by the ingress rules, that frame is passed to the Learning Process. The Learning Process creates a Dynamic Filtering Entry associated with the frame's VID in the Filtering Database if, and only if, each of the following is true:

- The port on which the frame was received is in a state that allows learning.
- The source MAC address in the frame denotes a specific end station.
- The resulting number of entries would not exceed the capacity of the Filtering Database.
- The Member set for the frame's VID includes at least one port.

This Dynamic Filtering Entry associates the reception port with the source MAC address for use in future forwarding/filtering decisions.

A MAC address is said to denote a group address if the least significant bit of the first octet of the Destination Address is set, and denotes an individual end station otherwise.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Source MAC Address Denotes an End Station

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit 10 untagged frames with a source address of 00-02-02-AA-02-11.
3. Before Ageing Time elapses, from TS3 transmit 10 untagged frames with a destination address identical to the source address used in step 2.
4. Wait 2 seconds.

Part B: Source MAC Address Denotes a Broadcast Address

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit 10 broadcast frames with a source address of FF-FF-FF-FF-FF-FF.
3. Before Ageing Time elapses, from TS3 transmit 10 untagged frames with a destination address identical to the source address used in step 2.
4. Wait 2 seconds.

Part C: Source MAC Address Denotes a Multicast Address

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit 10 multicast frames with a source address of 01-02-02-CC-02-11.
3. Before Ageing Time elapses, from TS3 transmit 10 untagged frames with a destination address identical to the source address used in step 2.
4. Wait 2 seconds.

Observable Results:

Part A:

- TS1 must receive all frames transmitted by TS3.
- TS2 must not receive the traffic sent by TS3.

Part B:

- TS1 and TS2 must receive all of the frames transmitted by TS3.

Part C:

- TS1 and TS2 must receive all of the frames transmitted by TS3.

Possible Problems: None.

Test FDB.op.2.3 — Filtering Database Overflow Behavior

Purpose: To verify how the DUT handles new entries when the Filtering Database is at capacity.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 8.7

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

Discussion: When a frame is received on a port and is not discarded by the ingress rules, that frame is passed to the Learning Process. The Learning Process creates a Dynamic Filtering Entry associated with the frame's VID in the Filtering Database if, and only if, each of the following is true:

- The port on which the frame was received is in a state that allows learning.
- The source MAC address in the frame denotes a specific end station.
- The resulting number of entries would not exceed the capacity of the Filtering Database.
- The Member set for the frame's VID includes at least one port.

This Dynamic Filtering Entry associates the reception port with the source MAC address for use in future forwarding/filtering decisions.

If the Filtering Database is already filled to capacity, but a new entry would otherwise be made, then an existing entry may be removed to make room for the new entry.

Different devices are able to store different number of learned addresses in the filtering database. This test will vary according to the Filtering Database Size, defined in Appendix B, such that the number of frames sent will fill the filtering database completely.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Verifying the Filtering Database Overflow Behavior

1. Ensure that the DUT is configured with the Test Setup.
2. Set the Ageing Time on the DUT to its maximum configurable value.
3. From TS2, transmit untagged frames with a source address 00-00-00-00-00-01. Each successive frame must have an incremented source MAC address. Transmit an amount of frames equal to the Filtering Database Size defined in Appendix B plus 100 frames.
4. From TS1, transmit 10 untagged frames with a destination address of 00-00-00-00-00-32.
5. From TS3, transmit 10 untagged frames with a destination address equivalent to the Filtering Database Size value incremented by 50.
6. Wait 2 seconds.

Observable Results:

Part A:

- If the vendor specified that old learned addresses are removed to make room for new ones, TS2 must receive all of the frames transmitted by TS3. TS1 must not receive any frames from TS3.
- If the vendor specified that no new addresses are learned when the FDB capacity is reached, TS2 must receive all of the frames transmitted by TS1. TS3 must not receive any frames from TS1.
- In any case, either TS1 must not receive any frames transmitted by TS3 or TS3 must not receive any frames transmitted by TS1.

Possible Problems: None.

Test FDB.op.2.4 — Learning Based on VID

Purpose: To verify that the DUT learns source MAC addresses only when the Member Set of the VID associated with the received frame contains at least one port.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 8.7 [2] IEEE Std. 802.1Q-2011: sub-clause 8.8.10

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

Discussion: When a frame is received on a port and is not discarded by the ingress rules, that frame is passed to the Learning Process. The Learning Process creates a Dynamic Filtering Entry associated with the frame's VID in the Filtering Database if, and only if, each of the following is true:

- The port on which the frame was received is in a state that allows learning.
- The source MAC address in the frame denotes a specific end station.
- The resulting number of entries would not exceed the capacity of the Filtering Database.
- The Member set for the frame's VID includes at least one port.

This Dynamic Filtering Entry associates the reception port with the source MAC address for use in future forwarding/filtering decisions.

If the DUT is not VLAN-aware, this test cannot be completed.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Member Set Includes at least one Port

1. Ensure that the DUT is configured with the Test Setup.
2. Configure DUT.TS1 through DUT.TS3 to be members of VLAN 64.
3. From TS1, transmit 10 VLAN 64 tagged frames with a source address of 00-02-04-AA-03-11.
4. From TS3, transmit 10 VLAN 64 tagged frames with a destination address identical to the source address used in step 3.
5. Wait 2 seconds.

Part B: Member Set Includes no Ports

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit 10 VLAN 64 tagged frames with a source address of 00-02-04-BB-02-11.
3. Configure DUT.TS1 through DUT.TS3 to be members of VLAN 64.
4. From TS3, transmit 10 VLAN 64 tagged frames with a destination address identical to the source address used in step 2.
5. Wait 2 seconds.

Observable Results:

Part A:

- TS1 must receive all of the frames transmitted by TS3.
- TS2 must not receive any of the frames transmitted by TS3.

Part B:

- TS1 and TS2 must receive all the frames transmitted by TS3.

Possible Problems: None.

Test FDB.op.2.5 — Learning from Frames with Errors

Purpose: To verify that the DUT learns source MAC addresses received only in error-free frames.

References: [1] IEEE Std. 802.3-2012: sub-clause 3.2.6
[2] IEEE Std. 802.3-2012: sub-clause 3.4
[3] IEEE Std. 802.1Q-2011: sub-clause 8.5
[4] IEEE Std. 802.1Q-2011: sub-clause 8.7

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

Discussion: All error-free received frames give rise to EM_UNITDATA indication primitives, which are handled by the individual MAC entity associated with the receiving port. All other frames are discarded by the MAC entity without giving rise to any EM_UNITDATA indication and thus are not passed to the Learning Process.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Frames with Invalid FCS

1. Ensure that the DUT is configured with the Test Setup.
2. From TS2, transmit 10 untagged frames with a source address of 00-02-05-AA-02-22. These frames must contain an invalid FCS.
3. From TS1, transmit 10 untagged frames with a destination address identical to the source address used in step 2.
4. Wait 2 seconds.

Part B: Frames with Incorrect Length Field

1. Ensure that the DUT is configured with the Test Setup.
2. From TS2, transmit 10 untagged frames with a source address of 00-02-05-BB-02-22. These frames must contain a length field with a value equal to 1000 and the total frame size must be equal to 500.
3. From TS1, transmit 10 untagged frames with a destination address identical to the source address in step 2.
4. Wait 2 seconds.

Observable Results:

Parts A and B:

- TS2 and TS3 must receive all of the frames transmitted by TS1.

Possible Problems: None.

Test FDB.op.2.6 — Learning from Frames Discarded on Ingress

Purpose: To verify that the DUT learns source MAC addresses received only from frames that are not discarded by the Ingress Rules.

References:
[1] IEEE Std. 802.1Q-2011: sub-clause 6.9
[2] IEEE Std. 802.1Q-2011: sub-clause 8.5
[3] IEEE Std. 802.1Q-2011: sub-clause 8.7
[4] IEEE Std. 802.1Q-2011: sub-clause 8.8.10
[5] IEEE Std. 802.1Q-2011: Table 9-1

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

Discussion: All frames that are not discarded as a result of the application of the ingress rules are submitted to the Forwarding Process then the Learning Process. If the vlan_identifier parameter carried in a received indication is identical to the null VLAN ID and the Acceptable Frame Types parameter for the port through which the frame was received is set to the value Admit Only VLAN-tagged frames, then the frame shall be discarded.

If the Enable Ingress Filtering parameter for the port through which the frame was received is Set, and if the port is not in the Member Set for the frame's VLAN classification, then the frame is discarded.

If the Acceptable Frame Types parameter cannot be set, parts A and B cannot be completed.

If the Enable Ingress Filtering parameter cannot be set, parts C and D cannot be completed.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Acceptable Frame Types Parameter - Untagged Frames

1. Ensure that the DUT is configured with the Test Setup.
2. Set the Acceptable Frame Types parameter for DUT.TS2 to *Admit Only VLAN-tagged Frames*.
3. From TS2, transmit 10 untagged frames with a source address of 00-02-06-AA-03-22.
4. From TS1, transmit 10 untagged frames with a destination address identical to the source address used in step 3.
5. Wait 2 seconds.

Part B: Acceptable Frame Types Parameter - Tagged Frames

1. Ensure that the DUT is configured with the Test Setup.
2. Set the Acceptable Frame Types parameter for DUT.TS2 to *Admit Only VLAN-tagged Frames*.
3. From TS2, transmit 10 VLAN 1 tagged frames with a source address of 00-02-06-BB-03-22.
4. From TS1, transmit 10 untagged frames with a destination address identical to the source address used in step 3.
5. Wait 2 seconds.

Part C: Enable Ingress Filtering Parameter - Port not Included in Member Set

1. Ensure that the DUT is configured with the Test Setup.
2. Set the Enable Ingress Filtering parameter for DUT.TS2 to *Set*.
3. Configure DUT.TS1 and DUT.TS3 to be tagged members of VLAN 64.
4. From TS2, transmit 10 VLAN 64 tagged frames with a source address of 00-02-06-CC-04-22.
5. From TS1, transmit 10 VLAN 64 tagged frames with a destination address identical to the source address used in step 4.
6. Wait 2 seconds.

Part D: Enable Ingress Filtering Parameter - Port Included in Member Set

1. Ensure that the DUT is configured with the Test Setup.
2. Set the Enable Ingress Filtering parameter for DUT.TS2 to *Set*.
3. Configure DUT.TS1 through DUT.TS3 to be tagged members of VLAN 64.
4. From TS2, transmit 10 VLAN 64 tagged frames with a source address of 00-02-06-DD-04-22.
5. From TS1, transmit 10 VLAN 64 tagged frames with a destination address identical to the source address used in step 4.
6. Wait 2 seconds.

Observable Results:

Parts A and B:

- TS2 and TS3 must receive all of the frames transmitted by TS1.

Part C:

- TS3 must receive all of the frames transmitted by TS1.

Part D:

- TS2 must receive all of the frames transmitted by TS1.
- TS3 must not receive any of the frames transmitted by TS1.

Possible Problems: None.

Test FDB.op.2.7 — Duplicate Dynamic Filtering Entries

Purpose: To verify that the DUT does not create more than one Dynamic Filtering Entry in the Filtering Database for a given combination of MAC address and FID.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 8.3
[2] IEEE Std. 802.1Q-2011: sub-clause 8.7
[3] IEEE Std. 802.1Q-2011: sub-clause 8.8

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

Discussion: Dynamic Filtering Entries are created and updated by the Learning Process. They shall be automatically removed after a specified time, the Ageing Time, has elapsed since the entry was created or last updated. No more than one Dynamic Filtering Entry shall be created in the Filtering Database for a given combination of MAC address and FID.

If the Source MAC Address of a frame sent to the Learning Process has already been learned, the Dynamic Filtering Entry is updated accordingly. If the previously-learned address is a port other than the one on which this frame was received, the port map in the Dynamic Reservation Entry is updated to reflect this change.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Source MAC Address Denotes an End Station

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit 10 untagged frames with a source address of 00-02-07-AA-02-11.
3. From TS2, transmit 10 untagged frames with a source address identical to the address used in step 2.
4. From TS3, transmit 10 untagged frames with a destination address identical to the address used in step 2.
5. Wait 2 seconds.

Observable Results:

Part A:

- TS2 must receive all of the frames transmitted by TS3.
- TS1 must not receive any of the frames sent by TS3.

Possible Problems: None.

Test FDB.op.2.8 — New Entry Prevented due to Static Filtering Entry

Purpose: To verify that the DUT does not create a Dynamic Filtering Entry in the Filtering Database when a Static Filtering Entry already exists.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 8.8

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

Discussion: A Dynamic Filtering Entry for a given MAC address shall not be created or updated by the Learning Process if any Static Filtering Entry already exists for that MAC address.

This test is applicable if and only if the DUT supports user creation of Static Filtering Entries.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Prevention of New Entries Due to Static Filtering Entry

1. Ensure that the DUT is configured with the Test Setup.
2. Create a Static Filtering Entry for 00-02-88-AA-02-22 that has a control element specifying forwarding for DUT.TS2.
3. From TS1, transmit 10 untagged frames with a source address identical to the address used in step 2.
4. From TS3, transmit 10 untagged frames with a destination address identical to the address used in step 2.
5. Wait 2 seconds.

Observable Results:

Part A:

- TS1 must not receive any of the traffic transmitted by TS3.
- TS2 must receive all of the traffic transmitted by TS3.

Possible Problems: None.

Group 3: Miscellaneous

Scope: Miscellaneous functions of the Filtering Database.

Test FDB.op.3.1 — Duplicate Static Filtering Entries

Purpose: To verify that the DUT allows a Static Filtering Entry for a specific group MAC address and port to override another Static Filtering Entry specifying Forward All Groups for all ports.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 8.8.6

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

Discussion: Forwarding and filtering of group-addressed frames may be managed by specifying defaults for each VLAN and outbound port. A Static Filtering Entry specifying Forward All Groups causes all group-address frames to be forwarded unless an explicit Static Filtering Entry specifies filtering independent of any dynamic filtering information.

This test is applicable if and only if the DUT supports user creation of Static Filtering Entries.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Duplicate Static Filtering Entries

1. Ensure that the DUT is configured with the Test Setup.
2. Create a Static Filtering Entry for 01-03-01-AA-02-11 with a control element specifying filtering for DUT.TS1.
3. From TS2, transmit 10 untagged frames with a destination address identical to the address used in step 2.
4. Wait 2 seconds.

Observable Results:

Part A:

- TS1 must not receive any of the frames transmitted by TS2.
- TS3 must receive all of the frames transmitted by TS2.

Possible Problems: None.

Test FDB.op.3.2 — Basic Filtering Services

Purpose: To verify that the DUT supports the appropriate MAC address specifications and control element values in its Static Filtering Entries.

References: [1] IEEE Std. 802.1Q-2011: 8.8.1

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

Discussion: A Static Filtering Entry shall contain a unique MAC Address specification and a Port Map with a control element for each outbound port. These control elements shall have a destination MAC Address specified to be Forwarded or Filtering on the basis of dynamic filtering information, Group Filtering behavior, or independently of any dynamic filtering information.

All bridges shall have the capability to support the first two values for the MAC Address specification, and the first two values for each control element for all Static Filtering Entries.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Forwarding for an Individual Address

1. Ensure that the DUT is configured with the Test Setup.
2. Create a Static Filtering Entry for 00-03-02-AA-02-22 with a control element specifying forwarding for DUT.TS2.
3. From TS1, transmit 10 untagged frames with a destination address identical to the address used in step 2.
4. Wait 2 seconds.

Part B: Filtering for an Individual Address

1. Ensure that the DUT is configured with the Test Setup.
2. Create a Static Filtering Entry for 00-03-02-BB-02-22 with a control element specifying filtering for DUT.TS2 and DUT.TS3.
3. From TS1, transmit 10 untagged frames with a destination address identical to the address used in step 2.
4. Wait 2 seconds.

Part C: Forwarding for a Group Address

1. Ensure that the DUT is configured with the Test Setup.
2. Create a Static Filtering Entry for 01-03-02-CC-02-22 with a control element specifying forwarding for DUT.TS2 and filtering for DUT.TS3.
3. From TS1, transmit 10 untagged frames with a destination address identical to the address used in step 2.
4. Wait 2 seconds.

Part D: Filtering for a Group Address

1. Ensure that the DUT is configured with the Test Setup.
2. Create a Static Filtering Entry for 01-03-02-DD-02-22 with a control element specifying filtering for DUT.TS2 and DUT.TS3.
3. From TS1, transmit 10 untagged frames with a destination address identical to the address used in step 2.
4. Wait 2 seconds.

Observable Results:

Parts A and C:

- TS2 must receive all of the frames transmitted by TS1.
- TS3 must not receive any of the frames transmitted by TS1.

Parts B and D:

- TS2 and TS3 must not receive any of the frames transmitted by TS1.

Possible Problems: None.

Test FDB.op.3.3 — Extended Filtering Services

Purpose: To verify that the DUT supports the appropriate MAC address specifications and control element values in its Static Filtering Entries on Bridges that support Extended Filtering Services.

References: [1] IEEE Std. 802.1Q-2011: 8.8.1

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

Discussion: A Static Filtering Entry shall contain a unique MAC Address specification and a Port Map with a control element for each outbound port. These control elements shall have a destination MAC Address specified to be Forwarded or Filtering on the basis of dynamic filtering information, Group Filtering behavior, or independently of any dynamic filtering information.

A bridge that supports Extended Filtering Services shall have the capability to support all four values for the MAC Address specification and all three control element values for Static Filtering Entries that specify group MAC Addresses, and may have the capability to support all three control element values for Static Filtering Entries that specify individual MAC Addresses. MAC Address Registration Entries are dynamic filtering entries created by MMRP.

This test is applicable if and only if the DUT supports Extended Filtering Services.

Parts C and D are applicable if and only if the DUT supports MMRP.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Forwarding for All Group Addresses

1. Ensure that the DUT is configured with the Test Setup.
2. Create a Static Filtering Entry with a control element specifying filtering for all ports on the DUT.
3. Create a Static Filtering Entry with a control element specifying forwarding for *All Group Addresses* with a VID of 64 for DUT.TS2
4. From TS1, transmit 10 VLAN 64 tagged frames with a destination address of 01-03-03-AA-00-11.
5. Wait 2 seconds.

Part B: Filtering for All Group Addresses

1. Ensure that the DUT is configured with the Test Setup.
2. Create a Static Filtering Entry with a control element specifying filtering for *All Group Addresses* with a VID of 64 for DUT.TS2.
3. From TS1, transmit 10 VLAN 64 tagged frames with a destination address of 01-03-03-BB-00-11.
4. Wait 2 seconds.

Part C: Forwarding for All Unregistered Group Addresses

1. Ensure that the DUT is configured with the Test Setup.
2. Create a Static Filtering Entry with a control element specifying forwarding for *All Unregistered Group Addresses* with a VID of 1 for DUT.TS2.
3. From TS1, transmit 10 untagged frames with a source address of 01-03-03-CC-03-11.
4. Wait 2 seconds.
5. From TS3, use MMRP to establish and maintain registration for an address identical to the address used in step 3.
6. From TS1, transmit 10 untagged frames with a destination address identical to the address used in step 3.
7. Wait 2 seconds.

Part D: Filtering for All Unregistered Group Addresses

1. Ensure that the DUT is configured with the Test Setup.
2. Create a Static Filtering Entry with a control element specifying filtering for *All Unregistered Group Addresses* with a VID of 1 for DUT.TS2.
3. From TS1, transmit 10 untagged frames with a source address of 01-03-03-DD-03-11.
4. Wait 2 seconds.
5. From TS2 and TS3, use MMRP to establish and maintain registration for an address identical to the address used in step 3.
6. From TS1, transmit 10 untagged frames with a destination address identical to the address used in step 3.
7. Wait 2 seconds.

Part E: Forwarding for All Individual Addresses

1. Ensure that the DUT is configured with the Test Setup.
2. Create a Static Filtering Entry with a control element specifying filtering for all ports on the DUT.
3. Create a Static Filtering Entry with a control element specifying forwarding for *All Individual Addresses* with a VID of 64 for DUT.TS2.
4. From TS1, transmit 10 VLAN 64 tagged frames with a destination address of 00-03-03-EE-00-11.
5. Wait 2 seconds.

Part F: Filtering for All Individual Addresses

1. Ensure that the DUT is configured with the Test Setup.
2. Create a Static Filtering Entry with a control element specifying filtering for *All Individual Addresses* with a VID of 64 for DUT.TS2.
3. From TS1, transmit 10 VLAN 64 tagged frames with a destination address of 00-03-03-FF-00-11.
4. Wait 2 seconds.

Observable Results:

Part A and E:

- TS2 must receive all of the frames transmitted by TS1.
- TS3 must not receive any of the frames transmitted by TS1.

Part B and F:

- TS2 and TS3 must not receive any of the frames transmitted by TS1.

Part C:

- In step 3, TS2 and TS3 must receive all of the frames transmitted by TS1.
- In step 6, TS3 must receive all of the frames transmitted by TS1.
- In step 6, TS2 must not receive any of the frames transmitted by TS1.

Part D:

- In step 3, TS2 and TS3 must not receive any of the frames transmitted by TS1.
- In step 6, TS2 and TS3 must receive all of the frames transmitted by TS1.

Possible Problems: None.

Group 4: Ageing Time

Scope: Various aspects of aging out dynamic entries in the filtering database.

Test FDB.op.4.1 — Ageing Time Verification

Purpose: To verify that the DUT ages out dynamic filtering entries in the Filtering Database after Ageing Time elapses.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 8.8
[2] IEEE Std. 802.1Q-2011: sub-clause 8.8.3
[3] IEEE Std. 802.1Q-2011: sub-clause 13.24.3
[4] IEEE Std. 802.1Q-2011: Table 8-6
[5] IEEE Std. 802.1Q-2011: Table 8-7

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

Discussion: The aging out of Dynamic Filtering Entries ensures that end stations that have been moved to a different part of the Bridged LAN will not be permanently prevented from receiving frames. It also mitigates issues which may arise due to changes in the active topology of STP, which may cause end stations to appear to move from the point of view of a bridge. During such a topology change, a modified mechanism is used for removing entries from the filtering database.

The Ageing Time may be set in management, and has a range of 10.0 – 1000000.0 seconds. If the Ageing Time can be set in management, the bridge shall have the capability to use values in the range specified, with a granularity of 1 second. The Default Aging Time is 300 seconds.

If the stpVersion parameter is TRUE, a bridge uses its Forward Delay time as the Ageing Time during a topology change. Otherwise, if the rstpVersion parameter is TRUE, all learned entries for non-edge ports are immediately flushed. The default value of the Forward Delay parameter is 15.0 seconds.

Part A is applicable if and only if the DUT allows modification of the Ageing Time.

Part D is applicable if and only if the DUT supports Spanning Tree operation using a ForceProtocolVersion value of 0.

Part E is applicable if and only if the DUT supports Spanning Tree operation using a ForceProtocolVersion value of 2 or greater.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Setting the Ageing Time in Management

1. Ensure that the DUT is configured with the Test Setup.
2. Attempt to set the Ageing Time to 9 seconds.
3. Attempt to set the Ageing Time to 10 seconds.
4. Attempt to set the Ageing Time to 1000000 seconds.
5. Attempt to set the Ageing Time to 1000001 seconds.

Part B: Default Ageing Time

1. Perform a Factory Reset on the DUT.
2. Ensure that the DUT is configured with the Test Setup but do not explicitly configure the Ageing Time.
3. From TS1, transmit 1 untagged frame with a source address of 00-04-01-BB-03-11.
4. From TS2, begin continuously transmitting untagged frames with a destination address identical to the address used in step 3.
5. Wait the Default Ageing Time plus 2 seconds.

Part C: Configured Ageing Time

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit 1 untagged frame with a source address of 00-04-01-CC-02-11.
3. From TS2, begin continuously transmitting untagged frames with a destination address identical to the address used in step 2.
4. Wait Ageing Time plus 2 seconds.
   (Proceed with the following steps if and only if the DUT allows modification of the Ageing Time.)

5. Repeat steps 2-4 with a configured Ageing Time value of 10 seconds.
6. Repeat steps 2-4 with a configured Ageing Time value of 1000 seconds.

Part D: Ageing Time During a Spanning Tree Topology Change (stpVersion)

1. Ensure that the DUT is configured with the Test Setup.
2. Configure the DUT to operate with a *ForceProtocolVersion* value of 0.
3. From TS3, transmit a Configuration BPDU which causes DUT.TS3 to transition to the Backup port role.
4. Wait 36 seconds.
5. From TS1, transmit 1 untagged frame with a source address of 00-04-01-DD-05-11.
6. From TS2, continuously transmit untagged frames with a destination address identical to the source address used in step 5.
7. Wait Forward Delay plus 2 seconds.

Part E: Flushing of Learned Entries during a Topology Change (rstpVersion)

1. Ensure that the DUT is configured with the Test Setup.
2. Configure the DUT to perate with the greatest *ForceProtocolVersion* value supported.
3. From TS3, at a rate of 1 every 2 seconds, begin transmitting RST BPDUs with a Root Priority better than the DUT's Bridge Priority, with the topology change flag reset and indicating the Designated port role.
4. From TS1 and TS2, begin transmitting RST BPDUs with a Root Identifier identical to that used by TS3, a Root Path Cost greater than that propagated by the DUT, with the topology change flag reset and indicating the Root port role at a rate of 1 every 2 seconds.
5. Wait until TS1, TS2, and TS3 are each receiving BPDUs with the forwarding flag set, and the topology change flag reset.
6. From TS1, transmit 1 untagged frame with a source address 00-04-01-EE-06-11.
7. From TS2, transmit 10 untagged frames containing a destination address identical to the source address used in step 6.
8. Set the topology change flag in only the next BPDU transmitted by TS3.
9. Repeat step 7.

Observable Results:

Part A:

- In steps 2 and 5, the DUT must not allow the specified values to be configured.
- In steps 3 and 4, the DUT must allow the specified values to be configured.

Part B:

- In step 4, the elapsed time between when TS3 receives the frame transmitted by TS1 in step 3 and when TS3 first receives a frame from TS2 must be within 1 second of the Default Ageing Time.

Part C:

- In step 4 and any repetitions of step 4, the elapsed time between when TS3 receives the frame transmitted by TS1 in step 3 and when TS3 first receives a frame from TS2 must be within 1 second of the Ageing Time.

Part D:

- In step 4, TS3 must receive the frame transmitted by TS1.
- In step 6, TS3 must begin receiving the frames transmitted by TS2 Forward Delay (with a tolerance of 1 second) seconds after it received the frame transmitted by TS1.

Part E:

- In step 7, TS3 must not receive any of the frames transmitted by TS2.
- In step 9, TS3 must receive all of the frames transmitted by TS2.

Possible Problems: None.

Test FDB.op.4.2 — Static Filtering Entries Not Aged Out

Purpose: To verify that the DUT does not use Ageing Time to age out Static Filtering Entries in the Filtering Database.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 8.8
[2] IEEE Std. 802.1Q-2011: sub-clause 8.8.9
[3] IEEE Std. 802.1Q-2011: Table 8-6

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

Discussion: Static filtering information is added to, modified, and removed from the Filtering Database only under explicit management control. It shall not be automatically removed by any aging mechanism.

Part B is applicable if and only if the DUT allows the creation of Static Filtering Entries.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Permanent Filtering Database Entries Are Not Aged Out

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit 10 untagged frames with a destination address of 01-80-C2-00-00-02.
3. Wait Ageing Time + 2 seconds.
4. Repeat step 2.

Part B: Static Filtering Entries Are Not Aged Out

1. Ensure that the DUT is configured with the Test Setup.
2. Create a Static Filtering Entry for 00-04-02-BB-02-22 that has a control element specifying forwarding for DUT.TS2 and filtering for DUT.TS3.
3. From TS1, transmit 10 untagged frames with a destination address identical to the address used in step 2.
4. Wait Ageing Time + 2 seconds.
5. Repeat step 3.

Observable Results:

Part A:

- TS2 must not receive any of the frames being transmitted by TS1.

Part B:

- TS2 must receive all of the frames transmitted by TS1.
- TS3 must not receive any of the frames transmitted by TS1.

Possible Problems: None.

Test FDB.op.4.3 — Static VLAN Registration Entries Not Aged Out

Purpose: To verify that the DUT does not use Ageing Time to age out Static VLAN Registration Entries in the Filtering Database.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 8.8
[2] IEEE Std. 802.1Q-2011: sub-clause 8.8.9
[3] IEEE Std. 802.1Q-2011: Table 8-6

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

Discussion: Static VLAN Registration Entries are added to, modified, and removed from the Filtering Database only under explicit management control. They shall not be automatically removed by any ageing mechanism.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Static VLAN Registration Entries Are Not Aged Out

1. Ensure that the DUT is configured with the Test Setup.
2. Configure DUT.TS1 and DUT.TS2 to be tagged members of VLAN 2.
3. From TS1, transmit 10 VLAN 2 tagged frames.
4. Wait Ageing Time.
5. Repeat step 3.

Observable Results:

Part A:

- TS2 must receive all of the frames transmitted by TS1.

Possible Problems: None.

Group 5: Frame Reception

Scope: Various aspects associated with frame reception.

Test FDB.op.5.1 — Minimum Untagged Size

Purpose: To verify that the DUT forwards untagged frames of minimum size and discards those with a size less than this minimum.

References: [1] IEEE Std. 802.3-2012: sub-clause 4.4.2
[2] IEEE Std. 802.1Q-2011: sub-clause 6.7.1
[3] IEEE Std. 802.1Q-2011: sub-clause 8.5

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

Discussion: The minimum size for an untagged frame is 64 bytes. Frames that are smaller than this minimum shall be discarded upon reception.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Minimum Untagged Size

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit 10 untagged 64 byte frames.
3. Wait 2 seconds.

Part B: Below Minimum Untagged Size

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit 10 untagged 63 byte frames.
3. Wait 2 seconds.

Observable Results:

Part A:

- TS2 must receive all of the frames transmitted by TS1.

Part B:

- TS2 must not receive any of the frames transmitted by TS1.

Possible Problems: None.

Test FDB.op.5.2 — Maximum Tagged Size

Purpose: To verify that the DUT forwards untagged frames of maximum size and discards those with a size greater than this maximum.

References: [1] IEEE Std. 802.3-2012: sub-clause 4.2.7.1
[2] IEEE Std. 802.3-2012: sub-clause 4.4.2
[3] IEEE Std. 802.1Q-2011: sub-clause 6.7.1
[4] IEEE Std. 802.1Q-2011: sub-clause 8.5

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

Discussion: A single maximum allowable frame size is utilized and varies based on implementation. Devices conforming to IEEE 802.3-2012 may choose either 1518, 1522, or 2000 octets and apply this as the maximum frame size for both tagged and untagged frames.

Prior versions of 802.3 allowed for implementations in which the maximum frame size differs for untagged and tagged frames. In such implementations, the maximum frame size for untagged frames is 1518 octets, and the maximum frame size for tagged frames is 1522 octets.

This test will vary according to the Maximum Untagged Size, defined in Appendix B.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Maximum Tagged Size

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit 10 frames tagged for the Default VLAN. Each of the transmitted frames is of Maximum Tagged Size, as specified in Appendix B.
3. Wait 2 seconds.

Part B: Maximum Tagged Size Exceeded

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit 10 frames tagged for the Default VLAN. Each of the transmitted frames is of Maximum Tagged Size, as specified in Appendix B, plus one octet.
3. Wait 2 seconds.

Observable Results:

Part A:

- TS2 must receive all of the frames transmitted by TS1.

Part B:

- TS2 must not receive any of the frames transmitted by TS1.

Possible Problems: None.

Test FDB.op.5.3 — Bad FCS Received

Purpose: To verify that the DUT discards received frames that contain an invalid FCS.

References: [1] IEEE Std. 802.3-2012: sub-clause 3.2.9 [2] IEEE Std. 802.1Q-2011: sub-clause 8.5

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

Discussion: IEEE 802.3-2012 requires that all transmitted Ethernet frames contain a 4 octet frame check sequence at the end of each frame. The FCS is a cyclic redundancy check computed over all prior octets of the frame. The FCS serves as an error detection mechanism to protect against errors which occur as the frame is in flight.

The FCS is recomputed upon reception based on the received frame data. A frame that is received in error shall be discarded upon reception.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Frames with Bad FCS Discarded

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit 10 untagged frames with invalid frame check sequences.
3. Wait 2 seconds.

Observable Results:

Part A:

- TS2 must not receive any of the frames transmitted by TS1.

Possible Problems: None.

Test FDB.op.5.4 — Frame Ordering Maintained

Purpose: To verify that the DUT does not deliver frames out of order.

References: [1] IEEE Std. 802.1Q-2011: 6.5.3

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

Discussion: The MAC Service does not permit the reordering of frames with a given user priority for a given combination of destination address and source address.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Frame Ordering Maintained

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit untagged frames at line rate while incrementing the data fields in each successive frame.
3. Wait 2 seconds.

Observable Results:

Part A:

- None of the received frames should arrive out of the order in which they were transmitted by TS1.

Possible Problems: None.

Test FDB.op.5.5 — Frames Not Duplicated

Purpose: To verify that the DUT does not duplicate any frames that it receives when forwarding them.

References: [1] IEEE Std. 802.1Q-2011: 6.5.4

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

Discussion: The MAC Service does not permit the duplication of frames.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Frames Not Duplicated

1. Ensure that the DUT is configured with the Test Setup.
2. From TS1, transmit untagged frames while incrementing the data fields in each successive frame.
3. Wait 2 seconds.

Observable Results:

Part A:

- No duplicate test frames should be received by TS2.

Possible Problems: None.

Test FDB.op.5.6 — Maximum Bridge Transit Delay

Purpose: To verify that the DUT discards frames as necessary to enforce a Maximum Bridge Transit Delay.

References: [1] IEEE Std. 802.1Q-2011: sub-clause 6.5.5
[2] IEEE Std. 802.1Q-2011: sub-clause 6.5.6
[3] IEEE Std. 802.1D-2004: Table 7-3
[4] IEEE Std. 802.3-2012: Annex 31B

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

Discussion: The MAC Service ensures that a Maximum Bridge Transit Delay is experienced for a particular instance of communication. To enforce the maximum frame lifetime, a Bridge may be required to discard frames. The MAC Sublayer to a Bridge does not include the transit delay already experienced by any particular frame, therefore Bridges discard frames to enforce a maximum delay in each Bridge.

The value of the Maximum Bridge Transit Delay is based on both the maximum delays imposed by all Bridges in the network and the desired maximum frame lifetime. A recommended and absolute maximum value is specified in Table 7-3.

If the DUT does not support PAUSE operations, this test cannot be completed.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: Maximum Bridge Transit Delay

1. Ensure that the DUT is configured with the Test Setup.
2. From TS2, transmit PAUSE frames continuously. The PAUSE frames must cause a delay longer than the gap between PAUSE frames.
3. From TS1, transmit 10 untagged frames.
4. After 4 seconds have elapsed, stop transmitting PAUSE frames from TS2.
5. Wait 2 seconds.

Observable Results:

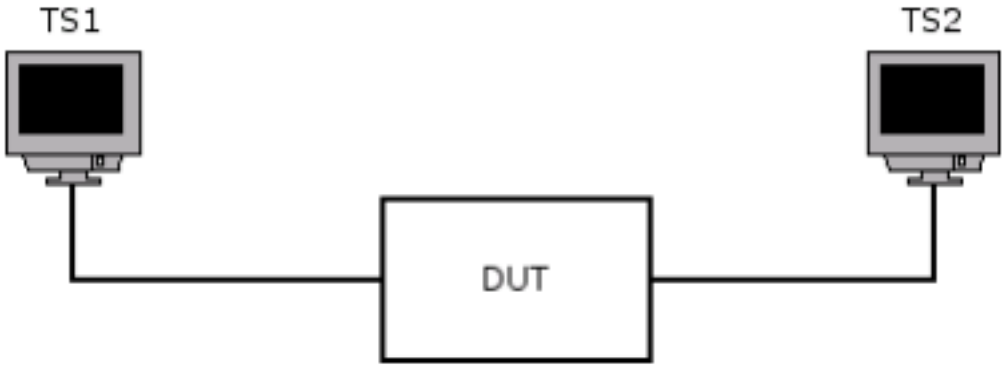
Part A:

- TS2 should not recieve any frames transmitted by TS1.

Possible Problems: None.

Appendix A: Default Test Setup

The following diagram describes a general test layout with multiple Test Stations connected to the DUT.



Each test in this suite uses the following setup for the DUT unless otherwise stated:

- Reset the device to factory defaults.
- Configure Ageing Time to 300 seconds.
- Clear all Dynamic Entries in the Filtering Database.
- Enable the most recent version of the Spanning Tree Protocol supported by the bridge.
- Configure all Spanning Tree timer values to their recommended defaults.
  - Hello Timer: 2 Seconds
  - Max Age Time: 20 Seconds
  - Forward Time: 15 Seconds
- Ensure VLAN awareness is enabled.
- Ensure that a Static Filtering Entry exists which specifies forward all groups on all ports.
- For each port used during the tests:
  - If applicable, set to be an untagged member of VLAN 1 with PVID of 1.
  - Set the Acceptable Frame Types parameter to Accept All Frames.
  - Set the Enable Ingress Filtering parameter to *Reset* (i.e. Disable Ingress Filtering).

Appendix B: Vendor Support Questionnaire

In order to provide top-tier services to our customers, the technician executing the test suite against a device under test needs to know which options and parameter values the device is claiming support for.

This appendix contains a list of support options which are to be specified by the vendor prior to testing.

Ageing Time:	Minimum Value: _____ Maximum Value: _____
Frame Size Constraints:	Maximum Tagged Size: _____
Filtering Services:	Filtering Database Size: _____ (Learned Address count) ☐ Basic Filtering Services Supported ☐ Extended Filtering Services Supported
Behavior on Filtering Database Overflow:	☐ Old Entries Overwritten ☐ New Entries Ignored
VLAN Types:	☐ C-VLANs Supported ☐ S-VLANs Supported