

ETHERNET TESTING SERVICES

MAC Merge Frame Preemption for Interspersing Express Traffic Conformance Test Plan

Version 1.0
Technical Document



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Ethernet Testing Services

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MODIFICATION RECORD

- **June 14, 2017 Version 1.0**

Peter Scruton: Added tests and released with assistance in identifying changes from various UNH-IOL employees. Revised and added various procedures and text, as well as correcting duplicate tests and test parts.

- **May 19, 2017 Version 0.2 Draft**

Peter Scruton: Added tests and moved the draft closer to release with assistance in identifying editorial changes from Joshua Amero. Revised, eliminated, and added various procedures and text.

- **August 22, 2016 Version 0.1 Draft**

Peter Scruton: Initial Version utilizing UNH-IOL Ethernet MAC test suite and other UNH-IOL documents as template.

REFERENCES

Abbreviated Form	Specification
IEEE Std 802.3TM-2015	IEEE Std 802.3 TM -2015 (Revision of IEEE Std 802.3-2012), The IEEE Standard for Ethernet, by the LAN/MAN Standards Committee of the IEEE Computer Society, Approved 3 September 2015 by IEEE-SA Standards Board.
IEEE Std 802.3-2015 w/ 802.3br-2016	IEEE Std 802.3 TM -2015 as amended by IEEE Std 802.3br TM -2016, IEEE Approved Draft Standard for Ethernet Amendment: Specification and Management Parameters for Interspersing Express Traffic

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Peter Scruton University of New Hampshire

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InterOperability Laboratory

INTRODUCTION

Overview

The University of New Hampshire's InterOperability Laboratory (IOL) is an institution designed to improve the interoperability of standards based products by providing an environment where a product can be tested against other implementations of a standard. This suite of tests has been developed to help implementers evaluate the functioning of their Clause 99 MAC Merge Sublayer based products. The tests do not determine if a product conforms to the IEEE Std 802.3, nor are they purely interoperability tests. Rather, they provide one method to isolate problems within a MAC device. In addition, a failure observed upon completion of the tests contained in this test plan may indicate a system implementation error and not a MAC error. Successful completion of all tests contained in this plan does not guarantee that the tested device will operate with other devices. However, combined with satisfactory operation in the IOL's interoperability test bed, these tests provide a reasonable level of confidence that the Device Under Test (DUT) will function well in most environments.

Organization of Tests

The tests contained in this document are organized to simplify the identification of information related to a test and to facilitate in the actual testing process. Each test contains an identification section that describes the test and provides cross-reference information. The discussion section covers background information and specifies why the test is to be performed. Tests are grouped by similar functions and further organized by technology. Each test contains the following information:

Test Number

The Test Number associated with each test follows a simple grouping structure. Listed first is the General Clause of the IEEE Std 802.3 standard that is under test, followed by the Test Group Number, followed by the test's number within the group. This allows for the addition of future tests to the appropriate groups of the test plan without requiring the renumbering of the subsequent tests.

Purpose

The purpose is a brief statement outlining what the test attempts to achieve. The test is written at the functional level.

References

The references section lists cross-references to the IEEE Std 802.3 standards and other documentation that might be helpful in understanding and evaluating the test and results.

Resource Requirements

The requirements section specifies the hardware, and test equipment that will be needed to perform the test. The items contained in this section are special test devices or other facilities, which may not be available on all devices.

Last Modification

This specifies the date of the last modification to this test.

Discussion

The discussion covers the assumptions made in the design or implementation of the test as well as known limitations. Other items specific to the test are covered here.

Test Setup

The setup section describes the configuration of the test environment. Small changes in the configuration should be included in the test procedure.

Procedure

The procedure section of the test description contains the step-by-step instructions for carrying out the test. It provides a cookbook approach to testing, and may be interspersed with observable results.

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Observable Results

The observable results section lists specific items that can be examined by the tester to verify that the DUT is operating properly. When multiple values are possible for an observable result, this section provides a short discussion on how to interpret them. The determination of a pass or fail for a certain test is often based on the successful (or unsuccessful) detection of a certain observable result.

Possible Problems

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

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GROUP 1: Checking for Proper Reception

Scope: The following tests cover MAC Merge operations specific to proper reception of packets.

Overview: These tests are designed to verify that the DUT properly accepts preemptable packets under different conditions where acceptance of the packet is required. The MAC Merge functions explored are defined in Clause 99 of IEEE Std 802.3TM-2015 as amended by IEEE Std 802.3brTM-2016.

Test #99.1.1 – Acceptance of Preemptable Packets with and without Preemption Active

Purpose: To verify that the DUT accepts Preemptable Packets after the DUT has indicated Preemption is active through transmitting an AEC-TLV.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4 (MAC Merge sublayer operation)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM11
- [4] ANNEX A (informative) Acronym Definitions
- [5] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: May 22, 2017

Discussion: The processing of preemptable packets involves receiving one or more packets containing a single frame and piecing them together [1]. These are passed up to the preemptable MAC as they are received by the MAC Merge Sublayer. The MAC Merge sublayer, if present, will always be in the position to receive Preemptable Packets [2]. Thus, regardless of whether or not Preemption is active or enabled, the DUT should receive preemptable frames.

Test Setup: Connect the DUT to the testing station with the appropriate medium.

Test Procedure:

Part A: Accepting Preemptable Frames after Preemption is Active

- A:1. Disconnect and after two or more seconds reconnect the link.
- A:2. Cause the DUT to enter a mode with Preemption Active such that it transmits an AEC-TLV to that affect.
- A:3. Transmit a Preemptable Frame to the DUT which is sent in two or more Preemptable Packets.
- A:4. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A4	FAIL	The DUT was not observed to accept the preemptable frame.
A4	PASS	The DUT was observed to accept the preemptable frame.

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Part B: *Accepting Preemptable Frames when Preemption is not Active*

- B:1. Disconnect and after several or more seconds reconnect the link.
- B:2. Send an AEC-TLV indicating no support, not enabled, and not active.
- B:3. Observe the transmissions from the DUT for several seconds.
- B:4. Transmit a Preemptable Frame to the DUT which is sent in two or more Preemptable Packets.
- B:5. Observe the transmissions from the DUT.

Observable results:

Step	Result	Description
B3	FAIL	The DUT was observed to send a Verify Packet.
B3	FAIL	The DUT was observed to send an AEC-TLV indicating preemption is active.
B5	FAIL	The DUT was observed to not accept the preemptable frame.
B5	PASS	The DUT was observed to accept the preemptable frame.

Possible Problems: None

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Test #99.1.2 – Accepts all Frame Count and Frag_count Combinations

Purpose: To verify that the DUT accepts Preemptable Packets with all frame count and frag_count combinations.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM11
- [4] ANNEX A (informative) Acronym Definitions
- [5] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 12, 2017

Discussion: The processing of preemptable packets involves receiving a frame with an SMD-S. If that mPacket did not contain a complete frame, it also involves receiving a series of one or more subsequent mPackets (containing an SMD-C with the same frame count as the preceding SMD-S) containing the rest of the frame. For reception of a Preemptable mPacket the frame count only informs the DUT what frame count it is currently at, and if continued, what packet it is a continuation for. Thus it should be insensitive to what the frame count is as long as the current packet is complete prior to receiving a new packet with a possibly different frame count [2]. For transmission the Transmit Processing State Diagram indicates that the frame count for transmission starts at 0, then goes to 1, 2, 3, and then continues to repeat this pattern from 0 again.[2]

Test Setup: Connect the DUT to the testing station with the appropriate medium.

Test Procedure:

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Part A: *Part A: Accepting All Combinations of Frame Count and frag_count*

- A:1. Disconnect and after several or more seconds reconnect the link.
- A:2. Cause the DUT to enter a mode with Preemption Active such that it transmits an AEC-TLV to that affect.
- A:3. Transmit a series of 4 complete Preemptable Frames (each broken into five packets (four 304-byte mPackets and one 318-byte mPacket)).
 - a) The five mPackets of the first frame should have frame count set to 0 and the second through the fifth packets should have frag_counts of 0 (second), 1 (third), 2 (fourth), and 3 (fifth).
 - b) The five packets of the second frame should have frame count set to 1 and the second through the fifth packets should have frag_counts of 0 (second), 1 (third), 2 (fourth), and 3 (fifth).
 - c) The five packets of the third frame should have frame count set to 2 and the second through the fifth packets should have frag_counts of 0 (second), 1 (third), 2 (fourth), and 3 (fifth).
 - d) The five packets of the fourth frame should have frame count set to 3 and the second through the fifth packets should have frag_counts of 0 (second), 1 (third), 2 (fourth), and 3 (fifth).
- A:4. While transmitting, observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A4	FAIL	The DUT was not observed to accept all the preemptable frames.
A4	PASS	The DUT was observed to accept all the preemptable frames.

Possible Problems: None

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Test #99.1.3 – Non-ordered Frame Counts

Purpose: To verify that the DUT accepts Preemptable Packets with unordered frame counts.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM11
- [4] ANNEX A (informative) Acronym Definitions
- [5] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 12, 2017

Discussion: The processing of preemptable packets involves receiving a frame with an SMD-S. If that mPacket did not contain a complete frame, it also involves receiving a series of one or more subsequent mPackets (containing an SMD-C with the same frame count as the preceding SMD-S) containing the rest of the frame. For reception of a Preemptable mPacket the frame count only informs the DUT what frame count it is currently at, and if continued, what packet it is a continuation for. Thus it should be insensitive to what the frame count is as long as the current packet is complete prior to receiving a new packet with a possibly different frame count [2]. For transmission the Transmit Processing State Diagram indicates that the frame count for transmission starts at 0, then goes to 1, 2, 3, and then continues to repeat this pattern from 0 again.[2]

Test Setup: Connect the DUT to the testing station with the appropriate medium.

Test Procedure:

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Part A: *Accepting Unordered Preemptable Frames (2 packets per frame)*

- A:1. Disconnect and after several or more seconds reconnect the link.
- A:2. Cause the DUT to enter a mode with Preemption Active such that it transmits an AEC-TLV to that affect.
- A:3. Transmit a series of complete Preemptable Frames (each broken into two packets; the first of which adheres to the declared additional fragment size of the DUT, the second of which is at least 64 bytes) to the DUT.
 - a) The two packets of the first frame should have frame count set to 3.
 - b) The two packets of the second frame should have frame count set to 2.
 - c) The two packets of the third frame should have frame count set to 1.
 - d) The two packets of the fourth frame should have frame count set to 0.
 - e) The two packets of the fifth frame should have frame count set to 3.
- A:4. While transmitting, observe the transmissions from the DUT for up to two seconds.
- A:5. Repeat Steps A1 and A2
- A:6. Transmit a series of complete Preemptable Frames (each broken into two packets; the first of which adheres to the declared additional fragment size of the DUT, the second of which is at least 64 bytes) to the DUT.
 - a) The two packets of the first frame should have frame count set to 1.
 - b) The two packets of the second frame should have frame count set to 2.
 - c) The two packets of the third frame should have frame count set to 1.
- A:7. While transmitting, observe the transmissions from the DUT for up to two seconds.
- A:8. Repeat Steps A1 and A2
- A:9. Transmit a series of complete Preemptable Frames (each broken into two packets; the first of which adheres to the declared additional fragment size of the DUT, the second of which is at least 64 bytes) to the DUT.
 - a) The two packets of the first frame should have frame count set to 0.
 - b) The two packets of the second frame should have frame count set to 3.
 - c) The two packets of the third frame should have frame count set to 0.
 - d) The two packets of the fourth frame should have frame count set to 3.
- A:10. While transmitting, observe the transmissions from the DUT for up to two seconds.
- A:11. Repeat Steps A1 and A2
- A:12. Transmit a series of complete Preemptable Frames (each broken into two packets; the first of which adheres to the declared additional fragment size of the DUT, the second of which is at least 64 bytes) to the DUT.
 - a) The two packets of the first frame should have frame count set to 0.
 - b) The two packets of the second frame should have frame count set to 0.
 - c) The two packets of the third frame should have frame count set to 0.
 - d) The two packets of the fourth frame should have frame count set to 0.
- A:13. While transmitting, observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A4	FAIL	The DUT was not observed to accept all the preemptable frames.
A7	FAIL	The DUT was not observed to accept all the preemptable frames.
A10	FAIL	The DUT was not observed to accept all the preemptable frames.
A13	FAIL	The DUT was not observed to accept all the preemptable frames.
A13	PASS	The DUT was observed to accept all the preemptable frames.

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Part B: Accepting Unordered Preemptable Frames (1 packet per frame)

- B:1. Disconnect and after several or more seconds reconnect the link.
- B:2. Cause the DUT to enter a mode with Preemption Active such that it transmits an AEC-TLV to that affect.
- B:3. Transmit a series of complete Preemptable Frames (each frame transmitted in a single packet) to the DUT.
 - a) The packet of the first frame should have frame count set to 3.
 - b) The packet of the second frame should have frame count set to 2.
 - c) The packet of the third frame should have frame count set to 1.
 - d) The packet of the fourth frame should have frame count set to 0.
 - e) The packet of the fifth frame should have frame count set to 3.
- B:4. While transmitting, observe the transmissions from the DUT for up to two seconds.
- B:5. Repeat Steps B1 and B2
- B:6. Transmit a series of complete Preemptable Frames to the DUT.
 - a) The packet of the first frame should have frame count set to 1.
 - b) The packet of the second frame should have frame count set to 2.
 - c) The packet of the third frame should have frame count set to 1.
- B:7. While transmitting, observe the transmissions from the DUT for up to two seconds.
- B:8. Repeat Steps B1 and B2
- B:9. Transmit a series of complete Preemptable Frames to the DUT.
 - a) The packet of the first frame should have frame count set to 0.
 - b) The packet of the second frame should have frame count set to 3.
 - c) The packet of the third frame should have frame count set to 0.
 - d) The packet of the fourth frame should have frame count set to 3.
- B:10. While transmitting, observe the transmissions from the DUT for up to two seconds.
- B:11. Repeat Steps B1 and B2
- B:12. Transmit a series of complete Preemptable Frames to the DUT.
 - a) The packet of the first frame should have frame count set to 0.
 - b) The packet of the second frame should have frame count set to 0.
 - c) The packet of the third frame should have frame count set to 0.
 - d) The packet of the fourth frame should have frame count set to 0.
- B:13. While transmitting, observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
B4	FAIL	The DUT was not observed to accept all the preemptable frame.
B7	FAIL	The DUT was not observed to accept all the preemptable frame.
B10	FAIL	The DUT was not observed to accept all the preemptable frame.
B13	FAIL	The DUT was not observed to accept all the preemptable frame.
B13	PASS	The DUT was observed to accept all the preemptable frame.

Possible Problems: None

Test #99.1.4 – Acceptance of Minimum Sized Fragmented Frame

Purpose: To verify that the DUT accepts minimum sized Preemptable Packets.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM11
- [4] ANNEX A (informative) Acronym Definitions
- [5] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 13, 2017

Discussion: The processing of preemptable packets involves receiving a frame with an SMD-S. If that mPacket did not contain a complete frame, it also involves receiving a series of one or more subsequent mPackets (containing an SMD-C with the same frame count as the preceding SMD-S) containing the rest of the frame. The variable additional fragment size (0-3) communicated from the AEC-TLV is used to inform the link partner of the minimum sized non-final fragments that you support (0 means 64, 1 means 128, 2 means 192, and 3 means 256). Any non-final subsequent fragments of that frame must also be that length. The final fragment may be as little as 64 bytes in length.

Test Setup: Connect the DUT to the testing station with the appropriate medium.

Test Procedure:

Part A: *Accepting a Preemptable Frame (2 packets per frame both packets of minimum size)*

- A:1. If either Preemption is not already Active or the declared value of additional fragment size from the DUT is unknown, cause the DUT to enter a mode with Preemption Active such that it transmits an AEC-TLV to that affect, noting the value of additional fragment size in this AEC-TLV.
- A:2. Transmit a complete Preemptable Frame broken into two packets; the first of which is the calculated minimum Preemptable Packet size as declared in the additional fragment size of the AEC-TLV of the DUT and the second of which is 64 bytes, to the DUT.
 - a) If the additional fragment size is 1 this would be a 188-byte preemptable frame split into a 128-byte mPacket with 124 bytes of frame data plus a 4-byte mCRC and a 64-byte mPacket with 60 bytes of frame data and the 4 bytes of the original CRC.
- A:3. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A3	FAIL	The DUT was not observed to accept the preemptable frame.
A3	PASS	The DUT was observed to accept the preemptable frame.

Possible Problems: None

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Test #99.1.5 – Acceptance of a Maximally Fractured 1518-Byte Frame

Purpose: To verify that the DUT accepts Preemptable Packets with unordered frame counts.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM11
- [4] ANNEX A (informative) Acronym Definitions
- [5] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: May 22, 2017

Discussion: The processing of preemptable packets involves receiving a frame with an SMD-S. If that mPacket did not contain a complete frame, it also involves receiving a series of one or more subsequent mPackets (containing an SMD-C with the same frame count as the preceding SMD-S) containing the rest of the frame. The variable additional fragment size (0-3) communicated from the AEC-TLV is used to inform the link partner of the minimum sized non-final fragment that you support (0 means 64, 1 means 128, 2 means 192, and 3 means 256). The final fragment of that frame may be 64 bytes in length.

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms).

Test Procedure:

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Part A: *Accepting a Maximally Fractured Preemptable Frame without interfering express traffic*

- A:1. If Preemption is not already Active, cause the DUT to enter a mode with Preemption Active such that it transmits an AEC-TLV to that affect, noting the value of additional fragment size in this AEC-TLV.
- A:2. Transmit to the DUT a valid 1518-byte complete Preemptable Frame broken into as many mPackets as is supported (The minimum size non-final fragments are calculated utilizing the minimum Preemptable Packet size as declared in the additional fragment size of the AEC-TLV of the DUT. The final fragment may be as small as 64 bytes.).
 - a) If the additional fragment size is 0 and the maximum frame size is 1518 bytes this would be 25. One configuration would be twenty-four 64 byte mPackets with 60 bytes of frame data plus a 4-byte mCRC and a 78-byte mPacket with 74 bytes of frame data and the 4 bytes with the original CRC. (For an additional fragment size of 3, one configuration would be: four 256-byte mPackets containing 252 bytes of frame data plus a 4-byte mCRC, a 450-byte mPacket with 446-bytes of frame data plus a 4-byte mCRC and finally a 64-byte mPacket with 60 bytes of frame data and then the 4-byte original CRC.)
- A:3. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A3	FAIL	The DUT was not observed to accept the preemptable frame.
A3	PASS	The DUT was observed to accept the preemptable frame.

Part B: *Accepting a Maximally Fractured Preemptable Frame with interfering express traffic*

- B:1. If Preemption is not already Active, cause the DUT to enter a mode with Preemption Active such that it transmits an AEC-TLV to that affect, noting the value of additional fragment size in this AEC-TLV.
- B:2. Transmit to the DUT a valid 1518-byte complete Preemptable Frame broken into as many mPackets as is supported (The minimum size initial fragment is the calculated minimum Preemptable Packet size as declared in the additional fragment size of the AEC-TLV of the DUT and subsequent fragments may be as small as 64 bytes.). After each of the non-final Preemptable packets transmit an Express Packet.
 - a) If the additional fragment size is 0 and the maximum frame size is 1518 bytes this would be 25. One configuration would be twenty-four 64-byte mPackets with 60 bytes of frame data plus a 4-byte mCRC and a 78-byte mPacket with 74 bytes of frame data and the 4 bytes with the original CRC.
- B:3. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
B3	FAIL	The DUT was not observed to accept the preemptable frame.
B3	PASS	The DUT was observed to accept the preemptable frame.

Possible Problems: None

Test #99.1.6 – Acceptance of a Preempted Frame After Long Intervals

Purpose: To verify that the DUT still accepts a Preemptable Frame even if a long interval occurs between Preemptable Packets of that frame.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016 : PICS Item MM11
- [4] ANNEX A (informative) Acronym Definitions
- [5] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 13, 2017

Discussion: The processing of preemptable packets involves receiving a frame with an SMD-S. If that mPacket did not contain a complete frame, it also involves receiving a series of one or more subsequent mPackets (containing an SMD-C with the same frame count as the preceding SMD-S) containing the rest of the frame. Preemptable frames may be delayed by express traffic, respond frames, or the hold signal. Long delays between preemptable packets of a frame should be tolerated.

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms).

Test Procedure:

Part A: Part A: Accepting a 1518-byte Preempted Frame without interfering traffic

- A:1. If Preemption is not already Active, cause the DUT to enter a mode with Preemption Active such that it transmits an AEC-TLV to that affect, noting the value of additional fragment size in this AEC-TLV.
- A:2. Transmit the first of two segments of a valid 1518-byte complete Preemptable Frame. This first segment should contain 1454 bytes of the frame data plus a 4-byte mCRC.
- A:3. Wait at least one minute.
- A:4. Transmit the last segment of the 1518-byte frame.
- A:5. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A5	FAIL	The DUT was not observed to accept the preemptable frame.
A5	PASS	The DUT was observed to accept the preemptable frame.

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Part B: *Accepting a 1518-byte Preempted Frame with interfering traffic*

- B:1. If Preemption is not already Active, cause the DUT to enter a mode with Preemption Active such that it transmits an AEC-TLV to that affect, noting the value of additional fragment size in this AEC-TLV.
- B:2. Transmit the first of two segments of a valid 1518-byte complete Preemptable Frame. This first segment should contain 1454 bytes of the frame data plus a 4-byte mCRC.
- B:3. Wait at least one minute while sending a large amount of express frames as well as some verify frames.
- B:4. Transmit the last segment of the 1518-byte frame.
- B:5. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
B5	FAIL	The DUT was not observed to accept the preemptable frame.
B5	PASS	The DUT was observed to accept the preemptable frame.

Possible Problems: None

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Test #99.1.7 – Acceptance of Preemptable Packets with Odd Number of Bytes

Purpose: To verify that the DUT still accepts a Preemptable Frame even if one or more of the mPackets of that Preemptable Frame have an odd number of bytes.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM11
- [4] ANNEX A (informative) Acronym Definitions
- [5] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 13, 2017

Discussion: The processing of preemptable packets involves receiving a frame with an SMD-S. If that mPacket did not contain a complete frame, it also involves receiving a series of one or more subsequent mPackets (containing an SMD-C with the same frame count as the preceding SMD-S) containing the rest of the frame. Preemptable frames may be split and should be processed regardless of where the split(s) occurs, so long as the mPackets are of sufficient size.

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms).

Test Procedure:

Part A: *Accepting a 512-Byte Preempted Frame (split into two mPackets of sizes 259 and 257 bytes)*

- A:1. With the DUT in a mode with Preemption Active, transmit two segments of a valid 512-byte complete Preemptable Frame. This first segment should contain 255 bytes of the frame data plus a 4-byte mCRC. The second should contain the remaining 257 bytes, including the original CRC.
- A:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A2	FAIL	The DUT was not observed to accept the preemptable frame.
A2	PASS	The DUT was observed to accept the preemptable frame.

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Part B: *Accepting a 511-Byte Preempted Frame (split into two mPackets of sizes 257 and 258 bytes)*

- B:1. With the DUT in a mode with Preemption Active, transmit two segments of a valid 511-Byte complete Preemptable Frame. This first segment should contain 253 bytes of the frame data plus a 4-byte mCRC. The second should contain the remaining 258 bytes, including the original CRC.
- B:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
B2	FAIL	The DUT was not observed to accept the preemptable frame.
B2	PASS	The DUT was observed to accept the preemptable frame.

Part C: *Accepting a 511-Byte Preempted Frame (split into two mPackets of sizes 258 and 257 bytes)*

- C:1. With the DUT in a mode with Preemption Active, transmit two segments of a valid 511-Byte complete Preemptable Frame. This first segment should contain 254 bytes of the frame data plus a 4-byte mCRC. The second should contain the remaining 257 bytes, including the original CRC.
- C:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
C2	FAIL	The DUT was not observed to accept the preemptable frame.
C2	PASS	The DUT was observed to accept the preemptable frame.

Possible Problems: None

Test #99.1.8 – Acceptance of Preemptable Packets with Varying Preamble Size

Purpose: To verify that the DUT still accepts a Preemptable Frame without respect to the amount of preamble present.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM11
- [4] ANNEX A (informative) Acronym Definitions
- [5] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 13, 2017

Discussion: An mPacket should be processed regardless of the amount of integer bytes of preamble received. For Preemptable Frames on the initial SMD-S packet, it should loop between CHECK_FOR_START and RX_PREAMBLE for as little or as long as is required to receive all Preamble bytes, see Figure 99-6 – Receive Processing State Diagram [2]. Similarly, for continued frames it should loop in the CHECK_FOR_RESUME state [2].

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms).

Test Procedure:

Part A: *Accepting a Preempted Frame with Short Preamble in Initial mPacket (split into two mPackets of sizes 260 and 256 bytes)*

- A:1. With the DUT in a mode with Preemption Active, transmit two segments of a valid 512-byte complete Preemptable Frame. This first segment should contain the minimum amount of Preamble supported by the PHY (1 byte for 100BASE-TX, 2 bytes for 1000BASE-T) an SMD-S, 256 bytes of the frame data, plus a 4-byte mCRC. The second should contain the remaining 256 bytes, including the original CRC.
- A:2. Observe the transmissions from the DUT for up to two seconds.
- A:3. If more than one speed is supported, then steps A1 and A2 should be repeated for each speed that supports preemption.

Observable results:

Step	Result	Description
A2	FAIL	The DUT was not observed to accept each preemptable frame.
A2	PASS	The DUT was observed to accept each preemptable frame.

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Part B: *Accepting a Preempted Frame with Short Preamble in Final mPacket (split into two mPackets of sizes 260 and 256 bytes)*

- B:1. With the DUT in a mode with Preemption Active, transmit two segments of a valid 512-byte complete Preemptable Frame. The first segment should contain the first 256 bytes of frame data and a 4-byte mCRC. The second segment should contain the minimum amount of Preamble supported by the PHY (1 byte for 100BASE-TX, 2 bytes for 1000BASE-T), an SMD-C, a frag_count field (set to 0), and 256 bytes of frame data (which includes the original 4-byte CRC).
- B:2. Observe the transmissions from the DUT for up to two seconds.
- B:3. If more than one speed is supported, then steps B1 and B2 should be repeated for each speed that supports preemption.

Observable results:

Step	Result	Description
B2	FAIL	The DUT was not observed to accept each preemptable frame.
B2	PASS	The DUT was observed to accept each preemptable frame.

Part C: *Accepting a Preempted Frame with Long Preamble in Initial mPacket (split into two mPackets of sizes 260 and 256 bytes)*

- C:1. With the DUT in a mode with Preemption Active, transmit two segments of a valid 512-byte complete Preemptable Frame. This first segment should contain 64 bytes of Preamble, an SMD-S, 256 bytes of the frame data, plus a 4-byte mCRC. The second should contain the remaining 256 bytes, including the original CRC.
- C:2. Observe the transmissions from the DUT for up to two seconds.
- C:3. If more than one speed is supported, then steps C1 and C2 should be repeated for each speed that supports preemption.

Observable results:

Step	Result	Description
C2	FAIL	The DUT was not observed to accept each preemptable frame.
C2	PASS	The DUT was observed to accept each preemptable frame.

Part D: *Accepting a Preempted Frame with Long Preamble in Final mPacket (split into two mPackets of sizes 260 and 256 bytes)*

- D:1. With the DUT in a mode with Preemption Active, transmit two segments of a valid 512-byte complete Preemptable Frame. The first segment should contain the first 256 bytes of frame data and a 4-byte mCRC. The second segment should contain 64 bytes of preamble, an SMD-C, a frag_count field (set to 0), and 256 bytes of frame data (which includes the original 4-byte CRC).
- D:2. Observe the transmissions from the DUT for up to two seconds.
- D:3. If more than one speed is supported, then steps D1 and D2 should be repeated for each speed that supports preemption.

Observable results:

Step	Result	Description
D2	FAIL	The DUT was not observed to accept each preemptable frame.
D2	PASS	The DUT was observed to accept each preemptable frame.

Possible Problems: None

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Test #99.1.9 – Acceptance of Non-Preemptable Packets with Varying Preamble Size

Purpose: To verify that the DUT still accepts Express, Verify, and Respond Frames without respect to the amount of preamble present.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.3 (Variables)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.6 (Timers)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [5] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM11
- [6] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM13
- [7] ANNEX A (informative) Acronym Definitions
- [8] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 13, 2017

Discussion: An mPacket should be processed regardless of the amount of integer bytes of preamble received. For reception of Non-Preemptable Frames the DUT should loop between CHECK_FOR_EXPRESS and EXPRESS_PREAMBLE for as little or as long as is required to receive all Preamble bytes, see Figure 99-7 – Express Filter State Diagram [4].

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms).

Test Procedure:

Part A: Accepting an Express Frame with Short Preamble

- A:1. With the DUT in a mode with Preemption Active, transmit a valid 64-byte Express Frame. This packet should contain the minimum amount of Preamble supported by the PHY (1 byte for 100BASE-TX, 2 bytes for 1000BASE-T) an SMD-E, and 64 bytes of the frame data (including the original CRC).
- A:2. Observe the transmissions from the DUT for up to two seconds. If more than one speed is supported, then steps A1 and A2 should be repeated for each speed that supports preemption.

Observable results:

Step	Result	Description
A2	FAIL	The DUT was not observed to accept the Express frame.
A2	PASS	The DUT was observed to accept the Express frame.

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Part B: *Accepting an Express Frame with Long Preamble*

- B:1. With the DUT in a mode with Preemption Active, transmit a valid 64-byte Express Frame. This packet should contain 64 bytes of Preamble, an SMD-E, and 64 bytes of the frame data (including the original CRC).
- B:2. Observe the transmissions from the DUT for up to two seconds. If more than one speed is supported, then steps B1 and B2 should be repeated for each speed that supports preemption.

Observable results:

Step	Result	Description
B2	FAIL	The DUT was not observed to accept the Express frame.
B2	PASS	The DUT was observed to accept the Express frame.

Part C: *Accepting a Verify Frame with Short Preamble*

- C:1. With the DUT in a mode with Preemption Active, transmit a valid 64-byte Verify Frame. This packet should contain the minimum amount of Preamble supported by the PHY (1 byte for 100BASE-TX, 2 bytes for 1000BASE-T) an SMD-V, 60 bytes of (0x00) and an mCRC.
- C:2. Observe the transmissions from the DUT for up to two seconds. If more than one speed is supported, then steps C1 and C2 should be repeated for each speed that supports preemption.

Observable results:

Step	Result	Description
C2	FAIL	The DUT was not observed transmit a Respond Frame, indicating it did not accept the Verify Frame.
C2	PASS	The DUT was observed to transmit a Respond Frame, indicating it accepted the Verify Frame with minimum-sized preamble.

Part D: *Accepting a Verify Frame with Long Preamble*

- D:1. With the DUT in a mode with Preemption Active, transmit a valid 64-byte Verify Frame. This packet should contain 64 bytes of Preamble, an SMD-E, 60 bytes of (0x00) and an mCRC.
- D:2. Observe the transmissions from the DUT for up to two seconds. If more than one speed is supported, then steps D1 and D2 should be repeated for each speed that supports preemption.

Observable results:

Step	Result	Description
D2	FAIL	The DUT was not observed transmit a Respond Frame, indicating it did not accept the Verify Frame.
D2	PASS	The DUT was observed to transmit a Respond Frame, indicating it accepted the Verify Frame with long preamble.

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Part E: Accepting a Respond Frame with Short Preamble

- E:1. Disconnect and after several or more seconds reconnect the link.
- E:2. Cause the DUT to enter a mode with Preemption Supported.
- E:3. Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- E:4. After a Verify frame has been transmitted by the DUT, quickly (so as to be completely received prior to $2 * \text{verifyTime}$ (range from 1 – 128 ms, see [2]) * 0.8 (see [3]) cause the DUT to transmit a valid 64-byte Respond Frame.
 - a) This packet should contain the minimum amount of Preamble supported by the PHY (1 byte for 100BASE-TX, 2 bytes for 1000BASE-T) an SMD-R, 60 bytes of 0x00 and an mCRC.
 - b) The timing of transmission can also be achieved through continuously sending this Respond frame.
- E:5. Observe the transmissions from the DUT for up to two seconds.
 - a) If neither an AEC-TLV with Preemption Active or a Preemptable Packet is observed attempt to provoke the DUT to a send Preemptable traffic.
- E:6. If more than one speed is supported, then steps E1 through E5 should be repeated for each speed that supports preemption.

Observable results:

Step	Result	Description
E5	FAIL	The DUT was observed to transmit an AEC-TLV with Not Active.
E5	FAIL	The DUT was observed to transmit a Preemptable Frame as an Express Frame (indicating Preemption is not Active).
E5	PASS	The DUT was observed to transmit either an AEC-TLV with Active or a Preemptable Packet.

Part F: Accepting a Respond Frame with Long Preamble

- F:1. Disconnect and after several or more seconds reconnect the link.
- F:2. Cause the DUT to enter a mode with Preemption Supported.
- F:3. Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- F:4. After a Verify frame has been transmitted by the DUT, quickly (so as to be completely received prior to $2 * \text{verifyTime}$ (range from 1 – 128 ms, see [2]) * 0.8 (see [3]) cause the DUT to transmit a valid 64-byte Respond Frame.
 - a) This packet should contain 64 bytes of Preamble, an SMD-R, 60 bytes of 0x00 and an mCRC.
 - b) The timing of transmission can also be achieved through continuously sending this Respond frame.
- F:5. Observe the transmissions from the DUT for up to two seconds.
 - a) If neither an AEC-TLV with Preemption Active or a Preemptable Packet is observed attempt to provoke the DUT to a send Preemptable traffic.
- F:6. If more than one speed is supported, then steps F1 through F5 should be repeated for each speed that supports preemption.

Observable results:

Step	Result	Description
F5	FAIL	The DUT was observed to transmit an AEC-TLV with Not Active.
F5	FAIL	The DUT was observed to transmit a Preemptable Frame as an Express Frame (indicating Preemption is not Active).
F5	PASS	The DUT was observed to transmit either an AEC-TLV with Active or a Preemptable Packet.

Possible Problems: The DUT may not support Verification, in which case verification of Respond Frame acceptance may not be feasible.

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Test #99.1.10 – Acceptance of Preemptable Packets after Erred SMD or unexpected SMD-C

Purpose: To verify that the DUT still accepts a Preemptable Frame split into two mPackets if either before the first or between the two mPackets an mPacket with an erred SMD is received, or if an unexpected SMD-C is received prior to the first mPacket of the Preemptable Frame.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM11
- [4] ANNEX A (informative) Acronym Definitions
- [5] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 13, 2017

Discussion: If during or before the reception of Preemptable Packets of a Preemptable Frame an erred SMD is received (does not map to a valid SMD) then this should be ignored without interfering with the reception of future, valid mPackets, see Figure 99-6 – Receive Processing State Diagram [2]. If the Erred SMD or an unexpected SMD-C occurs before the first mPacket of a Preemptable Frame the DUT should transition to BAD_FRAG and back to IDLE_RX_PROC awaiting the next frame, see Figure 99-6 – Receive Processing State Diagram [2]. If the Erred SMD occurs between mPackets of a Preemptable Frame then it should transition from CHECK_FOR_RESUME to WAIT_FOR_DV_FALSE and back to WAIT FOR RESUME after the mPacket with the Erred SMD ceases, see Figure 99-6 – Receive Processing State Diagram [2].

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms).

Test Procedure:

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Part A: *Accepting a Preempted Frame with Erred SMD before Initial mPacket (Preempted Frame split into two mPackets of sizes 260 and 256 bytes)*

- A:1. With the DUT in a mode with Preemption Active, transmit a 256-Byte mPacket with an SMD set to 0x00. After 96 bit times, transmit the first of two segments of a valid 512-byte complete Preemptable Frame (256-bytes of frame data and 4-byte mCRC). The second should follow 96-bit times later and contain the remaining 256 bytes, including the original CRC.
- A:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A2	FAIL	The DUT was not observed to accept each preemptable frame.
A2	PASS	The DUT was observed to accept each preemptable frame.

Part B: *Accepting a Preempted Frame with SMD-C0 before Initial mPacket (Preempted Frame split into two mPackets of sizes 260 and 256 bytes)*

- B:1. With the DUT in a mode with Preemption Active, transmit a 256-Byte mPacket with SMD-C0. After 96 bit times, transmit the first of two segments of a valid 512-byte complete Preemptable Frame with frame count of 0 (256-bytes of frame data and 4-byte mCRC). The second should follow 96-bit times later and contain the remaining 256 bytes, including the original CRC.
- B:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
B2	FAIL	The DUT was not observed to accept each preemptable frame.
B2	PASS	The DUT was observed to accept each preemptable frame.

Part C: *Accepting a Preempted Frame with Erred SMD between mPackets of a Preemptable Frame (Preempted Frame split into two mPackets of sizes 260 and 256 bytes)*

- C:1. With the DUT in a mode with Preemption Active, transmit the first of two segments of a valid 512-byte complete Preemptable Frame (256-bytes of frame data and 4-byte mCRC). After 96 bit times transmit a 256-Byte mPacket with SMD of (0x00). After 96 bit times, transmit the second mPacket of the Preemptable Frame which contains the remaining 256 bytes, including the original CRC.
- C:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
C2	FAIL	The DUT was not observed to accept each preemptable frame.
C2	PASS	The DUT was observed to accept each preemptable frame.

Possible Problems: None

Test #99.1.11 – Acceptance of New Preemptable Packet if Previous is Unfinished

Purpose: To verify that the DUT accepts a new Preemptable Frame when previous Preemptable Frame is unfinished if the variable keepSaferD is TRUE [2]. Otherwise the DUT should reject the new Preemptable frame [2].

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.3 (Variables)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM11
- [5] ANNEX A (informative) Acronym Definitions
- [6] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: May 22, 2017

Discussion: When the previous Preemptable Frame is unfinished the DUT should accept a new Preemptable Frame if the variable keepSaferD is TRUE [2]. If the variable is not TRUE the DUT should reject the new Preemptable frame [2].

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms).

Test Procedure:

Part A: *Accepting a New Preempted Frame when previous is unfinished (Unfinished Preempted Frame has Frame Count 0, and new has Frame Count 1)*

- A:1. With the DUT in a mode with Preemption Active, transmit a 256-Byte mPacket with an SMD-S0 and an mCRC in the CRC field. After 96 bit times, transmit a second Preemptable Packet containing a complete 256-byte frame with Frame Count 1.
- A:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A2	FAIL	The DUT was not observed to accept the preemptable frame and either keepSaferD is TRUE or both the frame in Part B was accepted and the value of keepSaferD is not known.
A2	PASS	The DUT was not observed to accept the preemptable frame and keepSaferD is not TRUE.
A2	FAIL	The DUT was observed to accept the preemptable frame and keepSaferD is not TRUE.
A2	PASS	The DUT was observed to accept the preemptable frame and keepSaferD is TRUE.
A2	INFO	The value of keepSaferD was not known.

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Part B: *Accepting a New Preempted Frame when previous is unfinished (Unfinished Preempted Frame has Frame Count 0, and new also has Frame Count 0)*

- B:1. With the DUT in a mode with Preemption Active, transmit a 256-Byte mPacket with an SMD-S0 and an mCRC in the CRC field. After 96 bit times, transmit a second Preemptable Packet containing a complete 256-byte frame with Frame Count 0.
- B:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
B2	FAIL	The DUT was not observed to accept the preemptable frame and either keepSafterD is TRUE or both the frame in Part A was accepted and the value of keepSafterD is not known.
B2	PASS	The DUT was not observed to accept the preemptable frame and keepSafterD is not TRUE.
B2	FAIL	The DUT was observed to accept the preemptable frame and either keepSafterD is not TRUE.
B2	PASS	The DUT was observed to accept the preemptable frame and keepSafterD is TRUE.
B2	INFO	The value of keepSafterD was not known.

Possible Problems: None

Test #99.1.12 – Acceptance of Verify Frames

Purpose: To verify that the DUT properly accepts Verify Frames.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.3 (MAC Merge Packet (mPacket))
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.3 (Verify preemption operation)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.3 (Variables)
- [5] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM7
- [6] ANNEX A (informative) Acronym Definitions
- [7] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 14, 2017

Discussion: As long as `disableVerify` is not set, a conformant device will attempt the transmission of Verify frames three times after `pEnable` is set (see Verify State Diagram Figure 99-8 a). The verify mPacket is sent when TX_VERIFY state (in Figure 99-5, Transmit Processing State Diagram) is entered causing Preamble, SMD-V, 60 octets of 0x00, and an mCRC. When processing a received verify mPacket after the SMD-V is observed the state RCV_V is entered (see Express Filter State Diagram Figure 99-7). If the final 4 bytes of data in the mPacket contain an mCRC value then this is considered a valid verify mPacket and `rcv_v` is set to True. This should occur regardless of the contents or length of the data in the mPacket.

Test Setup: Connect the DUT to the testing station with the appropriate medium. If possible, configure the DUT to set `disableVerify` to FALSE.

Test Procedure:

Part A: *Acceptance of Verify frames*

- A:1. Disconnect the DUT from the test station, wait 2 seconds, and reconnect the DUT to the test station.
- A:2. Wait up to 2 seconds for the reception of an AEC-TLV indicating Preemption is enabled.
- A:3. Transmit an mPacket with 7 bytes of preamble, SMD-V, 60 bytes of 0xFF, and an mCRC.
- A:4. Observe transmissions from the DUT for up to 1 second.
- A:5. Transmit an mPacket with 7 bytes of preamble, SMD-V, 1514 bytes of 0x1F, and an mCRC.
- A:6. Observe transmissions from the DUT for up to 1 second.

Observable results:

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Step	Result	Description
A	N/A	The DUT only supports disableVerify set to TRUE.
A2	FAIL	The DUT was not observed to transmit an AEC-TLV with Preemption Enabled.
A4	FAIL	The DUT was not observed to transmit a valid Respond mPacket containing 7 bytes of preamble, SMD-R, 60 bytes of 0x00, and a valid mCRC.
A6	FAIL	The DUT was not observed to transmit a valid Respond mPacket containing 7 bytes of preamble, SMD-R, 60 bytes of 0x00, and a valid mCRC.
A6	PASS	The DUT was observed to transmit valid Respond mPackets.

Possible Problems: None

Test #99.1.13 – Acceptance of Respond Frames

Purpose: To verify that the DUT properly accepts Respond Frames.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.3 (MAC Merge Packet (mPacket))
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.3 (Verify preemption operation)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.3 (Variables)
- [5] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM8
- [6] ANNEX A (informative) Acronym Definitions
- [7] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 14, 2017

Discussion: As long as `disableVerify` is not set, a conformant device will attempt the transmission of Verify frames three times after `pEnable` is set (see Verify State Diagram Figure 99-8 a). The verify mPacket is sent when TX_VERIFY state (in Figure 99-5, Transmit Processing State Diagram) is entered causing Preamble, SMD-V, 60 octets of 0x00, and an mCRC. When processing a received respond mPacket after the SMD-R is observed the state RCV_R is entered (see Express Filter State Diagram Figure 99-7). If the final 4 bytes of data in the mPacket contain an mCRC value then this is considered a valid verify mPacket and `rcv_r` is set to True. This should occur regardless of the contents or length of the data in the mPacket.

Test Setup: Connect the DUT to the testing station with the appropriate medium. If possible, configure the DUT to set `disableVerify` to FALSE.

Test Procedure:

Part A: Respond mPacket with 0xFF instead of 0x00 in data

- A:1. Disconnect the DUT from the test station, wait 2 seconds, and reconnect the DUT to the test station.
- A:2. Transmit an AEC-TLV indicating Preemption Supported and Enabled
- A:3. Observe transmissions, while waiting up to 2 seconds to receive a Verify mPacket. Upon receiving this mPacket proceed within 2.4 mS to transmit as specified in the next step.
- A:4. Transmit an mPacket with 7 bytes of preamble, SMD-R, 60 bytes of 0xFF, and an mCRC.
- A:5. Cause the DUT to send preemptable traffic.
- A:6. Verify that preemptable traffic has an SMD-S.

Observable results:

Step	Result	Description
A	N/A	The DUT only supports <code>disableVerify</code> set to TRUE.
A3	FAIL	The DUT was not observed to transmit a valid Verify mPacket containing 7 bytes of preamble, SMD-V, 60 bytes of 0x00, and a valid mCRC.
A6	FAIL	The DUT was not observed to transmit preemptable traffic with an SMD-S.
A6	PASS	The DUT was observed to transmit preemptable traffic with an SMD-S.

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Part B: Respond mPacket with 0x1F instead of 0x00 in data and frame size of 1518

- B:1. Disconnect the DUT from the test station, wait 2 seconds, and reconnect the DUT to the test station.
- B:2. Transmit an AEC-TLV indicating Preemption Supported and Enabled
- B:3. Observe transmissions, while waiting up to 2 seconds to receive a Verify mPacket. Upon receiving this mPacket proceed within 2.4 mS to transmit as specified in the next step.
- B:4. Transmit an mPacket with 7 bytes of preamble, SMD-V, 1514 bytes of 0x1F, and an mCRC.
- B:5. Cause the DUT to send preemptable traffic.
- B:6. Verify that preemptable traffic has an SMD-S.

Observable results:

Step	Result	Description
B	N/A	The DUT only supports disableVerify set to TRUE.
B3	FAIL	The DUT was not observed to transmit a valid Verify mPacket containing 7 bytes of preamble, SMD-V, 60 bytes of 0x00, and a valid mCRC.
B6	FAIL	The DUT was not observed to transmit preemptable traffic with an SMD-S.
B6	PASS	The DUT was observed to transmit preemptable traffic with an SMD-S.

Possible Problems: None

GROUP 2: Checking for Proper Rejection

Scope: The following tests cover MAC Merge operations specific to properly rejecting packets.

Overview: These tests are designed to verify that the DUT properly discards packets with errors. The MAC Merge functions explored are defined in Clause 99 of IEEE Std 802.3™-2015 as amended by IEEE Std 802.3br™-2016.

Test #99.2.1 – Reject Undersized Packets

Purpose: To verify that the DUT rejects undersized mPackets.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 4.2.9 (Procedure ReceiveLinkMgmt)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 4A.2.9 (Procedure ReceiveLinkMgmt)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.1 (Introduction)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [5] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [6] ANNEX A (informative) Acronym Definitions
- [7] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: May 22, 2017

Discussion: Above the MAC Merge Sublayer are two MAC instances, the eMAC and pMAC.[3] Regardless of whether these MACs follow Clause 4 or Annex 4A, Procedure ReceiveLinkMgmt rejects frames under 64 bytes in length.[1][2]

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms).

Test Procedure:

Part A: *Rejecting an undersized Preemptable Frame (63-byte)*

- A:1. With the DUT in a mode with Preemption Active, transmit a complete 63-byte Preemptable Frame in a single mPacket.
- A:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A2	FAIL	The DUT was observed to accept the preemptable frame.
A2	PASS	The DUT was not observed to accept the preemptable frame.

Part B: *Rejecting an undersized Express Frame (63-byte)*

- B:1. With the DUT in a mode with Preemption Active, transmit a 63-byte Express Frame.
- B:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
B2	FAIL	The DUT was observed to accept the Express Frame.
B2	PASS	The DUT was not observed to accept the Express Frame.

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Possible Problems: None

Test #99.2.2 – Reject non-zero Initial Frag_count

Purpose: To verify that the DUT rejects an initial continued Preemptable Frame where the frag_count is not 0.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM11
- [4] ANNEX A (informative) Acronym Definitions
- [5] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 12, 2017

Discussion: When receiving the mPacket that contains the initial continuation of a Preemptable Frame the frag_count must be 0.[1][2]

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms).

Test Procedure:

Part A: Rejecting a 512-Byte Preempted Frame (split into two mPackets of sizes 260 and 256 bytes where the second mPacket has a frag_count of 1)

- A:1. With the DUT in a mode with Preemption Active, transmit two segments of a valid 512-byte complete Preemptable Frame. This first segment should contain 256 bytes of the frame data plus a 4-byte mCRC. The second should contain the remaining 256 bytes, including the original CRC, however the frag_count should be set to 1.
- A:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A2	FAIL	The DUT was observed to accept the preemptable frame.
A2	PASS	The DUT was observed to not accept the preemptable frame.

Possible Problems: None

Test #99.2.3 – Reject Out of Order Frag_counts

Purpose: To verify that the DUT rejects a continued Preemptable Frame where the frag_counts of the mPackets making up that frame are not sequential.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM11
- [4] ANNEX A (informative) Acronym Definitions
- [5] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: May 22, 2017

Discussion: When receiving the mPacket that contains the initial continuation of a Preemptable Frame the frag_count must start at 0 and subsequent continuations must be sequential (1,2,3,0,1, ...).[1][2]

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms).

Test Procedure:

Part A: Rejecting a 1024-Byte Preempted Frame fragmented into 4 mPackets with out of order frag_counts

- A:1. With the DUT in a mode with Preemption Active, transmit a 1024-Byte Preempted Frame split into four mPackets of sizes 260, 260, 260, and 256 bytes (where the second mPacket has a frag_count of 0 and the third has a frag_count of 2 and the fourth has a frag_count of 1) and the frame data is sent across the first, then second, then third, and then fourth.
- A:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A2	FAIL	The DUT was observed to accept the preemptable frame.
A2	PASS	The DUT was observed to not accept the preemptable frame.

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Part B: *Rejecting a 1280-Byte Preempted Frame fragmented with 5 mPackets with out of order frag_counts*

- B:1. With the DUT in a mode with Preemption Active, transmit a 1280-Byte Preempted Frame split into five mPackets of sizes 260, 260, 260, 260, and 256 bytes (where the second mPacket has a frag_count of 0 and the third has a frag_count of 2 and the fourth has a frag_count of 1 and the fifth has a frag_count of 3) and the frame data is sent across the first, then second, then fourth, then third, and then fifth.
- B:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
B2	FAIL	The DUT was observed to accept the preemptable frame.
B2	PASS	The DUT was observed to not accept the preemptable frame.

Part C: *Rejecting a 1516-Byte Preempted Frame fragmented with 6 mPackets with frag_count 3 repeated*

- C:1. With the DUT in a mode with Preemption Active, transmit a 1516-Byte Preempted Frame split into six mPackets of sizes 256, 256, 256, 256, 256, and 256 bytes (where the second mPacket has a frag_count of 0, the third has a frag_count of 1, the fourth has a frag_count of 2, the fifth and the sixth both have a frag_count of 3) and the frame data is sent in order across the frames.
- C:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
C2	FAIL	The DUT was observed to accept the preemptable frame.
C2	PASS	The DUT was observed to not accept the preemptable frame.

Possible Problems: None

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Test #99.2.4 – Reject Initial Preemptable Packet with SMD-C

Purpose: To verify that the DUT rejects an initial continued Preemptable Frame where the frag_count is not 0.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM11
- [4] ANNEX A (informative) Acronym Definitions
- [5] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 13, 2017

Discussion: When receiving the mPacket that contains the initial mPacket of a Preemptable Frame the SMD must be an SMD-S.[1][2]

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms).

Test Procedure:

Part A: *Rejecting a 256-Byte Preempted Frame contained in a single mPacket with SMD as SMD-C0 and no frag_count field.*

- A:1. With the DUT in a mode with Preemption Active, transmit a complete Preemptable Frame in a 256-byte mPacket. However, instead of setting the SMD to an SMD-S value after seven bytes of preamble, set it to SMD-C0 and then transmit the complete frame.
- A:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A2	FAIL	The DUT was observed to accept the preemptable frame.
A2	PASS	The DUT was observed to not accept the preemptable frame.

Part B: *Rejecting a 256-Byte Preempted Frame contained in a single mPacket with SMD as SMD-C0 and frag_count field indicating 0.*

- B:1. With the DUT in a mode with Preemption Active, transmit a complete Preemptable Frame in a 256-byte mPacket. However after 6 bytes of preamble, send an SMD-C0, then a frag_count field indicating 0 (0xE6), and then transmit the complete frame.
- B:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

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Step	Result	Description
B2	FAIL	The DUT was observed to accept the preemptable frame.
B2	PASS	The DUT was observed to not accept the preemptable frame.

Possible Problems: None

Test #99.2.5 – Reject Frame with Incorrect SMD-C frame count

Purpose: To verify that the DUT rejects an mPacket with an incorrect SMD-C frame count.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4. (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM11
- [4] ANNEX A (informative) Acronym Definitions
- [5] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: May 22, 2017

Discussion: When receiving an mPacket that contains the continuation of a Preemptable Frame the Frame Count must match. [1][2]

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms).

Test Procedure:

Part A: *Rejecting a 512-Byte Preempted Frame contained in two mPackets where the Frame Count does not match.*

- A:1. With the DUT in a mode with Preemption Active, transmit a complete Preemptable Frame segmented into two mPackets; the first as a 260-byte mPacket with SMD as SMD-0 and the second as a 256-byte mPacket with SMD as SMD-C1 and frag_count of 0.
- A:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A2	FAIL	The DUT was observed to accept the preemptable frame.
A2	PASS	The DUT was observed to not accept the preemptable frame.

Possible Problems: None

Test #99.2.6 – Reject Frame with Incorrect value in CRC field

Purpose: To verify that the DUT rejects an mPacket with an incorrect value in the CRC field.

References:

- [1] I IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM11
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.3 (Variables)
- [5] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.6 (Timers)
- [6] ANNEX A (informative) Acronym Definitions
- [7] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 13, 2017

Discussion: When receiving an mPacket the CRC field for an Express Frame and final CRC field for a Preemptable Frame must be a CRC.[1][2] For Verify, Respond, and mPackets containing a Preemptable Frame that is unfinished the CRC field should contain an mCRC. [1][2]

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the test-ing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms).

Test Procedure:

Part A: *Rejecting an Express Frame with improper CRC*

- A:1. With the DUT in a mode with Preemption Active, transmit a valid 64-byte Express Frame. This packet should instead of the normal CRC have an incorrect CRC value (A value not equal to either the valid CRC or the mCRC).
- A:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A2	FAIL	The DUT was observed to accept the Express frame.
A2	PASS	The DUT was observed to not accept the Express frame.

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Part B: *Rejecting an Express Frame with mCRC*

- B:1. With the DUT in a mode with Preemption Active, transmit a valid 64-byte Express Frame. This packet should instead of the normal CRC have an mCRC value in the CRC field.
- B:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
B2	FAIL	The DUT was observed to accept the Express frame.
B2	PASS	The DUT was observed to not accept the Express frame.

Part C: *Rejecting a Preemptable Frame with improper CRC*

- C:1. With the DUT in a mode with Preemption Active, transmit a valid 256-byte Preemptable Frame contained in a single mPacket where the CRC is invalid, but not equal to an mCRC.
- C:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
C2	FAIL	The DUT was observed to accept the Preemptable frame.
C2	PASS	The DUT was observed to not accept the Preemptable frame.

Part D: *Rejecting an mPacket of a Preemptable Frame with inverted mCRC*

- D:1. With the DUT in a mode with Preemption Active, transmit a valid 512-byte Preemptable Frame segmented into two mPackets. This first mPacket should instead of the mCRC have an inverted mCRC value.
- D:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
D2	FAIL	The DUT was observed to accept the Preemptable frame.
D2	PASS	The DUT was observed to not accept the Preemptable frame.

Part E: *Rejecting a Verify Frame with a CRC instead of the mCRC*

- E:1. With the DUT in a mode with Preemption Active, transmit a valid 64-byte Verify Frame. This packet should contain a CRC value in the CRC field instead of an mCRC.
- E:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
E2	FAIL	The DUT was observed to transmit a Respond Frame indicating it accepted the Verify Frame.
E2	PASS	The DUT was not observed to transmit a Respond Frame, indicating it rejected the Verify Frame.

Part F: *Rejecting a Verify Frame with an inverted mCRC*

- F:1. With the DUT in a mode with Preemption Active, transmit a valid 64-byte Verify Frame. This packet should contain an inverted mCRC value in the CRC field instead of an mCRC.
- F:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
F2	FAIL	The DUT was observed to transmit a Respond Frame indicating it accepted the Verify Frame.
F2	PASS	The DUT was not observed to transmit a Respond Frame, indicating it rejected the Verify Frame.

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Part G: Rejecting a Respond Frame with CRC instead of the mCRC

- G:1. Disconnect and after several or more seconds reconnect the link.
- G:2. Cause the DUT to enter a mode with Preemption Supported.
- G:3. Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- G:4. After a Verify frame has been transmitted by the DUT, quickly (so as to be completely received prior to 3 * verifyTime (verifyTime ranges from 1 – 128 ms, see [4]) * 0.8 (see [5]) send to the DUT 64-byte Respond Frame(s) that are valid other than as noted below:
 - a) This packet should contain a CRC (rather than an mCRC).
 Note: The timing of transmission can also be achieved through continuously sending this Respond frame.
- G:5. Observe the transmissions from the DUT for up to two seconds.
 - a) If neither an AEC-TLV with Preemption Active or a Preemptable Packet is observed attempt to provoke the DUT to a send Preemptable traffic.

Observable results:

Step	Result	Description
G5	FAIL	The DUT was observed to either transmit an AEC-TLV with Active or a Preemptable mPacket with SMD not equal to SMD-E, indicating acceptance of the Respond Frame.
G5	PASS	The DUT was observed to send all Preemptable mPackets with an SMD of SMD-E, and any observed AEC-TLV specifies Not Active (indicating Preemption is not Active).

Part H: Rejecting a Respond Frame with inverted mCRC instead of the mCRC

- H:1. Disconnect and after several or more seconds reconnect the link.
- H:2. Cause the DUT to enter a mode with Preemption Supported.
- H:3. Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- H:4. After a Verify frame has been transmitted by the DUT, quickly (so as to be completely received prior to 3 * verifyTime (verifyTime ranges from 1 – 128 ms, see [4]) * 0.8 (see [5]) send to the DUT 64-byte Respond Frame(s) that are valid other than as noted below:
 - a) This packet should contain an inverted mCRC.
 Note: The timing of transmission can also be achieved through continuously sending this Respond frame.
- H:5. Observe the transmissions from the DUT for up to two seconds.
 - a) If neither an AEC-TLV with Preemption Active or a Preemptable Packet is observed attempt to provoke the DUT to a send Preemptable traffic.

Observable results:

Step	Result	Description
H5	FAIL	The DUT was observed to either transmit an AEC-TLV with Active or a Preemptable mPacket with SMD not equal to SMD-E, indicating acceptance of the Respond Frame.
H5	PASS	The DUT was observed to send all Preemptable mPackets with an SMD of SMD-E, and any observed AEC-TLV specifies Not Active (indicating Preemption is not Active).

Possible Problems: The DUT may not support Verification, in which case verification of Respond Frame acceptance may not be feasible. Even in the case where Verification is not supported, the DUT should still reply to valid Verify frames.

Test #99.2.7 – Rejection of mPackets with Erred SMD

Purpose: To verify that the DUT rejects mPackets with an undefined value in the SMD field.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM11
- [4] ANNEX A (informative) Acronym Definitions
- [5] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: May 22, 2017

Discussion: An mPacket with an undefined value in the SMD field should be discarded. [2]

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms).

Test Procedure:

Part A: *Rejecting an Express Frame with Erred SMD (0xAB)*

- A:1. With the DUT in a mode with Preemption Active, transmit an Express Frame with an SMD set to 0xAB.
- A:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A2	FAIL	The DUT was observed to accept the Express Frame.
A2	PASS	The DUT was not observed to accept the Express Frame.

Part B: *Rejecting an Express Frame with Erred SMD (0x9B)*

- B:1. With the DUT in a mode with Preemption Active, transmit an Express Frame with an SMD set to 0x9B.
- B:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
B2	FAIL	The DUT was observed to accept the Express Frame.
B2	PASS	The DUT was not observed to accept the Express Frame.

Part C: *Rejecting an Express Frame with Erred SMD (0x55)*

- C:1. With the DUT in a mode with Preemption Active, transmit an Express Frame with an SMD set to 0x55.
- C:2. Observe the transmissions from the DUT for up to two seconds.

Observable results:

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Step	Result	Description
C2	FAIL	The DUT was observed to accept the Express Frame.
C2	PASS	The DUT was not observed to accept the Express Frame.

Possible Problems: None

GROUP 3: Transmission

Scope: The following tests cover MAC Merge operations specific to properly transmitting packets.

Overview: These tests are designed to verify that the DUT properly transmits packets. The MAC Merge functions explored are defined in Clause 99 of IEEE Std 802.3™ -2015 as amended by IEEE Std 802.3br™-2016.

Test #99.3.1 – Proper Transmission of Express Frames

Purpose: To verify that the DUT properly transmits Express Frames.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.3 (Variables)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM9
- [5] ANNEX A (informative) Acronym Definitions
- [6] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: August 27, 2016

Discussion: Any frame transmitted with an SMD-E (0xD5) should be considered an Express Frame. Such frames should have valid CRCs.

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms)

Test Procedure:

Part A: *Proper transmission of Express Frame*

- A:1. Ensure the DUT is in a mode with Preemption Active.
 - a) Send a Verify Frame to the DUT. If a Respond Frame is not observed, repeat the Test Setup.
- A:2. By any DUT supported mechanism, cause the DUT to transmit Express Frames.
 - a) If a Bridge, this may require an additional test station sending priority tagged frames considered Express Frames by the DUT.
 - b) If an End station, this may require the DUT to support a mode to force transmission of Express Frames, or for the test station to emulate a compatible link partner (eg: 1722.1 and MSRP).
- A:3. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A1	FAIL	The DUT was not observed to transmit a Respond Frame.
A3	FAIL	The DUT was not observed to transmit any Express Frames.
A3	FAIL	The DUT was observed to transmit a preamble with length other than 7 bytes.
A3	FAIL	The DUT was observed to transmit an mPacket with an undefined SMD.
A3	FAIL	The DUT was observed to transmit any frame with an SMD-E but with an mCRC.
A3	PASS	The DUT was observed to transmit valid Express Frames.

Possible Problems: None

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Test #99.3.2 – Proper Transmission of Preemptable Frames

Purpose: To verify that the DUT properly transmits Preemptable Frames.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.3 (Variables)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM9
- [5] ANNEX A (informative) Acronym Definitions
- [6] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT. Multiple test stations may be required if the DUT is a bridge.

Last Modification: June 13, 2017

Discussion: Any frame transmitted with an SMD-S should be considered the beginning of a preemptable frame (or a complete preemptable frame). Any frame transmitted with an SMD-C should be considered the continuation of a previously preempted frame. To identify which part of the continuation is being sent a frag_count is assigned to each continuation fragment, starting with 0 and incrementing by 1 modulo 4 for each successive continuation fragment.

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms)

Test Procedure:

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Part A: Proper transmission of Preemptable Frames

- A:1. Ensure the DUT is in a mode with Preemption Active.
 - a) Send a Verify Frame to the DUT. If a Respond Frame is not observed, repeat the Test Setup.
- A:2. By any DUT supported mechanism, cause the DUT to transmit preempted preemptable frames (eg: cause Express Frames to be sent with preemptable traffic). These should be valid, maximum supported size Preemptable Frames (1518, 1522, or 2000).
 - a) If a Bridge, this may require additional test stations sending priority tagged frames considered Express Frames by the DUT into one ingress port, and preemptable traffic into a second ingress port.
 - b) If an End station, this may require the DUT to support a mode to force transmission of Express Frames, or for the test station to emulate a compatible link partner (eg: 1722.1 and MSRP).
- A:3. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A1	FAIL	The DUT was not observed to transmit a Respond Frame.
A3	FAIL	The first SMD-S received was sent with an SMD-S other than SMD-S0.
A3	FAIL	Any preemptable frame is observed to be sent with an SMD-S, but the SMD-S frame count is not +1 (modulo 4) from the last observed SMD-S frame count value from the DUT.
A3	FAIL	Any observed mPacket meets the following condition: The first mPacket with an SMD-C sent after an mPacket with SMD-S does not have a frag_count of 0 (zero).
A3	FAIL	Any observed mPacket meets the following condition: Consecutively received mPackets with the same SMD-C do not have frag_count values incrementing by +1 (modulo 4).
A3	FAIL	Any observed mPacket meets the following condition: Consecutively received mPackets with an SMD-C following an mPacket with an SMD-S do not have matching frame_cnt (txFrame) values (eg: SMD-S2 followed by any mPacket with SMD-C other than SMD-C2).
A3	FAIL	Any observed mPacket is less than 64 bytes in length.
A3	PASS	The DUT was observed to transmit valid preempted preemptable frames.

Part B: Proper transmission of Preemptable Frames when Preemption Not Enabled

- B:1. Perform steps A1 to A3.
- B:2. Disconnect and reconnect link, but do not send an AEC-TLV.
- B:3. By any DUT supported mechanism, cause the DUT to transmit preemptable frames.
 - a) If a Bridge, this may require additional test stations sending priority tagged frames considered Express Frames by the DUT into one ingress port, and preemptable traffic into a second ingress port.
 - b) If an End station, this may require the DUT to support a mode to force transmission of Express Frames, or for the test station to emulate a compatible link partner (eg: 1722.1 and MSRP).
- B:4. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
B3	FAIL	The DUT transmits any mPackets with an SMD other than SMD-E.
B3	PASS	The DUT was observed to transmit all traffic with an SMD-E.

Possible Problems: None

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Test #99.3.3 – Proper Transmission of mCRC in Preempted Frames

Purpose: To verify that the DUT properly transmits Preemptable Frames.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.3.6 (CRC)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.3 (Variables)
- [5] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM9
- [6] ANNEX A (informative) Acronym Definitions
- [7] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT. Multiple test stations may be required if the DUT is a bridge.

Last Modification: June 14, 2017

Discussion: Any frame transmitted with an SMD-S should be considered the beginning of a preemptable frame (or a complete preemptable frame). Any frame transmitted with an SMD-C should be considered the continuation of a previously preempted frame. To identify which part of the continuation is being sent, a frag_count is assigned to each continuation fragment. This frag_count starts at 0 and is incremented by 1 modulo 4 for each successive continuation fragment. Any non-final Preemptable mPacket should have an mCRC value in the CRC field [1,3].

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms)

Test Procedure:

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Part A: Proper transmission of Preemptable Frames

- A:1. Ensure the DUT is in a mode with Preemption Active.
- a) Send a Verify Frame to the DUT. If a Respond Frame is not observed, repeat the Test Setup.
- A:2. By any DUT supported mechanism, cause the DUT to transmit preempted preemptable frames (eg: cause Express Frames to be sent with preemptable traffic). These should be valid, maximum supported size Preemptable Frames (1518, 1522, or 2000).
- a) If a Bridge, this may require additional test stations sending priority tagged frames considered Express Frames by the DUT into one ingress port, and preemptable traffic into a second ingress port.
 - b) If an End station, this may require the DUT to support a mode to force transmission of Express Frames, or for the test station to emulate a compatible link partner (eg: 1722.1 and MSRP).
- A:3. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A1	FAIL	The DUT was not observed to transmit a Respond Frame.
A3	FAIL	The DUT was observed to transmit a non-final Preemptable mPacket with a value in the CRC field other than the proper mCRC value calculated from the bytes transmitted thus far in all mPackets pertaining to the current Preemptable frame.
A3	PASS	The DUT was observed to transmit valid preempted preemptable frames.

Possible Problems: None

Test #99.3.4 – Minimum Segmentable and Maximum Non-Segmentable Preemptable Frames

Purpose: To verify that the DUT does not segment a Preemptable Frame when doing so would result in an mPacket that is too small.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.5 (Receive Processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.3 (Variables)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM9
- [5] ANNEX A (informative) Acronym Definitions
- [6] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: May 15, 2017

Discussion: The variable additional fragment size (0-3) communicated from the AEC-TLV is used to inform the link partner of the minimum sized non-final fragments that you support (0 means 64, 1 means 128, 2 means 192, and 3 means 256). Any non-final subsequent fragments of that frame must also be that length. The final fragment may be as little as 64 bytes in length.

Test Setup: Connect the DUT to the testing station with the appropriate medium and transmit a valid frame to the DUT to ensure that the DUT is functioning properly.

Test Procedure:

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Part A: Segmentation of Preemptable Frames when Additional Fragment Size is 0

- A:1. Ensure the DUT is in a mode with Preemption Active and the communicated additional fragment size from the Testing Station was 0.
- a) Send a Verify Frame to the DUT. If a Respond Frame is not observed, repeat the Test Setup.
- A:2. By any DUT supported mechanism, cause the DUT to transmit a preempted preemptable frame of 124 bytes.
- a) If a Bridge, this may require additional test stations sending priority tagged frames considered Express Frames by the DUT into one ingress port, and preemptable traffic into a second ingress port.
 - b) If an End station, this may require the DUT to support a mode to force transmission of Express Frames, or for the test station to emulate a compatible link partner (eg: 1722.1 and MSRP).
- A:3. By any DUT supported mechanism, attempt to cause the DUT to transmit a preempted preemptable frame of 123 bytes.
- a) If a Bridge, this may require additional test stations sending priority tagged frames considered Express Frames by the DUT into one ingress port, and preemptable traffic into a second ingress port.
 - b) If an End station, this may require the DUT to support a mode to force transmission of Express Frames, or for the test station to emulate a compatible link partner (eg: 1722.1 and MSRP).
- A:4. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A1	FAIL	The DUT was not observed to transmit a Respond Frame.
A2	FAIL	The DUT was not observed to segment the preemptable frame.
A2	FAIL	The DUT was observed to transmit the first part of the Preemptable frame in an mPacket not equal to 64 bytes in length.
A2	FAIL	The DUT was observed to transmit the second part of the Preemptable frame in an mPacket not equal to 64 bytes in length.
A2	FAIL	The DUT was observed to send an mPacket less than 64 bytes in length.
A3	FAIL	The DUT was observed to segment the preemptable frame.
A3	PASS	The DUT was observed to not segment the non-segmentable preemptable frames.

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Part B: Segmentation of Preemptable Frames when Additional Fragment Size is 1

- B:1. Ensure the DUT is in a mode with Preemption Active and the communicated additional fragment size from the Testing Station was 1.
 - a) Send a Verify Frame to the DUT. If a Respond Frame is not observed, repeat the Test Setup.
- B:2. By any DUT supported mechanism, cause the DUT to transmit a preempted preemptable frame of 188 bytes.
 - a) If a Bridge, this may require additional test stations sending priority tagged frames considered Express Frames by the DUT into one ingress port, and preemptable traffic into a second ingress port.
 - b) If an End station, this may require the DUT to support a mode to force transmission of Express Frames, or for the test station to emulate a compatible link partner (eg: 1722.1 and MSRP).
- B:3. By any DUT supported mechanism, attempt to cause the DUT to transmit a preempted preemptable frame of 187 bytes.
 - a) If a Bridge, this may require additional test stations sending priority tagged frames considered Express Frames by the DUT into one ingress port, and preemptable traffic into a second ingress port.
 - b) If an End station, this may require the DUT to support a mode to force transmission of Express Frames, or for the test station to emulate a compatible link partner (eg: 1722.1 and MSRP).
- B:4. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
B1	FAIL	The DUT was not observed to transmit a Respond Frame.
B2	FAIL	The DUT was not observed to segment the preemptable frame.
B2	FAIL	The DUT was observed to transmit the first part of the Preemptable frame in an mPacket not equal to 128 bytes in length.
B2	FAIL	The DUT was observed to transmit the second part of the Preemptable frame in an mPacket not equal to 64 bytes in length.
B3	FAIL	The DUT was observed to segment the preemptable frame.
B3	PASS	The DUT was observed to not segment the non-segmentable preemptable frames.

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Part C: Segmentation of Preemptable Frames when Additional Fragment Size is 2

- C:1. Ensure the DUT is in a mode with Preemption Active and the communicated additional fragment size from the Testing Station was 2.
 - a) Send a Verify Frame to the DUT. If a Respond Frame is not observed, repeat the Test Setup.
- C:2. By any DUT supported mechanism, cause the DUT to transmit a preempted preemptable frame of 252 bytes.
 - a) If a Bridge, this may require additional test stations sending priority tagged frames considered Express Frames by the DUT into one ingress port, and preemptable traffic into a second ingress port.
 - b) If an End station, this may require the DUT to support a mode to force transmission of Express Frames, or for the test station to emulate a compatible link partner (eg: 1722.1 and MSRP).
- C:3. By any DUT supported mechanism, attempt to cause the DUT to transmit a preempted preemptable frame of 251 bytes.
 - a) If a Bridge, this may require additional test stations sending priority tagged frames considered Express Frames by the DUT into one ingress port, and preemptable traffic into a second ingress port.
 - b) If an End station, this may require the DUT to support a mode to force transmission of Express Frames, or for the test station to emulate a compatible link partner (eg: 1722.1 and MSRP).
- C:4. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
C1	FAIL	The DUT was not observed to transmit a Respond Frame.
C2	FAIL	The DUT was not observed to segment the preemptable frame.
C2	FAIL	The DUT was observed to transmit the first part of the Preemptable frame in an mPacket not equal to 192 bytes in length.
C2	FAIL	The DUT was observed to transmit the second part of the Preemptable frame in an mPacket not equal to 64 bytes in length.
C3	FAIL	The DUT was observed to segment the preemptable frame.
C3	PASS	The DUT was observed to not segment the non-segmentable preemptable frames.

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Part D: Segmentation of Preemptable Frames when Additional Fragment Size is 3

- D:1. Ensure the DUT is in a mode with Preemption Active and the communicated additional fragment size from the Testing Station was 3.
- a) Send a Verify Frame to the DUT. If a Respond Frame is not observed, repeat the Test Setup.
- D:2. By any DUT supported mechanism, cause the DUT to transmit a preempted preemptable frame of 316 bytes.
- a) If a Bridge, this may require additional test stations sending priority tagged frames considered Express Frames by the DUT into one ingress port, and preemptable traffic into a second ingress port.
 - b) If an End station, this may require the DUT to support a mode to force transmission of Express Frames, or for the test station to emulate a compatible link partner (eg: 1722.1 and MSRP).
- D:3. By any DUT supported mechanism, attempt to cause the DUT to transmit a preempted preemptable frame of 315 bytes.
- a) If a Bridge, this may require additional test stations sending priority tagged frames considered Express Frames by the DUT into one ingress port, and preemptable traffic into a second ingress port.
 - b) If an End station, this may require the DUT to support a mode to force transmission of Express Frames, or for the test station to emulate a compatible link partner (eg: 1722.1 and MSRP).
- D:4. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
D1	FAIL	The DUT was not observed to transmit a Respond Frame.
D2	FAIL	The DUT was not observed to segment the preemptable frame.
D2	FAIL	The DUT was observed to transmit the first part of the Preemptable frame in an mPacket not equal to 256 bytes in length.
D2	FAIL	The DUT was observed to transmit the second part of the Preemptable frame in an mPacket not equal to 64 bytes in length.
D3	FAIL	The DUT was observed to segment the preemptable frame.
D3	PASS	The DUT was observed to not segment the non-segmentable preemptable frames.

Possible Problems: None

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Test #99.3.5 – ipg_timer

Purpose: To verify that the DUT transmits consecutive frames with at least a minimum gap by properly adhering to ipg_timer.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.4 (Transmit processing)
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.3 (Variables)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.6 (Timers)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State diagrams)
- [5] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM9
- [6] ANNEX A (informative) Acronym Definitions
- [7] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT. Multiple test stations may be required if the DUT is a bridge.

Last Modification: May 22, 2017

Discussion: In the Transmit Processing State Diagram (Figure 99-5) ipg_timer must expire before transmitting an mPacket. ipg_timer is specified to expire 96 bit times after starting [3].

Test Setup: Connect the DUT to the testing station with the appropriate medium. If the DUT is not already in a mode with Preemption Active, then:

- a) Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- b) Respond to any received Verify Frame (If detection of Verify frames is not supported by the testing station, this can be emulated by transmitting a Respond Frame every millisecond for 100ms)

Test Procedure:

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Part A: Traffic mix of Preemptable and Express frames

- A:1. Ensure the DUT is in a mode with Preemption Active.
 - a) Send a Verify Frame to the DUT. If a Respond Frame is not observed, repeat the Test Setup.
- A:2. Cause the DUT to transmit a mix of traffic (Preemptable and Express) such that the expected traffic be egressed the Port Under Test exceeds line rate.
 - a) If a Bridge, this may require additional test stations sending priority tagged frames considered Express Frames by the DUT into one ingress port, and preemptable traffic at line rate (of the Port Under Test) into a second ingress port.
 - b) If an End station, this may require the DUT to support a mode to force transmission of Express Frames, or for the test station to emulate a compatible link partner (eg: 1722.1 and MSRP).
- A:3. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
A1	FAIL	The DUT was not observed to transmit a Respond Frame.
A3	FAIL	The DUT was observed to transmit any consecutive packets with a gap of less than 96 bit times.
A3	PASS	The DUT was not observed to transmit any consecutive packets with a gap of less than 96 bit times.

Part B: Traffic mix of Preemptable, Express, and Respond frames

- B:1. Ensure the DUT is in a mode with Preemption Active.
 - a) Send a Verify Frame to the DUT. If a Respond Frame is not observed, repeat the Test Setup.
- B:2. Cause the DUT to transmit a mix of traffic (Preemptable and Express) such that the expected traffic be egressed the Port Under Test exceeds line rate.
 - a) If a Bridge, this may require additional test stations sending priority tagged frames considered Express Frames by the DUT into one ingress port, and preemptable traffic at line rate (of the Port Under Test) into a second ingress port.
 - b) If an End station, this may require the DUT to support a mode to force transmission of Express Frames, or for the test station to emulate a compatible link partner (eg: 1722.1 and MSRP).
- B:3. Additionally send to the DUT on the Port Under Test a series of Verify mPackets at approximately 10% line rate (within 3%).
- B:4. Observe the transmissions from the DUT for up to two seconds.

Observable results:

Step	Result	Description
B1	FAIL	The DUT was not observed to transmit a Respond Frame.
B4	FAIL	The DUT was observed to transmit any consecutive packets with a gap of less than 96 bit times.
B4	PASS	The DUT was not observed to transmit any consecutive packets with a gap of less than 96 bit times.

Possible Problems: None

GROUP 4: Transmission of the Verify Frame

Scope: The following tests cover MAC Merge operations specific to proper transmission of the Verify Frame.

Overview: These tests are designed to verify that the DUT properly transmits the Verify Frame as well as looking at whether this frame is transmitted at the appropriate time(s). The MAC Merge functions explored are defined in Clause 99 of IEEE Std 802.3™ -2015 as amended by IEEE Std 802.3br™-2016.

Test #99.4.1 – Proper Transmission of Verify Frames

Purpose: To verify that the DUT properly transmits Verify Frames.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.3 (MAC Merge Packet (mPacket))
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.3 (Verify preemption operation)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.3 (Variables)
- [5] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.6 (Timers)
- [6] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM7
- [7] ANNEX A (informative) Acronym Definitions
- [8] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 14, 2017

Discussion: As long as `disableVerify` is not set, a conformant device will attempt the transmission of Verify frames three times after `pEnable` is set (see Verify State Diagram Figure 99-8 a). The `verify_timer` controls how long to wait after a Verify mPacket has been sent before giving up on that attempt. This timer is specified to be in the range of 1 to 128 ms, however a $\pm 20\%$ allowance is made on the time from when it is started to when it expires, which yields a range of 0.8ms to 153.6 ms. The `verify mPacket` is sent when `TX_VERIFY` state (in Figure 99-5, Transmit Processing State Diagram) is entered causing the transmission of Preamble, SMD-V, 60 octets of 0x00, and an mCRC.

Test Setup: Connect the DUT to the testing station with the appropriate medium. If possible, configure the DUT to set `disableVerify` to FALSE.

Test Procedure:

Part A: *Verify_timer_done*

- A:1. Disconnect the DUT from the test station, wait 2 seconds, and reconnect the DUT to the test station.
- A:2. Transmit an AEC-TLV indicating Preemption Supported and Enabled
- A:3. Wait 2 seconds.
 - a) Observe transmissions from the DUT.

Observable results:

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Step	Result	Description
A	N/A	The DUT only supports disableVerify set to TRUE.
A2	FAIL	The DUT was not observed to transmit a Verify Frame.
A2	FAIL	The DUT was not observed to transmit multiple Verify Frames.
A2	FAIL	The DUT was observed to transmit a Verify Frame with an incorrect mCRC value.
A2	FAIL	The DUT was not observed to transmit multiple Verify Frames separated by 0.8ms to a maximum of 153.6ms.
A2	FAIL	The gap between the first and second (gap a) and the second and third (gap b) are not both within the range of $0.4*(a+b)$ to $0.6*(a+b)$. As this would be indicative that it is not within +/- 20% of verifyTime.
A2	FAIL	If verifyTime is known: The DUT was not observed to transmit multiple Verify Frames separated by the known verifyTime +/- 20% -- eg: default verifyTime is 10ms, hence for default values, the acceptable range is only 8ms to 12ms.
A2	PASS	The DUT was observed to transmit validly spaced Verify Frames.

Part B: *verifyLimit*

- B:1. Disconnect the DUT from the test station, wait 2 seconds, and reconnect the DUT to the test station.
- B:2. Transmit an AEC-TLV indicating Preemption Supported and Enabled
- B:3. Wait 2 seconds.
 - a) Observe transmissions from the DUT.

Observable results:

Step	Result	Description
B	N/A	The DUT only supports disableVerify set to TRUE.
B2	FAIL	The DUT was not observed to transmit a Verify Frame.
B2	FAIL	The DUT was not observed to transmit exactly three (3) Verify Frames.
B2	PASS	The DUT was observed to transmit three (3) Verify Frames.

Possible Problems: A Verify frame does not take priority over a frame from the eMAC. The Verify frame is unaffected by the hold signal. So if any of the observed Verify frames are sent 96 bit times after a frame or a line rate series of frames from the eMAC then the Verify frame may have been delayed by this frame(s). Any delay due to this should not be considered part of the timer.

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Test #99.4.2 – Proper Format of Verify Frames

Purpose: To verify that the DUT properly transmits Verify Frames.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.3 (MAC Merge Packet (mPacket))
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.3 (Verify preemption operation)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.3 (Variables)
- [5] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.6 (Timers)
- [6] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM7
- [7] ANNEX A (informative) Acronym Definitions
- [8] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 14, 2017

Discussion: As long as disableVerify is not set, a conformant device will attempt the transmission of Verify frames three times after pEnable is set (see Verify State Diagram Figure 99-8 a). The verify mPacket is sent when TX_VERIFY state (in Figure 99-5, Transmit Processing State Diagram) is entered causing the transmission of Preamble, SMD-V, 60 octets of 0x00, and an mCRC.

Test Setup: Connect the DUT to the testing station with the appropriate medium. If possible, configure the DUT to set disableVerify to FALSE.

Test Procedure:

Part A: Verify format

- A:1. Disconnect the DUT from the test station, wait 2 seconds, and reconnect the DUT to the test station.
- A:2. Transmit an AEC-TLV indicating Preemption Supported and Enabled
- A:3. Wait 2 seconds.
 - a) Observe transmissions from the DUT.

Observable results:

Step	Result	Description
A	N/A	The DUT only supports disableVerify set to TRUE.
A2	FAIL	The DUT was not observed to transmit a Verify Frame.
A2	FAIL	The DUT was observed to transmit a Verify Frame with an incorrect mCRC value.
A2	FAIL	The DUT was observed to transmit a verify that did not have 7 bytes of preamble.
A2	FAIL	The DUT was observed to transmit a verify that did not have an SMD-V.
A2	FAIL	The DUT was observed to transmit a verify that did not have data of exactly 60 bytes.
A2	FAIL	The DUT was observed to transmit a verify that did not have data containing only bytes of 0x00.
A2	PASS	The DUT was observed to transmit valid verify frames.

Possible Problems: None

Test #99.4.3 – Proper Transmission of Verify Frame after Link Fail

Purpose: To verify that the DUT properly resumes transmission of Verify Frames after a link fail event.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.3 (MAC Merge Packet (mPacket))
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.3 (Variables)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.6 (Timers)
- [5] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM7
- [6] ANNEX A (informative) Acronym Definitions
- [7] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: May 16, 2017

Discussion: As long as `disableVerify` is not set, a conformant device will attempt the transmission of Verify frames three times after `pEnable` is set (see Verify State Diagram Figure 99-8 a). After `link_fail` the device should reenter the `INIT_VERIFICATION` state and set `verified` to `False` and restart verification. The `verify_timer` controls how long to wait after a Verify mPacket has been sent before giving up on that attempt. This timer is specified to be in the range of 1 to 128 ms, however a $\pm 20\%$ allowance is made on the time from when it is started to when it expires, which yields a range of 0.8ms to 153.6 ms.

Test Setup: Connect the DUT to the testing station with the appropriate medium. If possible, configure the DUT to set `disableVerify` to `FALSE`.

Test Procedure:

Part A: *Reset on link_fail*

- A:1. Ensure the DUT is in a mode with Preemption Active.
 - a) Send a Verify Frame to the DUT. If a Respond Frame is not observed, repeat the Test Setup.
- A:2. Disconnect the link to the DUT.
- A:3. Wait 2 seconds.
- A:4. Reconnect the link to the DUT.
- A:5. Transmit an AEC-TLV indicating Preemption Supported and Enabled
- A:6. Wait two seconds.
 - a) Observe the transmissions from the DUT.

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Observable results:

Step	Result	Description
A	N/A	The DUT only supports disableVerify set to TRUE.
A1	FAIL	The DUT was not observed to transmit a Respond Frame.
A6	FAIL	The DUT was not observed to transmit a Verify Frame.
A6	PASS	The DUT was observed to transmit a Verify Frame.

Possible Problems: None

Test #99.4.4 – Verify Transmission Inhibited if no TLV or not supported

Purpose: To verify that the DUT properly withholds transmission of Verify Frames if no AEC-TLVs are received.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.3 (MAC Merge Packet (mPacket))
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.2 (Determining that the link partner supports preemption)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 79.3.7 (Additional Ethernet Capabilities TLV)
- [5] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM3
- [6] ANNEX A (informative) Acronym Definitions
- [7] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: May 16, 2017

Discussion: According to [3] the preemption capability shall only be enabled if the link partner announced with an AEC-TLV its support.

Test Setup: Connect the DUT to the testing station with the appropriate medium. If possible, configure the DUT to set disableVerify to FALSE.

Test Procedure:

Part A: No AEC-TLV sent to DUT

- A:1. Disconnect the DUT from the test station, wait 2 seconds, and reconnect the DUT to the test station.
- A:2. Wait 2 seconds.
 - a) Observe transmissions from the DUT.

Observable results:

Step	Result	Description
A	N/A	The DUT only supports disableVerify set to TRUE.
A2	FAIL	The DUT was not observed to transmit an AEC-TLV.
A2	FAIL	The DUT was observed to transmit a Verify Frame.
A2	PASS	The DUT was not observed to transmit a Verify Frame.

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Part B: AEC-TLV does not indicate support for Preemption

- B:1. Disconnect the DUT from the test station, wait 2 seconds, and reconnect the DUT to the test station.
- B:2. Transmit an AEC-TLV indicating Preemption capability (bit 0) is not supported (set to 0).
- B:3. Wait 2 seconds.
 - a) Observe transmissions from the DUT.

Observable results:

Step	Result	Description
B	N/A	The DUT only supports disableVerify set to TRUE.
B3	FAIL	The DUT was not observed to transmit an AEC-TLV.
B3	FAIL	The DUT was observed to transmit a Verify Frame.
B3	PASS	The DUT was not observed to transmit a Verify Frame.

Possible Problems: None

GROUP 5: Checking for Respond Frame Transmission

Scope: The following tests cover MAC Merge operations specific to properly transmitting Respond frames.

Overview: These tests are designed to verify that the DUT properly responds to both normally formed Verify frames and acceptable variations and responds with a properly formatted Respond frame. The timing of the response should not be delayed by either other un-started preemptable frames or whether the port is currently paused. The MAC Merge functions explored are defined in Clause 99 of IEEE Std 802.3™ -2015 as amended by IEEE Std 802.3br™-2016.

Test #99.5.1 – Proper Transmission of Respond Frames

Purpose: To verify that the DUT properly transmits Respond Frames.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.3 (MAC Merge Packet (mPacket))
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.3 (Verify preemption operation)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.3 (Variables)
- [5] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.4 (Functions)
- [6] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.6 (Timers)
- [7] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM7
- [8] ANNEX A (informative) Acronym Definitions
- [9] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 14, 2017

Discussion: According to the Respond State Diagram (Figure 99-8b) in the RESPOND_IDLE state the DUT is constantly monitoring for rcv_v, which transitions to true after receiving a verify mPacket. After this transition occurs, send_r is set to true. This should eventually cause an entrance into the TX_RESPOND state (Figure 99-5, Transmit Processing State Diagram). The respond mPacket is sent when TX_RESPOND state is entered causing rPLS_DATA.requests to transmit Preamble, SMD-R, 60 octets of 0x00, and an mCRC (see function TX_R) [5].

Test Setup: Connect the DUT to the testing station with the appropriate medium. If possible, configure the DUT to set disableVerify to FALSE.

Test Procedure:

Part A: *After Verify_timer_done without any response*

- A:1. Disconnect the DUT from the test station, wait 2 seconds, and reconnect the DUT to the test station.
- A:2. Transmit an AEC-TLV indicating Preemption Supported and Enabled
- A:3. Wait 2 seconds.
 - a) Observe transmissions from the DUT.
- A:4. Transmit a Verify mPacket
- A:5. Observe transmissions from the DUT.

Observable results:

Step	Result	Description
A	N/A	The DUT only supports disableVerify set to TRUE.
A3	FAIL	The DUT was not observed to transmit any Verify Frames.
A5	FAIL	The DUT was not observed to transmit a Respond Frame.
A5	PASS	The DUT was observed to transmit a Respond Frame.

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Part B: *After Verify_timer_done with response*

- B:1. Disconnect the DUT from the test station, wait 2 seconds, and reconnect the DUT to the test station.
- B:2. Transmit an AEC-TLV indicating Preemption Supported and Enabled
- B:3. Wait up to 2 seconds for a Verify mPacket and then reply with a single Respond mPacket.
- B:4. Wait 2 seconds.
- B:5. Transmit a verify mPacket.
- B:6. Wait 1 second.
 - a) Observe transmissions from the DUT.

Observable results:

Step	Result	Description
B	N/A	The DUT only supports disableVerify set to TRUE.
B3	FAIL	The DUT was not observed to transmit a Verify Frame.
B6	FAIL	The DUT was not observed to transmit exactly one (1) respond mPacket.
B6	PASS	The DUT was observed to transmit exactly one (1) respond mPacket.

Part C: *Transmit multiple Verify frames*

- C:1. Disconnect the DUT from the test station, wait 2 seconds, and reconnect the DUT to the test station.
- C:2. Transmit an AEC-TLV indicating Preemption Supported and Enabled
- C:3. Wait up to 2 seconds for a Verify mPacket and then reply with a single Respond mPacket.
- C:4. Wait 2 seconds.
- C:5. Transmit 5 verify mPackets approximately 1mS apart.
- C:6. Wait 1 second.
 - a) Observe transmissions from the DUT.

Observable results:

Step	Result	Description
C	N/A	The DUT only supports disableVerify set to TRUE.
C3	FAIL	The DUT was not observed to transmit a Verify Frame.
C6	FAIL	The DUT was not observed to transmit exactly five (5) respond mPackets.
C6	PASS	The DUT was observed to transmit exactly five (5) respond mPackets.

Possible Problems: None

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Test #99.5.2 – Proper Format of Respond Frames

Purpose: To verify that the DUT transmits properly formed Respond Frames.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.3 (MAC Merge Packet (mPacket))
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.3 (Verify preemption operation)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.3 (Variables)
- [5] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.6 (Timers)
- [6] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM7
- [7] ANNEX A (informative) Acronym Definitions
- [8] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 13, 2017

Discussion: According to the Respond State Diagram (Figure 99-8b) in the RESPOND_IDLE state the DUT is constantly monitoring for rcv_v is true, which occurs after receiving a verify mPacket. After receipt send_r is set to true. This should eventually cause the DUT to enter the TX_RESPOND state (Figure 99-5, Transmit Processing State Diagram). The respond mPacket is sent when TX_RESPOND state is entered, causing the transmission of Preamble, SMD-R, 60 octets of 0x00, and an mCRC (TX_R).

Test Setup: Connect the DUT to the testing station with the appropriate medium. If possible, configure the DUT to set disableVerify to FALSE.

Test Procedure:

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Part A: Respond frame format

- A:1. Disconnect the DUT from the test station, wait 2 seconds, and reconnect the DUT to the test station.
- A:2. Transmit an AEC-TLV indicating Preemption Supported and Enabled
- A:3. Wait 2 seconds.
 - a) Observe transmissions from the DUT.
- A:4. Transmit a verify mPacket.
- A:5. Wait 1 second.
 - a) Observe transmissions from the DUT.

Observable results:

Step	Result	Description
A	N/A	The DUT only supports disableVerify set to TRUE.
A3	FAIL	The DUT was not observed to transmit a verify mPacket.
A5	FAIL	The DUT was observed to transmit a respond mPacket with an incorrect mCRC value.
A5	FAIL	The DUT was observed to transmit a respond mPacket that did not have 7 bytes of preamble.
A5	FAIL	The DUT was observed to transmit a respond mPacket that did not have an SMD-R.
A5	FAIL	The DUT was observed to transmit a respond mPacket that did not have data of exactly 60 bytes.
A5	FAIL	The DUT was observed to transmit a respond mPacket that did not have data containing only bytes of 0x00.
A5	PASS	The DUT was observed to transmit a valid respond mPacket.

Possible Problems: None

GROUP 6: Preemption Capabilities as Communicated through LLDP

Scope: The following tests cover proper handling of the Additional Ethernet Capabilities TLV.

Overview: These tests are designed to verify that the DUT properly communicates and accepts Preemption Capability through LLDP. The Link Layer Discovery Protocol functions explored are defined in Clause 79 of IEEE Std 802.3™-2015 as amended by IEEE Std 802.3br™-2016.

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Test #99.6.1 – Proper Format of AEC-TLV

Purpose: To verify that the DUT properly transmits the AEC-TLV.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.3 (MAC Merge Packet (mPacket))
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.3 (Verify preemption operation)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 79.3.7 (Additional Ethernet Capabilities TLV)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.3 (Variables)
- [5] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.6 (Timers)
- [6] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM7
- [7] ANNEX A (informative) Acronym Definitions
- [8] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 13, 2017

Discussion: The AEC-TLV is a TLV in an LLDPDU. This TLV is specified to have a 16 bit header with TLV type=127 and TLV information string length of 6 followed by the 802.3 OUI (00-12-0F), followed by an 802.3 sub-type of 0x07, followed by 2 bytes containing a bitmap of the additional Ethernet capabilities. Refer to Table 79-7a [3].

Test Setup: Connect the DUT to the testing station with the appropriate medium. If possible, configure the DUT to set disableVerify to FALSE.

Test Procedure:

Part A: AEC-TLV Format

- A:1. Disconnect the DUT from the test station, wait 2 seconds, and reconnect the DUT to the test station.
- A:2. Wait 2 seconds.
 - a) Observe transmissions from the DUT.
- A:3. Transmit an AEC-TLV indicating preemption capability support and preemption capability status.
- A:4. Wait up to 2 seconds for a verify mPacket and respond with a respond mPacket.
- A:5. Wait up to 30 seconds for an AEC-TLV.
 - a) Observe transmissions from the DUT.

Observable results:

Step	Result	Description
A2	FAIL	The DUT was not observed to transmit an LLDPDU containing an AEC-TLV.
A2	FAIL	The DUT was observed to transmit an improper AEC-TLV.
A2	FAIL	The DUT was observed to transmit an AEC-TLV indicating preemption capability is active.
A4	N/A	The DUT only supports disableVerify set to TRUE.
A5	FAIL	The DUT was not observed to transmit an AEC-TLV indicating preemption capability is active.
A5	PASS	The DUT was observed to transmit a valid AEC-TLV indicating preemption capability is active.

Possible Problems: None

GROUP 7: Transmission Precedence and Timing

Scope: The following tests cover MAC Merge operations specific to timing tolerance of preempting as well as properly following precedence order of transmission.

Overview: These tests are designed to verify that the DUT properly adheres to transmission precedence. In addition this tests the ability of the DUT to adhere to timing requirements for preempting and holding preemptable traffic. The MAC Merge functions explored are defined in Clause 99 of IEEE Std 802.3TM -2015 as amended by IEEE Std 802.3brTM-2016.

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Test #99.7.1 – Proper Frame Transmission Prioritization

Purpose: To verify that the DUT properly prioritizes frame transmission of Preemptable, Express, Verify, and Respond packets.

References:

- [1] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.3 (MAC Merge Packet (mPacket))
- [2] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.3 (Verify preemption operation)
- [3] IEEE Std 802.3-2015 w/ 802.3br-2016: subclause 99.4.7.7 (State Diagrams)
- [4] IEEE Std 802.3-2015 w/ 802.3br-2016: PICS Item MM9
- [5] ANNEX A (informative) Acronym Definitions
- [6] ANNEX B (informative) Definitions of Certain Key Words

Resource Requirements: A testing station capable of transmitting and receiving arbitrary packets and capable of monitoring traffic from the DUT.

Last Modification: June 14, 2017

Discussion: The Transmit Processing State Diagram (Figure 99-5) specifies what to send if multiple different types of mPackets are awaiting transmission[3]. There are three different sources that create frames to be transmitted: the eMAC, the pMAC, and the MAC Merge sublayer itself, which produces the Verify and Respond frames. The basic frame types that are scheduled and transmitted by the MAC Merge sublayer are Express frames (a frame from the eMAC), Preemptable frames (a frame from the pMAC), a Verify frame, and a Respond frame. Anytime a frame from the eMAC is ready for transmission it will be sent before any other waiting frame type. In the IDLE_TX_PROC state if there is no frame waiting from the eMAC and all three other types are ready for transmission then any Respond frames are sent next. If no other Express or Respond frames are waiting then the Verify frame is sent. If no other frame type is waiting the Preemptable frame will be sent. The other state to consider is the RESUME_WAIT state. This state is entered if a Preemptable frame was preempted. From this state if no Express frame is waiting to be transmitted and the hold signal is not set then the preempted frame will continue next, even if there is a Respond or Verify waiting to be transmitted.

Test Setup: Connect the DUT to the testing station with the appropriate medium. If possible, configure the DUT to set disableVerify to FALSE.

Test Procedure:

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Part A: *Incomplete Verification Case, Only Express Frames (BRIDGE PROCEDURE)*

- A:1. Disconnect the DUT from Test Station 1 (connected to the port under test), wait 2 seconds, and reconnect the DUT to the test station.
- A:2. At Test Station 2 (connected to another port of the Bridge) send at, or slightly faster, than line rate Express Frames destined for Test Station 1.
- A:3. Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- A:4. Observe transmissions from the DUT at Test Station 1.
- A:5. Transmit a Verify mPacket at Test Station 1 while observing transmissions from the DUT at Test Station 1.
- A:6. If at least three ports of the bridge are available then at Test Station 3 (connected to another port of the DUT) transmit line rate Preemptable Frames. If only two ports are available then the IPG and/or Preamble of the frames transmitted from Test Station 2 can be reduced such that a number of Preemptable frames can be sent while still maintaining at least a line rate input of Express Frames.
- A:7. Observe transmissions from the DUT at Test Station 1.

Part A: *Incomplete Verification Case, Only Express Frames (END STATION PROCEDURE)*

- A:1. Disconnect the DUT from Test Station, wait 2 seconds, and reconnect the DUT to the test station.
- A:2. Attempt to stimulate the DUT to transmit line rate Express Frames. This traffic should continue throughout this procedure. For end stations that are replying to frame stimuli, the IPG and preamble from the Test Station may be decreased to ensure that additional frames in the following parts can be sent while maintaining an egress from the DUT of line rate.
- A:3. Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- A:4. Observe transmissions from the DUT at Test Station.
- A:5. Transmit a Verify mPacket while observing transmissions from the DUT.
- A:6. Attempt to cause the DUT to also transmit Preemptable Frames.
- A:7. Observe transmissions from the DUT at Test Station 1.

Observable results:

Step	Result	Description
A	N/A	The DUT was not observed to consistently egress frames at line rate.
A	N/A	The DUT only supports disableVerify set to TRUE.
A4	FAIL	The DUT was observed to transmit a frame other than an Express Frame.
A5	FAIL	The DUT was observed to transmit a frame other than an Express Frame.
A7	FAIL	The DUT was observed to transmit a frame other than an Express Frame.
A7	FAIL	The DUT was observed to forward any traffic from Test Station 3. (Only applicable in Bridge Case)
A7	PASS	The DUT was only observed to transmit Express Frames.

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Part B: Completed Verification Case, Only Express Frames (BRIDGE PROCEDURE)

- B:1. Disconnect the DUT from Test Station 1 (connected to the port under test), wait 2 seconds, and reconnect the DUT to the test station.
- B:2. Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- B:3. From Test Station 1 wait up to 2 seconds for a Verify mPacket and then reply with a single Respond mPacket.
- B:4. At Test Station 2 (connected to another port of the Bridge) send at, or slightly faster, than line rate Express Frames destined for Test Station 1.
- B:5. Observe transmissions from the DUT at Test Station 1.
- B:6. Transmit a Verify mPacket at Test Station 1 while observing transmissions from the DUT at Test Station 1.
- B:7. If at least three ports of the bridge are available then at Test Station 3 (connected to another port of the DUT) transmit line rate Preemptable Frames. If only two ports are available then the IPG and/or Preamble of the frames transmitted from Test Station 2 can be reduced such that a number of Preemptable frames can be sent while still maintaining at least a line rate input of Express Frames.
- B:8. Observe transmissions from the DUT at Test Station 1.

Part B: Completed Verification Case, Only Express Frames (END STATION PROCEDURE)

- B:1. Disconnect the DUT from Test Station, wait 2 seconds, and reconnect the DUT to the test station.
- B:2. Transmit an AEC-TLV indicating Preemption Supported and Enabled.
- B:3. Wait up to 2 seconds for a Verify mPacket and then reply with a single Respond mPacket.
- B:4. Attempt to stimulate the DUT to transmit line rate Express Frames. This traffic should continue throughout this procedure. For end stations that are replying to frame stimuli, the IPG and preamble from the Test Station may be decreased to ensure that additional frames in the following parts can be sent while maintaining an egress from the DUT of line rate.
- B:5. Observe transmissions from the DUT at Test Station.
- B:6. Transmit a Verify mPacket while observing transmissions from the DUT.
- B:7. Attempt to cause the DUT to also transmit Preemptable Frames.
- B:8. Observe transmissions from the DUT at Test Station 1.

Observable results:

Step	Result	Description
B	N/A	The DUT was not observed to consistently egress frames at line rate.
B5	FAIL	The DUT was observed to transmit a frame other than an Express Frame.
B6	FAIL	The DUT was observed to transmit a frame other than an Express Frame.
B8	FAIL	The DUT was observed to transmit a frame other than an Express Frame.
B8	FAIL	The DUT was observed to forward any traffic from Test Station 3. (Only applicable in Bridge Case)
B8	PASS	The DUT was only observed to transmit Express Frames.

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Part C: Respond frame shall not occur when preemptable packet is ongoing

- C:1. Disconnect the DUT from the test station, wait 2 seconds, and reconnect the DUT to the test station.
- C:2. Transmit an AEC-TLV indicating Preemption Supported and Enabled
- C:3. Wait up to 2 seconds for a Verify mPacket and then reply with a single Respond mPacket.
- C:4. Wait 2 seconds.
- C:5. Cause the DUT to begin transmission of a 1518-byte Preemptable frame.
- C:6. While receiving the Preemptable frame, transmit a Verify Frame near the beginning of this reception.
- C:7. Observe the transmissions from the DUT.
- C:8. Cause the DUT to begin the transmission of another 1518-byte Preemptable frame.
- C:9. While receiving the Preemptable frame, transmit a Verify Frame near the beginning of this reception and then cause the DUT to preempt the frame in progress by having the DUT transmit an Express frame.
- C:10. Observe the transmissions from the DUT.

Observable results:

Step	Result	Description
C7	FAIL	The DUT preempted its transmission.
C7	FAIL	The DUT failed to complete the transmission of the Preemptable frame.
C7	FAIL	The DUT was not observed to transmit a Respond frame after transmitting the complete un-preempted, Preemptable frame.
C10	FAIL	The DUT did not preempt its transmission.
C10	FAIL	After preempting the transmission, the DUT failed to send in order: the Express frame, then the valid completion of the Preemptable frame, and finally the Respond frame.
C10	PASS	After preempting the transmission, the DUT sent in order: the Express frame, then the valid completion of the Preemptable frame, and finally the Respond frame.

Possible Problems: None

ANNEX A (informative) Acronym Definitions

Acronym Definitions

AEC-TLV	Additional Ethernet Capability TLV. An AEC-TLV is sent in an LLDP and communicates four things about the device sending it: preemption capability support (supported or not supported), preemption capability status (enabled or not enabled), preemption capability active (active or not active), and additional fragment size (0, 1, 2, or 3). (IEEE Std 802.3™ -2015 as amended by IEEE Std 802.3br™-2016 subclause 79.3.7.2)
CRC	cyclic redundancy check (IEEE Std 802.3™ -2015 subclause 1.5)
DA	Destination Address (IEEE Std 802.3™ -2015 subclause 1.5)
DTE	data terminal equipment (IEEE Std 802.3™ -2015 subclause 1.5)
DUT	Device Under Test
eMAC	Express Media Access Control (IEEE Std 802.3™ -2015 subclause 1.5 as amended by IEEE Std 802.3br™-2016)
FCS	Frame Check Sequence (IEEE Std 802.3™ -2015 subclause 1.5)
GMII	Gigabit Media Independent Interface (IEEE Std 802.3™ -2015 subclause 1.5)
IPG	interpacket gap (IEEE Std 802.3™ -2015 subclause 1.5)
LLC	logical link control (IEEE Std 802.3™ -2015 subclause 1.5)
LLDP	Link Layer Discovery Protocol (IEEE Std 802.1AB-2009 clause 4)
LLDPDU	LLDP data unit (IEEE Std 802.1AB-2009)
MAC	medium access control (IEEE Std 802.3™ -2015 subclause 1.5)
mCRC	A 32-bit value calculated similarly to the normal CRC value except the final step of the CRC is to complement all bits, while the mCRC final step complements only the bits in the last two bytes. Thus only the first two bytes will differ between the two. (IEEE Std 802.3™ -2015 subclause 3.2.9 and 99.3.6 as amended by IEEE Std 802.3br™-2016)
MDI	medium dependent interface (IEEE Std 802.3™ -2015 subclause 1.5)
MII	media independent interface (IEEE Std 802.3™ -2015 subclause 1.5)
MMSI	MAC Merge service interface (IEEE Std 802.3™ -2015 subclause 1.5 as amended by IEEE Std 802.3br™-2016)
PHY	Physical Layer entity (IEEE Std 802.3™ -2015 subclause 1.5)

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PICS	protocol implementation conformance statement (IEEE Std 802.3™ -2015 subclause 1.5)
PLS	physical signaling sublayer (IEEE Std 802.3™ -2015 subclause 1.5)
PMA	physical medium attachment (IEEE Std 802.3™ -2015 subclause 1.5)
pMAC	Preemptable Media Access Control (IEEE Std 802.3™ -2015 subclause 1.5 as amended by IEEE Std 802.3br™-2016)
PMD	physical medium dependent (IEEE Std 802.3™ -2015 subclause 1.5)
RS	reconciliation sublayer (IEEE Std 802.3™ -2015 subclause 1.5)
SA	source address (IEEE Std 802.3™ -2015 subclause 1.5)
SFD	start-of-frame delimiter (IEEE Std 802.3™ -2015 subclause 1.5)
SMD	Start mPacket Delimiter (IEEE Std 802.3™ -2015 subclause 99.3.3 as amended by IEEE Std 802.3br™-2016)
SMD-C	The SMD field has one of the four values indicating continuation: SMD-C0, SMD-C1, SMD-C2, or SMD-C3. (IEEE Std 802.3™ -2015 subclause 99.3.3 as amended by IEEE Std 802.3br™-2016)
SMD-C0	An SMD with value 0x61 indicating the mPacket contains the continuation of the preemptable frame, with frame count of 0. (IEEE Std 802.3™ -2015 subclauses 99.3.3 and 99.4.5 as amended by IEEE Std 802.3br™-2016)
SMD-C1	An SMD with value 0x52 indicating the mPacket contains the continuation of the preemptable frame, with frame count of 1. (IEEE Std 802.3™ -2015 subclauses 99.3.3 and 99.4.5 as amended by IEEE Std 802.3br™-2016)
SMD-C2	An SMD with value 0x9E indicating the mPacket contains the continuation of the preemptable frame, with frame count of 2. (IEEE Std 802.3™ -2015 subclauses 99.3.3 and 99.4.5 as amended by IEEE Std 802.3br™-2016)
SMD-C3	An SMD with value 0x2A indicating the mPacket contains the continuation of the preemptable frame, with frame count of 3. (IEEE Std 802.3™ -2015 subclauses 99.3.3 and 99.4.5 as amended by IEEE Std 802.3br™-2016)
SMD-E	An SMD with value 0xD5 indicating the mPacket contains an express packet. (IEEE Std 802.3™ -2015 subclauses 99.3.3 and 99.4 as amended by IEEE Std 802.3br™-2016)
SMD-R	An SMD with value 0x19 indicating the mPacket contains a respond packet. (IEEE Std 802.3™ -2015 subclauses 99.3.3 and 99.4.3 as amended by IEEE Std 802.3br™-2016)
SMD-S	The SMD field has one of the four values indicating the start of a preemptable packet: SMD-S0, SMD-S1, SMD-S2, or SMD-S3. (IEEE Std 802.3™ -2015 subclause 99.3.3 as amended by IEEE Std 802.3br™-2016)

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SMD-S0	An SMD with value 0xE6 indicating the mPacket contains the start of a preemptable frame, with frame count of 0. (IEEE Std 802.3 TM -2015 subclause 99.3.3 as amended by IEEE Std 802.3br TM -2016)
SMD-S1	An SMD with value 0x4C indicating the mPacket contains the start of a preemptable frame, with frame count of 1. (IEEE Std 802.3 TM -2015 subclause 99.3.3 as amended by IEEE Std 802.3br TM -2016)
SMD-S2	An SMD with value 0x7F indicating the mPacket contains the start of a preemptable frame, with frame count of 2. (IEEE Std 802.3 TM -2015 subclause 99.3.3 as amended by IEEE Std 802.3br TM -2016)
SMD-S3	An SMD with value 0xB3 indicating the mPacket contains the start of a preemptable frame, with frame count of 3. (IEEE Std 802.3 TM -2015 subclause 99.3.3 as amended by IEEE Std 802.3br TM -2016)
SMD-V	An SMD with value 0x07 indicating the mPacket contains a verify packet. (IEEE Std 802.3 TM -2015 subclauses 99.3.3 and 99.4.3 as amended by IEEE Std 802.3br TM -2016)
UCT	unconditional transition (IEEE Std 802.3 TM -2015 subclause 1.5)

ANNEX B (informative) Definitions of Certain Key Words

Definitions

Express Frame	A frame being sent from or destined to a eMAC. (IEEE Std 802.3™ -2015 subclauses 99.3.3, 99.3.6, and 99.4 as amended by IEEE Std 802.3br™-2016)
Express Packet	An mPacket containing SMD-E (0xD5) in the SMD field and a CRC-32 value in the CRC field. This contains a frame being sent from or destined to an eMAC. All fields match a normal packet and thus it is indistinguishable from a normal packet. (IEEE Std 802.3™ -2015 subclauses 99.3.3, 99.3.6, and 99.4 as amended by IEEE Std 802.3br™-2016)
mData	Start mPacket Delimiter (IEEE Std 802.3™ -2015 subclause 99.3.3 as amended by IEEE Std 802.3br™-2016)
mPacket	This is short for MAC Merge Packet and is used to describe any packet coming into the MAC Merge Sublayer. (IEEE Std 802.3™ -2015 subclause 99.3.3 as amended by IEEE Std 802.3br™-2016)
Preemptable Frame	A frame being sent from or destined to a pMAC. (IEEE Std 802.3™ -2015 subclauses 99.3.3, 99.3.6, and 99.4 as amended by IEEE Std 802.3br™-2016)
Preemptable Packet	An mPacket containing an SMD-S or an SMD-C in the SMD field. The CRC field indicates either a CRC-32 value to indicate the current frame is complete or an mCRC value to indicate the frame is to be continued at a later time. This packet contains an entire or partial frame being sent from or destined to a pMAC. (IEEE Std 802.3™ -2015 subclauses 99.3.3, 99.3.6, and 99.4 as amended by IEEE Std 802.3br™-2016)
SMD	Start mPacket Delimiter (IEEE Std 802.3™ -2015 subclause 99.3.3 as amended by IEEE Std 802.3br™-2016)
Verify Packet	An mPacket containing SMD-V (0x07) in the SMD field and an mCRC value in the CRC field. (IEEE Std 802.3™ -2015 subclauses 99.3.3 and 99.4.3 as amended by IEEE Std 802.3br™-2016)