Bridge Functions Consortium

Jumbo Frame
Feature Verification Test Suite
Version 0.2

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MODIFICATION RECORD

Version	Date	Editor(s)	Comments
0.1	2005-09-05	Curtis Knittle Curtis Simonson	Initial Draft
0.2	2006-09-26	Chester Balut Curtis Simonson	Industry Reviewed Test Suite

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Chester Balut	UNH InterOperability Lab
Curtis Knittle	Harmonic, Inc.
Curtis Simonson	UNH InterOperability Lab

INTRODUCTION

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

> *"In 1998, Alteon Networks, Inc. promoted an initiative to increase the maximum size of the MAC Client Data field from 1500-bytes to 9000-bytes. The initiative was not adopted by the IEEE 802.3 Working Group, but it was endorsed by a number of other companies. Larger frames would provide a more efficient use of the network bandwidth while reducing the number of frames that have to be processed."*[1]

This test suite has been designed based on the set of common accepted practices that pertain to Jumbo Frames. The test suite is designed to help determine whether or not the DUT will behave in accordance with the industry standard practice during normal operation.

These tests are not designed as performance tests. The relative performance of Jumbo Frame capable devices (e.g. forwarding rate, throughput latency, etc.) is beyond the scope of this document. These tests examine the DUT's Jumbo Frame functionality at ideal physical layer conditions.

These tests are not designed as conformance tests. Rather, they provide one method to isolate problems within a Jumbo Frame capable device that may affect interoperability. Successful completion of all tests contained in this suite does not guarantee that the tested device will operate with other Jumbo Frame capable devices. However, combined with satisfactory completion of interoperability testing, these tests provide a reasonable level of confidence that the DUT will function well in most Jumbo Frame capable environments.

[1] http://www.techfest.com/networking/lan/ethernet2.htm

REFERENCES

The following documents are referenced in this text:

http://sd.wareonearth.com/~phil/jumbo.html	"Gigabit Ethernet Jumbo Frames" by Phil Dykstra
http://www.psc.edu/~mathis/MTU/AlteonExtendedFrames_W0601.pdf	"Extended Frame Sizes for Next Generation Ethernets", a whitepaper by Alteon Networks
[IEEE Std 802.1D™-2004]	IEEE Computer Society LAN/MAN Standards Committee, "Media Access Control (MAC) Bridges"
[IEEE Std 802.1Q™-2003]	IEEE Computer Society LAN/MAN Standards Committee, "Virtual Bridged Local Area Networks"
[IEEE Std 802.3™-2003]	IEEE Computer Society LAN/MAN Standards Committee, "Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications"

DEFINITION OF TERMS

Abbreviations and Acronyms:

AAL5	ATM Adaptation Layer 5
ATM	Asynchronous Transfer Mode
DUT	Device Under Test
DUT.TS	Port on the DUT connected to Test Station (ex. DUT.TS1 refers to the Port on the DUT connected to Test Station 1)
FDDI	Fiber Distributed Data Interface
HIPPI	High-Performance Parallel Interface
MTU	Maximum Transmission Unit
TS	Test Station (ex. TS1 refers to Test Station 1)

Definitions:

Device Under Test	The Bridge on which the Jumbo.ver test suite is being conducted.
Test Station	A tool that supports the analysis and generation of test traffic, i.e. MAC frames.
Frame	A unit of data transmission on an IEEE 802 LAN MAC that conveys a PDU between MAC Service users. There are three types of frame; untagged, VLAN-tagged, and priority-tagged.
Jumbo Frame	An Ethernet frame containing a data size greater than 1500-bytes.
Untagged frame	An untagged frame is a frame that does not contain a tag header immediately following the Source MAC Address field of the frame […].
Virtual Bridged Local Area Network (LAN)	A Bridged LAN in which the existence of one or more VLAN-aware Bridges allows the definition, creation, and maintenance of VLANs.
Virtual Local Area Network (VLAN)	A subset of the active topology of a Bridged Local Area Network. Associated with each VLAN is a VLAN Identifier (VID).
VLAN-aware	A property of Bridges or end stations that recognize and support VLAN-tagged frames.
VLAN-tagged frame	A tagged frame whose tag header carries both VLAN identification and priority information.
VLAN-unaware	A property of Bridges or end stations that do not recognize VLAN-tagged frames.

MTUs for Common Media:

Media Type	**MTU (bytes)**
ATM AAL5	9000
FDDI	4500
HIPPI	65280

TEST ORGANIZATION

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

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

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

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

Resource Requirements: The Resource Requirements section specifies the software, hardware, and test equipment that will be needed to perform the test. The Discussion is a general discussion of the test and relevant section of the specification, including any assumptions made in the design or implementation of the test as well as known limitations.

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

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

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

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

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

TEST SETUP

Default Settings: DUT

Port Admin Status	Enabled (all ports)
Ageing Time	300 seconds
Bridge Spanning Tree Admin Status	Disabled
PVID	1 (all ports)
VLAN Membership	1 – untagged (all ports)
MTU	Maximum allowed size
DUT's Bridge Filtering Database (Content Addressable Memory)	No entries*

**This excludes reserved multicast MAC addresses.*

GROUP 1: Jumbo Frame Feature Verification

Scope

To verify that the DUT's properly processes Jumbo Frames, both untagged and VLAN-tagged, and determine the maximum frame size supported by the DUT.

Overview

IEEE Std 802.3-2002 specifies an maximum frame size of 1518 for untagged packets and 1522 for VLAN-tagged packets, which was originally defined for10Base-T Ethernet. Modern day engineering advances have allowed Ethernet device manufacturers to produce Ethernet devices that support larger frame sizes, Jumbo Frames. Proponents of Jumbo Frames point out that Jumbo Frames transfer larger blocks of data with less overhead and reduced frame processing on servers.

This group of Tests verify the extent of the DUT's Jumbo Frame functionality, including and beyond that of basic Jumbo Frame forwarding. In order for a Bridge to properly function in a Jumbo Frame-enabled network it must at least support Jumbo Frame forwarding, Jumbo Frame learning, tagged Jumbo Frame forwarding and tagged Jumbo Frame learning.

Jumbo.Ver.1.1: Basic Jumbo Frame Verification

Purpose: To determine the maximum frame size supported by the DUT and examine the DUT's Jumbo Frame learning behavior.

References:

- IEEE Std 802.3-2002
- IEEE Std 802.1D-2004
- IEEE Std 802.1Q-2003

Resource Requirements:

- 3 Test Stations

Discussion:

Ethernet devices claiming "Jumbo Frames" capabilities indicate support for data payloads greater than 1500 bytes (i.e. MTUs greater than 1518 bytes untagged and 1522 bytes tagged). This Test verifies the maximum data payload and MTU supported by the DUT. This Test also examines the DUT's learning behavior for Jumbo Frames.

Test Layout:

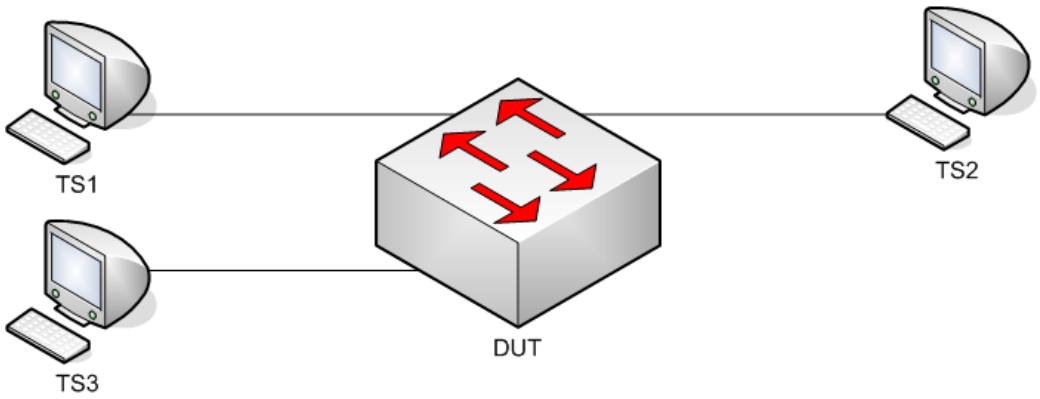

Figure 1 – Basic Jumbo Frame Verification

Procedure:

Part A: Maximum Data Payload and MTU – Informational

1. Ensure that the default values are configured on the DUT.
2. Start capture on TS2.
3. Continuously transmit, from TS1, Jumbo_Fr_X frames, where X = 1518 to 12000 in increments of 1, at 100% line rate.
4. Stop capture on TS2, and observe the captured frames (if any).

Part B: Jumbo Frame MAC address learning – Informational

5. Ensure that the default values are configured on the DUT.
6. Start capture on TS1, TS2 and TS3.
7. Transmit, from TS1, one Jumbo_Src22 frame.
8. Transmit, from TS2, one Jumbo_Src44 frame.
9. Transmit, from TS1, one Jumbo_Src66 frame.
10. Transmit, from TS2, one Jumbo_Src88 frame.
11. Transmit, from TS3, one Jumbo_Dest22 frame.
12. Transmit, from TS3, one Jumbo_Dest44 frame.
13. Transmit, from TS3, one Jumbo_Dest66 frame.
14. Transmit, from TS3, one Jumbo_Dest88 frame.
15. Stop capture on TS1, TS2 and TS3, and observe the captured frames (if any).

Observable Results:

- In Part A, during Step 3, TS1 must capture Jumbo_Fr_X frames untagged (record the largest size Jumbo_Fr_Tag_X frame captured by TS1 = "*DUT's untagged MTU*").
- In Part B, during Step 7, TS2 and TS3 must capture all Jumbo_Src22 frames transmitted by TS1 smaller than the *DUT's untagged MTU*, untagged. During Step 8, TS1 and TS3 must capture all Jumbo_Src44 frames transmitted by TS2 smaller than the *DUT's untagged MTU*, untagged. During Step 9, TS2 and TS3 must capture all Jumbo_Src66 frames transmitted by TS1 smaller than the *DUT's untagged MTU*, untagged. During Step 10, TS1 and TS3 must capture all Jumbo_Src88 frames transmitted by TS2 smaller than the *DUT's MTU*, untagged. During Step 11, TS1 must capture all Jumbo_Dest22 frames transmitted by TS3 smaller than the *DUT's untagged MTU*, untagged. During Step 12, TS2 must capture all Jumbo_Dest44 frames transmitted by TS3 smaller that the *DUT's untagged MTU*, untagged. During Step 13, TS1 must capture all Jumbo_Dest66 frames transmitted by TS3 smaller that the *DUT's untagged MTU*, untagged. During Step 14, TS2 must capture all Jumbo_Dest88 frames transmitted by TS3 smaller that the *DUT's untagged MTU*, untagged.
- All frames received during this Test must contain a CRC value equal to the frame's original CRC value.

Possible Problems:

- This Test cannot be completed, if the DUT does not support Jumbo Frames.
- In Part B, TS2 will not capture the frames transmitted by TS1 if the frame size is greater than the *DUT's untagged MTU*.

Jumbo.Ver.1.2: VLAN-tagged Jumbo Frame Verification

Purpose: To determine the maximum VLAN frame size supported by the DUT and examine the DUT's VLAN-tagged Jumbo Frame learning behavior.

References:

- IEEE Std 802.3-2002
- IEEE Std 802.1D-2004
- IEEE Std 802.1Q-2003

Resource Requirements:

- 4 Test Stations

Discussion:

VLAN-aware Ethernet devices claiming "Jumbo Frames" capabilities indicate support for data payloads greater than 1500 bytes (i.e. MTUs greater than 1522 bytes tagged). This Test verifies the maximum data payload for VLAN-tagged frames supported by the DUT. This Test also examines the DUT's learning behavior for Jumbo Frames.

Test Layout:

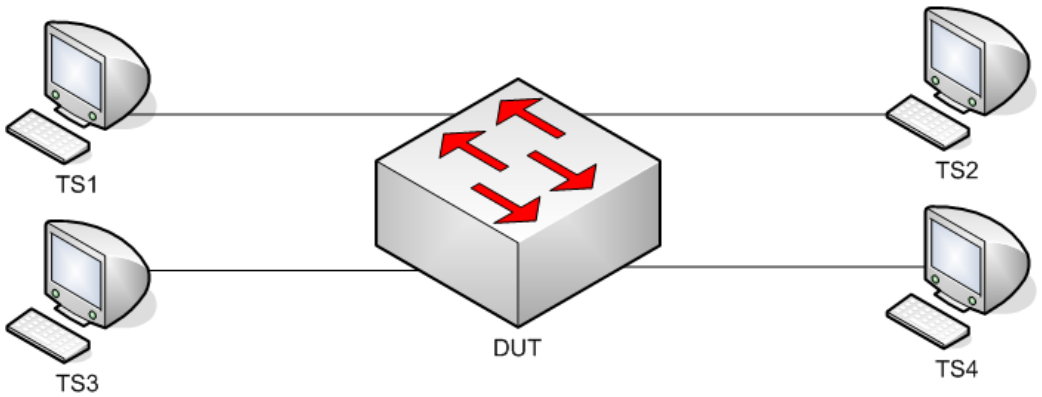

Figure 2 – VLAN Jumbo Frame Verification

Procedure:

Part A: Maximum VLAN-tagged frame Data Payload and MTU – Informational

1. Ensure that the default values are configured on the DUT.
2. Set DUT.TS1's PVID to 10.
3. Set DUT.TS2, DUT.TS3 and DUT.TS4's PVID to 1.
4. Set DUT.TS1 to untagged for VID 10.
5. Set DUT.TS2 and DUT.TS3 to tagged for VID 10.
6. Set DUT.TS3 to tagged for VID 1.
7. Set DUT.TS4 to untagged for VID1.
8. Start capture on TS1, TS2, TS3 and TS4.
9. Continuously transmit, from TS2, Jumbo_Fr_Tag_X frames, where X = 1523 to 12000 in increments of 1.
10. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames (if any).

Part B: Jumbo VLAN-tagged Frame MAC address learning – Informational

11. Ensure that the default values are configured on the DUT.
12. Set DUT.TS1's PVID to 10.
13. Set DUT.TS2, DUT.TS3 and DUT.TS4's PVID to 1.
14. Set DUT.TS1 to untagged for VID 10.
15. Set DUT.TS2 and DUT.TS3 to tagged for VID 10.
16. Set DUT.TS3 to tagged for VID 1.
17. Set DUT.TS4 to untagged for VID1.
18. Start capture on TS1, TS2, TS3, and TS4.
19. Transmit, from TS2, one Jumbo_Src_Tag22 frame (VID 10).
20. Transmit, from TS3, one Jumbo_Src_Tag44 frame (VID 1).
21. Transmit, from TS1, one Jumbo_Src66 frame (NO VID).
22. Transmit, from TS3, one Jumbo_Dest_Tag22 frame (VID 10).
23. Transmit, from TS3, one Jumbo_Dest_Tag44 frame (VID 1).
24. Transmit, from TS3, one Jumbo_Dest_Tag66 frame (VID 10).
25. Stop capture on TS1, TS2, TS3 and TS4, and observe the captured frames (if any).

Observable Results:

- In Part A, during Step 9, TS1 must capture Jumbo_Fr_Tag_X frames untagged (record the largest size Jumbo_Fr_Tag_X frame captured by TS1 = "*DUT's VLAN-tagged MTU*"). TS2 must not capture any Jumbo_Fr_Tag_X frames. TS3 must capture Jumbo_Fr_Tag_X frames VLAN-tagged for VID 10 (record the largest size Jumbo_Fr_Tag_X frame captured by TS1 – DUT's MTU) TS4 must not capture any Jumbo_Fr_Tag_X frames.
- In Part B, during Step 19, TS1 and TS3 must capture all Jumbo_Src_Tag22 frames transmitted by TS2 smaller than the *DUT's VLAN-tagged MTU*, untagged and VLAN-tagged for VID 10, respectively. During Step 20, TS1 and TS4 must capture all Jumbo_Src_Tag44 frames transmitted by TS3 smaller than the *DUT's VLAN-tagged MTU*, untagged and VLAN-tagged for VID 1, respectively. During Step 21, TS2 and TS3 must capture all Jumbo_Src66 frames transmitted by TS1 smaller than the *DUT's untagged MTU*, tagged for VID 10. During Step 22, TS2 must capture all Jumbo_Dest_Tag22 frames transmitted by TS3 smaller than the *DUT's VLAN-tagged MTU*, VLAN-tagged for VID 10. During Step 23, TS1, TS2, TS3 and TS4 must not capture any Jumbo_Dest_Tag44 frames. During Step 24, TS1 must capture all Jumbo_Dest_Tag66 frames transmitted by TS3 smaller that the *DUT's VLAN-tagged MTU*, untagged.
- All frames received during this Test must contain a CRC value equal to the frame's original CRC value.

Possible Problems:

- This Test cannot be completed, if the DUT is not a VLAN-aware Bridge.
- In Part B, all untagged and VLAN-tagged frames larger than the *DUT's untagged MTU* and the *DUT's VLAN-tagged MTU*, respectively, will not be forwarded by the DUT.

TEST FRAMES

Jumbo_Fr_X		
Octet(s)	**Description**	**Value (all numbers are hexadecimal)**
1-6	Destination MAC Address	00 22 22 22 22 22
7-12	Source MAC Address	<TS Source MAC>
-	VLAN Tag Header	None
13 - (X-4)	Data	Pseudo-random Data Pattern
(X-3) – (X)	Frame Check Sequence	Calculated at runtime

****X = Frame Size****

Jumbo_Fr_Tag_X		
Octet(s)	**Description**	**Value (all numbers are hexadecimal)**
1-6	Destination MAC Address	00 22 22 22 22 22
7-12	Source MAC Address	<TS Source MAC>
13 - 16	VLAN Tag Header	VID = 10, Priority = 0
17 - (X-4)	Data	Pseudo-random Data Pattern
(X-3) – (X)	Frame Check Sequence	Calculated at runtime

****X = Frame Size****

Jumbo_Src22		
Octet(s)	**Description**	**Value (all numbers are hexadecimal)**
1-6	Destination MAC Address	00 22 22 22 22 00
7-12	Source MAC Address	00 22 22 22 22 22
-	VLAN Tag Header	None
13 - 1996	Data	Pseudo-random Data Pattern
1997 - 2000	Frame Check Sequence	Calculated at runtime

Jumbo_Src44		
Octet(s)	**Description**	**Value (all numbers are hexadecimal)**
1-6	Destination MAC Address	00 44 44 44 44 00
7-12	Source MAC Address	00 44 44 44 44 44
-	VLAN Tag Header	None
13 - 3996	Data	Pseudo-random Data Pattern
3997 - 4000	Frame Check Sequence	Calculated at runtime

Jumbo_Src66		
Octet(s)	**Description**	**Value (all numbers are hexadecimal)**
1-6	Destination MAC Address	00 66 66 66 66 00
7-12	Source MAC Address	00 66 66 66 66 66
-	VLAN Tag Header	None
13 - 5996	Data	Pseudo-random Data Pattern
5997 - 6000	Frame Check Sequence	Calculated at runtime

Jumbo_Src88		
Octet(s)	**Description**	**Value (all numbers are hexadecimal)**
1-6	Destination MAC Address	00 88 88 88 88 00
7-12	Source MAC Address	00 88 88 88 88 88
-	VLAN Tag Header	None
13 - 7996	Data	Pseudo-random Data Pattern
7997 - 8000	Frame Check Sequence	Calculated at runtime

Jumbo_Dest22		
Octet(s)	**Description**	**Value (all numbers are hexadecimal)**
1-6	Destination MAC Address	00 22 22 22 22 22
7-12	Source MAC Address	00 00 22 22 22 22
-	VLAN Tag Header	None
13 - 1996	Data	Pseudo-random Data Pattern
1997 - 2000	Frame Check Sequence	Calculated at runtime

Jumbo_Dest44		
Octet(s)	**Description**	**Value (all numbers are hexadecimal)**
1-6	Destination MAC Address	00 44 44 44 44 44
7-12	Source MAC Address	00 00 44 44 44 44
-	VLAN Tag Header	None
13 - 3996	Data	Pseudo-random Data Pattern
3997 - 4000	Frame Check Sequence	Calculated at runtime

Jumbo_Dest66		
Octet(s)	**Description**	**Value (all numbers are hexadecimal)**
1-6	Destination MAC Address	00 66 66 66 66 66
7-12	Source MAC Address	00 00 66 66 66 66
-	VLAN Tag Header	None
13 - 5996	Data	Pseudo-random Data Pattern
5997 - 6000	Frame Check Sequence	Calculated at runtime

Jumbo_Dest88		
Octet(s)	**Description**	**Value (all numbers are hexadecimal)**
1-6	Destination MAC Address	00 88 88 88 88 88
7-12	Source MAC Address	00 00 88 88 88 88
-	VLAN Tag Header	None
13 - 7996	Data	Pseudo-random Data Pattern
7997 - 8000	Frame Check Sequence	Calculated at runtime

Jumbo_Src_Tag22		
Octet(s)	**Description**	**Value (all numbers are hexadecimal)**
1-6	Destination MAC Address	00 22 22 22 22 00
7-12	Source MAC Address	00 22 22 22 22 22
13 - 16	VLAN Tag Header	VID = 10, Priority = 0
17 - 1996	Data	Pseudo-random Data Pattern
1997 - 2000	Frame Check Sequence	Calculated at runtime

Jumbo_Src_Tag44		
Octet(s)	**Description**	**Value (all numbers are hexadecimal)**
1-6	Destination MAC Address	00 44 44 44 44 00
7-12	Source MAC Address	00 44 44 44 44 44
13 - 16	VLAN Tag Header	VID = 1, Priority = 0
17 - 3996	Data	Pseudo-random Data Pattern
3997 - 4000	Frame Check Sequence	Calculated at runtime

Jumbo_Dest_Tag22		
Octet(s)	**Description**	**Value (all numbers are hexadecimal)**
1-6	Destination MAC Address	00 22 22 22 22 22
7-12	Source MAC Address	00 00 22 22 22 22
13 - 16	VLAN Tag Header	VID = 10, Priority = 0
17 - 1996	Data	Pseudo-random Data Pattern
1997 - 2000	Frame Check Sequence	Calculated at runtime

Jumbo_Dest_Tag44		
Octet(s)	**Description**	**Value (all numbers are hexadecimal)**
1-6	Destination MAC Address	00 44 44 44 44 44
7-12	Source MAC Address	00 00 44 44 44 44
13 - 16	VLAN Tag Header	VID = 1, Priority = 0
17 - 3996	Data	Pseudo-random Data Pattern
3997 - 4000	Frame Check Sequence	Calculated at runtime

Jumbo_Dest_Tag66		
Octet(s)	**Description**	**Value (all numbers are hexadecimal)**
1-6	Destination MAC Address	00 66 66 66 66 66
7-12	Source MAC Address	00 00 66 66 66 66
13 - 16	VLAN Tag Header	VID = 10, Priority = 0
17 - 5996	Data	Pseudo-random Data Pattern
5997 - 6000	Frame Check Sequence	Calculated at runtime

All frames must contain a valid FCS.