



## **Technical Specification**

### **MEF 18**

# **Abstract Test Suite for Circuit Emulation Services over Ethernet based on MEF 8**

**May 2007**

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# 1. Abstract

This document describes a set of test procedures for evaluating the conformance of equipment for delivering Circuit Emulation Services over Ethernet (CESoETH) to the MEF 8 Implementation Agreement.

# 2. Terminology

This document uses the terms defined in MEF8, plus the following additional terms:

Term	Definition
DUT	Device Under Test
MRTIE	Maximum Relative Time Interval Error
PRBS	Pseudo-Random Binary Sequence

Table 2-1: Terms and Abbreviations

# 3. Scope

The scope of this document is limited to the description of testing procedures for pass/fail assessment of conformance with each of the operating modes in MEF 8. Conformance with MEF 8 should be viewed as a pre-requisite for any interoperability testing. This document does not cover either interoperability tests or performance evaluation.

# 4. Compliance Levels

The key words “**MUST**”, “**MUST NOT**”, “**REQUIRED**”, “**SHALL**”, “**SHALL NOT**”, “**SHOULD**”, “**SHOULD NOT**”, “**RECOMMENDED**”, “**MAY**”, and “**OPTIONAL**” in this document are to be interpreted as described in [RFC 2119]. All key words must be used in upper case, bold text.

The following convention is used to identify tests:

<doc reference>.Rn-Rp (e.g. MEF8.R1-R3) Test covers all requirements from Rn to Rp inclusive

<doc reference>.Rn,Rp (e.g. MEF8.R1,R3) Test covers only the requirements Rn and Rp, not those in-between

## 5. Testing Framework

### 5.1 MEF 8 CONFORMANCE

MEF 8 describes several operating modes for the implementation of CESoETH. Figure 5-1 shows these modes using a tree diagram (section numbers given are from MEF 8). Only one mode is mandatory to claim conformance with MEF 8, structure-agnostic emulation using a raw (i.e. non-octet-aligned) encapsulation. Several optional operating modes are described in MEF 8, e.g. structure-aware emulation modes, and different signaling types.

Within each operating mode, a number of requirements are defined. Some of these requirements are mandatory (as indicated by the key words “MUST” or “SHALL”), and some are optional (as indicated by the key words “SHOULD”, “MAY” or “OPTIONAL”). There are three categories of requirements for MEF8 compliance:

- **Mandatory** – the mandatory requirements for the mandatory structure-agnostic emulation mode. These requirements must be met to claim MEF 8 conformance.
- **Dependent** – the mandatory requirements for the optional modes. These requirements must be met to claim MEF 8 conformance for those optional modes (i.e. their status is *dependent* on whether the relevant operating mode is supported).
- **Optional** – these requirements describe permitted options. These requirements do not have to be met to claim MEF 8 conformance.

Table 8-1 in section 8 lists each of the MEF 8 requirements, together with its category and the reference of the test used to verify it. This specification defines tests for all the mandatory requirements in section 6, and dependent requirements in section 7.

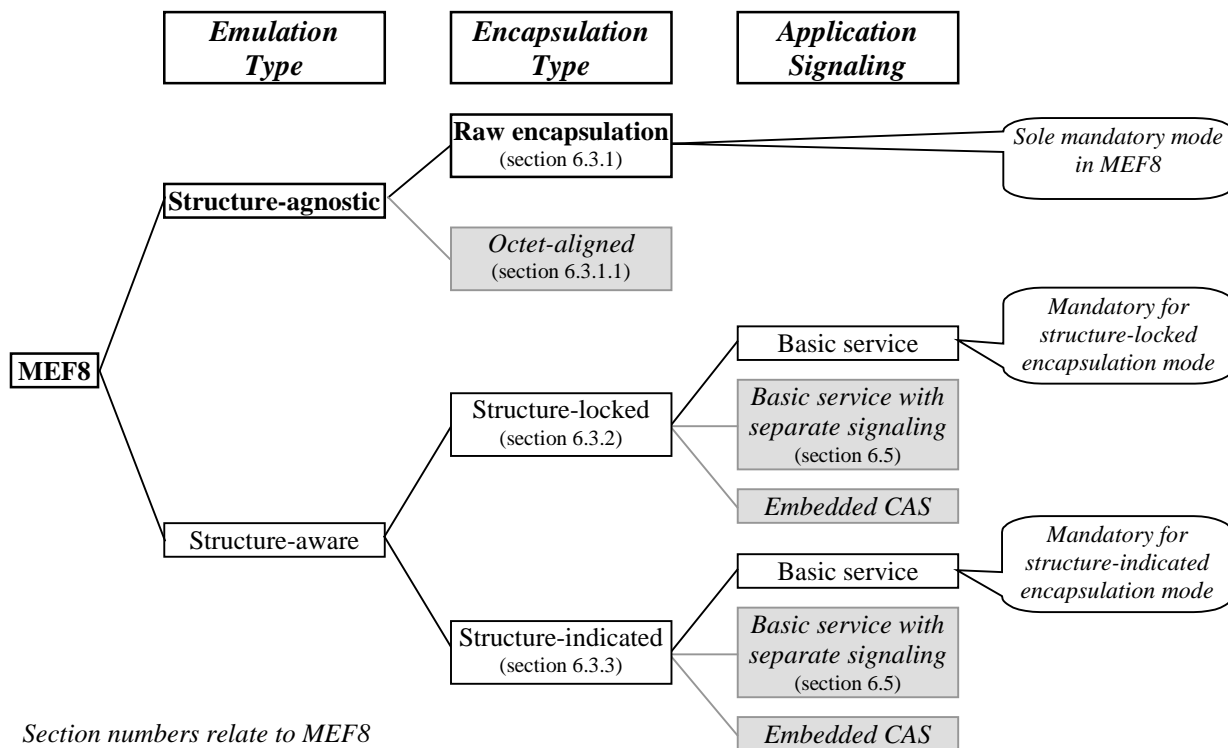


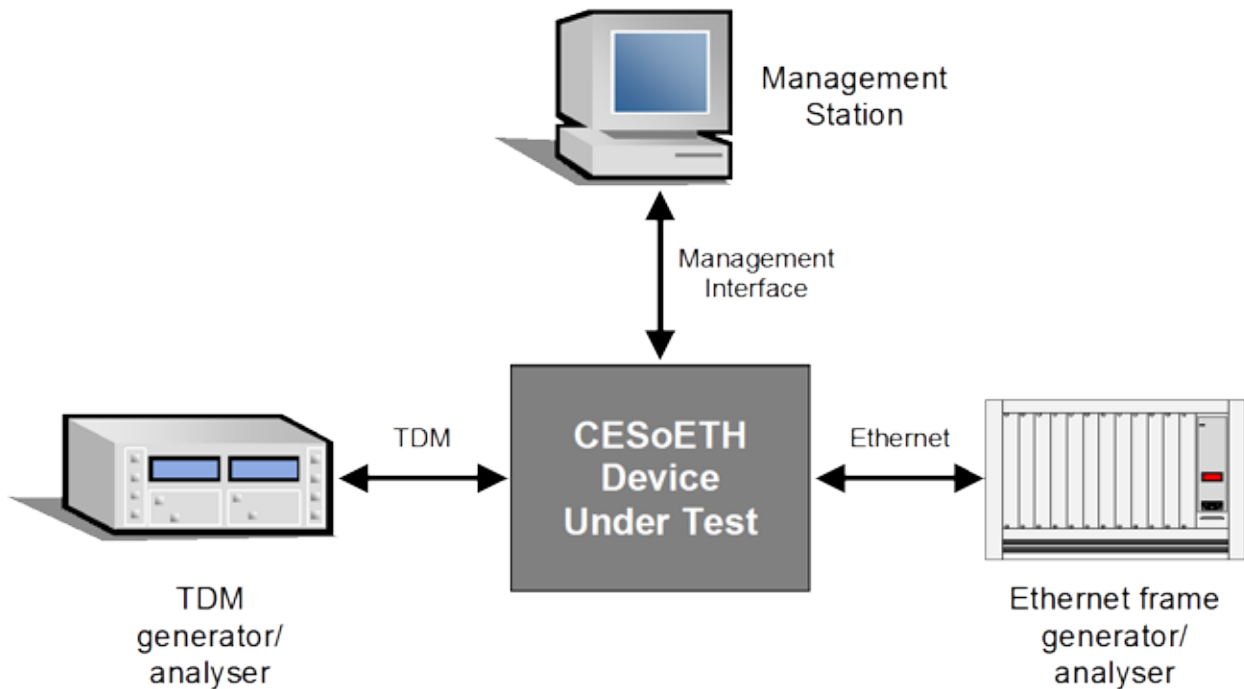
Figure 5-1: MEF8 Operating Modes

## 5.2 GENERIC TEST BEDS

The majority of tests will use one of the two following generic test beds. Some tests will require extra facilities, and these are described alongside the relevant tests. Note that the device under test may be provided by multiple pieces of equipment, provided the necessary functions and interfaces are provided.

### 5.2.1 Test Bed 1

The first generic test bed consists of equipment for generating and receiving TDM services (e.g. DS1, E1, DS3 or E3 circuits), the device under test, equipment for examining the content of Ethernet frames, and equipment for generating Ethernet frames with specific contents. The device under test is controlled by a management station. This is connected to the device via a management interface. The nature of this interface will be specific to the device under test.



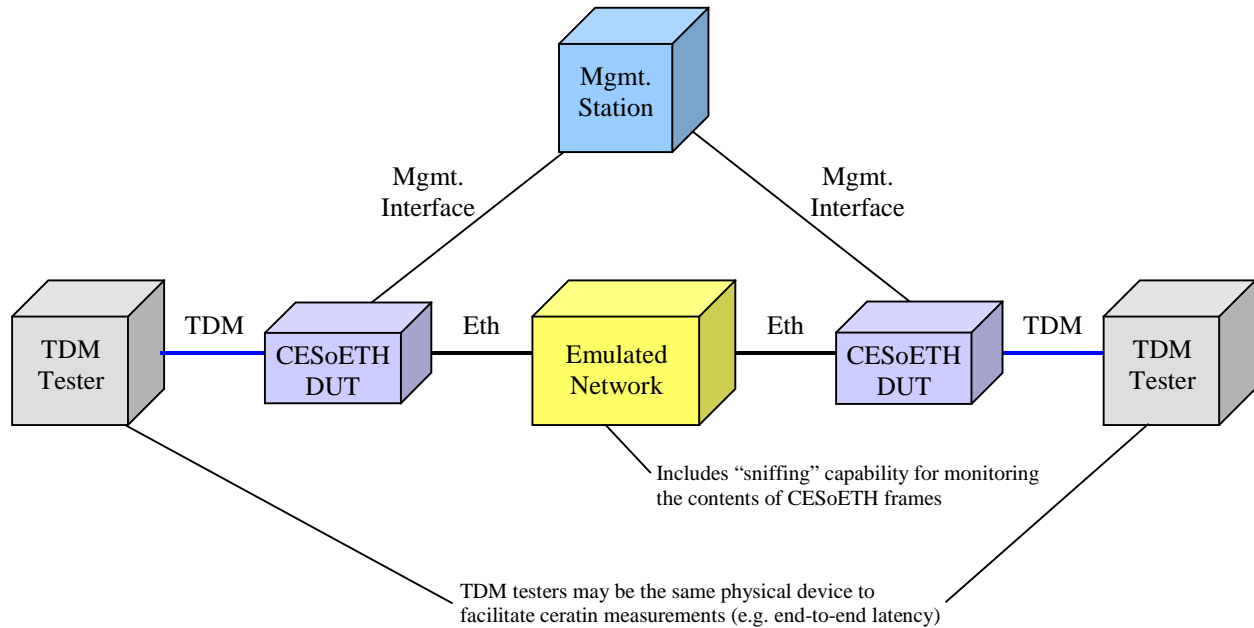
**Figure 5-2: Generic Test Bed 1**

The generic test procedure will be to set up the device under test and the test equipment, then either:

- a. Generate a TDM circuit using the TDM generator, and apply to the device under test. Examine the contents of the resulting Ethernet frames containing the TDM data using the Ethernet frame analyser. Verify that the format and contents are correct.  
If relevant to the particular test, use the management station to verify that the correct alarms have been reported, and that the statistics recorded are correct.
- b. Generate a stream of Ethernet frames using the frame generator, and apply to the device under test. Examine the resulting TDM stream using the TDM analyser. Verify that the format and contents are correct.  
If relevant to the particular test, use the management station to verify that the correct alarms have been reported, and that the statistics recorded are correct.

**5.2.2 Test Bed 2**

The second generic test bed consists of equipment for generating and receiving TDM services (e.g. DS1, E1, DS3 or E3 circuits), two identical devices to be tested, and equipment representing an Ethernet network. The devices under test are controlled by a management station, connected via a management interface. The nature of this interface will be specific to the device under test.



**Figure 5-3: Generic Test Bed 2**

The generic test procedure will be to set up the devices under test and the test equipment, and then generate a TDM circuit using the TDM generator, and apply to the first device under test. Ethernet frames generated by this device are passed through the emulated network to the second device under test. This recreates the TDM stream, which is passed to a TDM tester for analysis. In practice, the two TDM testers shown may actually be the same device, facilitating error checking of the data or measurements such as end-to-end TDM latency.

Note that the function and nature of the emulated network may vary according to the test being conducted. For example, in test case 6 it takes the form of an actual network of Ethernet switches (as described in Appendix VI of G.8261). In many of the tests, the emulated network simply needs to have the capability to act as an Ethernet “sniffer”, monitoring the contents of the stream of Ethernet frames flowing between the two DUTs without modifying or impairing the stream. Lastly, some tests also require the ability to impair the stream in the following ways, and these tests may require a “network emulator” box:

- Delay frames by a variable amount
- Delete frames
- Re-order frames
- Duplicate frames
- Insert spurious frames
- Insert data errors

The descriptions of each test describe how the emulated network should be configured and behave for the correct operation of the test.



## 6. Tests for Mandatory Requirements

### 6.1 ENCAPSULATION LAYERS

This section describes the testing of the encapsulation layers, as described in MEF 8, Section 6.2. It covers requirements R1 to R29.

#### 6.1.1 Emulated Circuit Identifier and Frame Sequencing

ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT	
Test Name	<b>Test Case 1:</b> Emulated Circuit Identifier and Sequencing
Test Definition ID	MEF8.R1,R17-R18
Reference document	MEF 8
Test Type	Conformance
Test Status	Mandatory
Requirement Description	<p>R1. Each TDM-bound IWF at a given MAC address <b>MUST</b> have a unique ECID value.</p> <p>R17. The SN field <b>MUST</b> be incremented by one for every CESoETH frame transmitted into the MEN with the same ECID value, including those frames that are fragments of multiframe structures.</p> <p>R18. The initial value of the SN field on setup of an emulated circuit <b>SHALL</b> be random.</p>
Test Object	Determine that the attached device operates with a valid ECID attribute and sequencing function.
Test-Bed Configuration	Generic Test Bed 1, with at least one CESoETH IWF connected at the MEF UNI. Each IWF is configured for Structure-Agnostic emulation of E1, DS1, E3 or DS3.
Test Procedure	<p>TDM testers generate circuits for emulation by the CESoETH IWFs.</p> <p>Ethernet Tester monitors the CESoETH service frames at the ingress UNI, and used to verify that data frames associated with the same CES flow use the same destination MAC address, have the correct CESoETH Ethertype, have the proper ECID attribute, and that the sequence number increments correctly every frame.</p> <p>Where multiple CESoETH IWFs are connected (e.g. in the case of a DUT that is capable of emulating several TDM circuits simultaneously), the Ethernet tester must also verify that the number of different ECID's received from the tested CESoETH device is equal to the number of CESoETH IWFs connected at the MEF UNI.</p> <p>Each IWF must be torn down and re-established several times, to verify that the initial value of the sequence number is random.</p>
Units	Value of Sequence Number
Variables	Multiple CESoETH IWFs per DUT
Results	Pass or Fail
Remarks	

### 6.1.2 CESoETH control word

<b>ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT</b>	
Test Name	<b>Test Case 2: 'R' bit of the CESoETH Control Word and its Usage</b>
Test Definition ID	MEF8.R4-R7
Reference document	MEF 8
Test Type	Conformance
Test Status	Mandatory
Requirement Description	<p>R4. A TDM-bound IWF SHALL enter a Loss of Frames State (LOFS) following detection of a locally preconfigured number of consecutive lost (including late frames that are discarded) CESoETH frames.</p> <p>R5. A TDM-bound IWF SHALL exit the Loss of Frames State (LOFS) following reception of a locally preconfigured number of consecutive CESoETH frames.</p> <p>R6. An MEN-bound IWF SHALL set the 'R' bit to 1 on all frames transmitted into the MEN while its local TDM-bound IWF is in the Loss of Frames State (LOFS). The 'R' bit SHALL be cleared at all other times.</p> <p>R7. On detection of a change in state of the 'R' bit in incoming CESoETH frames, a TDM-bound IWF MUST report it to the local management entity.</p>
Test Object	Verify that the CESoETH IWF device sets the 'R' bit to 1 on frames transmitted into the MEN while its local TDM-bound IWF is in the Loss of Frames State (LOFS). Verify that the CESoETH IWF device sets the 'R' bit to 0 at all other times.
Test-Bed Configuration	Generic Test Bed 2 as shown in Figure 5-3. Network emulator required. Each IWF is configured for Structure-Agnostic emulation of E1, DS1, E3 or DS3.
Test Procedure	<p>Valid CESoETH flow set up in both directions between the two CESoETH IWFs (known as the "left" and "right" IWFs for the purposes of this test). Verify that frames received back from both IWFs are valid, and contain 'R'=0.</p> <p>Network emulator is used to stop traffic flow in the left-to-right direction for a period larger than the pre-configured number of consecutive frames defined in R4. Verify that the frames received back from the right-hand IWF have the 'R' bit set to 1. Verify that the management station for the left-hand IWF correctly reports the 'R' bit being set in frames received.</p> <p>Network emulator re-enables the traffic flow in the left-to-right direction for a period larger than the pre-configured number of consecutive frames defined in R5. Verify that the frames received back from the DUT now have the 'R' bit cleared again. Verify that the management station for the left-hand IWF correctly reports the 'R' bit being cleared again in frames received.</p> <p>Test repeated using different threshold numbers for R4 and R5, and blocking frames in the right-to-left direction.</p>
Units	N/A
Variables	Number of consecutive frames before R flag is set. Number of consecutive frames before R flag is cleared.
Results	Pass or Fail
Remarks	

ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT	
Test Name	<b>Test Case 3: 'L' bit and 'M' bits of the CESoETH Control Word and their Usage</b>
Test Definition ID	MEF8.R8,R10,R14
Reference document	MEF 8
Test Type	Conformance
Test Status	Mandatory
Requirement Description	<p>R8. For structure-agnostic emulation, an MEN-bound IWF MUST set the 'L' bit to one when loss of signal (LOS) is detected on the TDM service interface.</p> <p>R10. An MEN-bound IWF MUST clear the 'L' bit as soon as the defect condition is rectified.</p> <p>R14. A CES IWF (of either direction) MUST correctly support the conditions described for which the value of the 'M' field equals "00". Support for any other condition is OPTIONAL.</p>
Test Object	Verify that the CESoETH IWF device sets the 'L' bit to 1 and 'M' bits to "00" on frames transmitted into the MEN while LOS is detected on the TDM service interface. Verify that the CESoETH IWF device sets the 'L' bit to 0 at all other times.
Test-Bed Configuration	Generic Test Bed 1 as shown in Figure 5-2. Each IWF is configured for Structure-Agnostic emulation of E1, DS1, E3 or DS3.
Test Procedure	<p>TDM tester generates a circuit for emulation by the DUT. Ethernet tester used to verify that the CESoETH frames generated by the DUT are correctly formed with the L bit and M bits clear.</p> <p>TDM tester generates LOS on the TDM circuit. Ethernet tester used to verify that the CESoETH frames generated by the DUT now have the L bit set. The M bits should still be clear.</p> <p>TDM tester clears LOS fault, and generates a valid circuit again. Ethernet tester used to verify that the CESoETH frames generated by the DUT now have the L bit cleared again. The M bits should also still be clear.</p>
Units	N/A
Variables	LOS condition of TDM circuit.
Results	Pass or Fail
Remarks	

<b>ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT</b>	
Test Name	<b>Test Case 4: ‘L’ bit and ‘M’ bits of the CESoETH Control Word and their Usage</b>
Test Definition ID	MEF8.R16
Reference document	MEF 8
Test Type	Conformance
Test Status	Mandatory
Requirement Description	R16. A TDM-bound IWF MUST silently discard a CESoETH frame where the ‘M’ field is set to a value it does not support.
Test Object	Verify that the CESoETH device correctly discards frames where the ‘M’ field is set to a value it doesn’t support..
Test-Bed Configuration	Generic Test Bed 1 as shown in Figure 5-2. Each IWF is configured for Structure-Agnostic emulation of E1, DS1, E3 or DS3.
Test Procedure	<p>Ethernet tester generates CESoETH frames with the L and M bits cleared. TDM tester verifies that the circuit is correctly generated.</p> <p>Ethernet tester changes the value of the L and M bits to each of the combinations specified in MEF 8, Table 6-1. For all values other than M=00, the CESoETH frames should be discarded, and replacement data generated according to MEF 8 R67. Note that this is easier to observe if the IWF is configured to generate AIS, as in MEF8 R12a and R68a.</p> <p>Note that RDI is a structure-aware condition, therefore frames with the combination L=0, M=10 should be discarded. Frames containing non-TDM data do not contribute to the TDM output, therefore frames containing L=0, M=11 should also be discarded.</p>
Units	N/A
Variables	Values of L and M bits in the CESoETH control word.
Results	Pass or Fail
Remarks	

## 6.2 PAYLOAD FORMAT

This section describes the testing of the payload format, as described in MEF 8, Section 6.3. It covers requirements R30 to R46.

### 6.2.1 Structure Agnostic Emulation

ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT	
Test Name	Test Case 5: Structure Agnostic Emulation
Test Definition ID	MEF8.R30-R31
Reference document	MEF 8
Test Type	Conformance
Test Status	Mandatory
Requirement Description	<p>R30. A CES IWF <b>MUST</b> support structure-agnostic emulation, as defined in section 6.3.1 of MEF8. The use of the octet-aligned payload format for DS1, or either of the structure-aware encapsulation formats is <b>OPTIONAL</b>.</p> <p>R31. CESoETH implementations <b>MUST</b> support at least the following TDM payload sizes where the indicated services are offered:</p> <ul style="list-style-type: none"> <li>a. E1: 256 octets</li> <li>b. DS1: 192 octets</li> <li>c. E3: 1024 octets</li> <li>d. DS3: 1024 octets.</li> </ul> <p>The use of any other TDM payload size is <b>OPTIONAL</b>.</p> <p>Additional requirements from Y1413:</p> <ul style="list-style-type: none"> <li>· The number of octets shall be the same in both directions, and shall remain unchanged for the lifespan of the connection of the TFM data</li> </ul>
Test Object	Determine that the attached device operates with structure agnostic emulation using the defined default payload sizes.
Test-Bed Configuration	<p>Generic Test Bed 2 as shown in Figure 5-3. Ethernet sniffer required to monitor CESoETH frames.</p> <p>CESoETH IWFs configured to support Structure-Agnostic emulation of E1, DS1, E3 and/or DS3 circuits, with the default payload size as defined in R31.</p>

Test Procedure	<p>TDM testers generate framed or unframed TDM circuit for emulation by the CESoETH IWFs. Circuits to contain a standard <math>2^{20}-1</math> PRBS pattern<sup>1</sup> (as defined in O.150) to enable data integrity verification.</p> <p>Ethernet sniffer is used to monitor the CESoETH service frames flowing in both directions, allowing verification that data frames contain the correct number of octets as defined in R31 for both directions, and that the number of octets in payload does not change for the whole test sequence.</p> <p>TDM testers check the received PRBS pattern to verify correct payload transport from end-to-end in both directions. Since this is a “clean” laboratory environment with no impairments applied, there should be zero bit errors detected over a test lasting between ten and thirty minutes.</p> <p>Repeat for different circuit types as appropriate for DUTs.</p>
Units	<p>Payload size in octets</p> <p>Bit Error Rate expressed as number of errored bits received/total number of bits received</p>
Variables	Type of TDM circuit (framed, unframed, DS1, E1, DS3, E3)
Results	Pass or Fail
Remarks	

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<sup>1</sup> The PRBS sequence length was chosen to be much larger than the packet length (2048 bits for a standard E1 circuit, 8192 bits for E3 or DS3).  $2^{20}-1$  is often used for error rate testing in PDH circuits, and is at least 128 times longer than the longest packet. However it is short enough to allow the test procedure to be carried out in a reasonable time frame, without waiting too long for the test analyzer to lock onto the sequence.

### 6.3 SYNCHRONISATION

This section describes the testing of the synchronisation requirements, as described in MEF 8, Section 6.4. It covers requirements R47 and R48.

ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT	
Test Name	<b>Test Case 6:</b> Synchronization Test
Test Definition ID	MEF8.R47-R48
Reference document	MEF 8
Test Type	Conformance
Test Status	Mandatory
Requirement Description	<p>R47. The method of synchronization used <b>MUST</b> be such that the TDM-bound IWF meets the traffic interface requirements specified in ITU-T recommendations [G.823] for E1 and E3 circuits, and [G.824] for DS1 and DS3 circuits. <sup>1</sup></p> <p>R48. Jitter and wander that can be tolerated at the MEN-bound IWF TDM input <b>MUST</b> meet the traffic interface requirements specified in ITU-T recommendations [G.823] for E1 and E3 circuits, and [G.824] for DS1 and DS3 circuits.</p>
Test Object	Determine that the relevant clock quality standards are met when the device is operated over a test network.
Test-Bed Configuration	<p>Uses the test bed described in [G.8261], Appendix VI.2.2 (Figure VI.4), with the CESoETH IWFs configured for structure-agnostic emulation of DS1, E1, DS3 or E3 circuits as appropriate.</p> <p>All tests to be conducted with devices configured in adaptive timing mode.</p> <p>Use of the incoming TDM clock or an external reference is not tested, since the clock quality depends entirely on the quality of the supplied clock, not the device action.</p> <p>Use of a free-run timing is also not tested, since it is not locked to the source, and therefore key parameters such as MRTIE do not apply.</p>

<sup>1</sup> Since MEF8 was introduced in 2004, ITU-T recommendation G.8261 has been released (May 2006), specifying tighter limits for the network wander allowed in circuit emulated segments of a TDM transmission path. However, until MEF8 is formally changed, these tighter limits cannot be used for determining compliance with MEF8.

Test Procedure	<p>Follow selected test procedures as defined in [G.8261], Appendix VI.2, using Network Traffic Model 2 only (see section VI.2.2.1.2 of G.8261 - this is closer to the expected traffic mix in a general Metro Ethernet Network).</p> <p>For each test, verify that the MRTIE (or MTIE as appropriate) is within G.823/G.824 traffic interface mask over duration of tests.<sup>1</sup></p> <p><b>Test Case 6a: Static Load Test/Sudden Changes in Network Load</b></p> <p>Follow Test Case 2 defined in section V1.2.2.3 of G.8261, using Network Traffic Model 2. Note that this will also cover the “Static Load Test” defined in Test Case 1 (section VI.2.2.2 of G.8261)</p> <p><b>Test Case 6b: Slow Variation of Network Load</b></p> <p>Follow Test Case 3 defined in section V1.2.2.4 of G.8261, using Network Traffic Model 2.</p> <p><b>Test Case 6c: Temporary Network Outages</b></p> <p>Follow Test Case 4 defined in section V1.2.2.5 of G.8261, using Network Traffic Model 2, with network interruptions of 10 and 100s. This test should be repeated 10 times to verify that the results are consistent.</p> <p><b>Test Case 6d: Temporary Congestion</b></p> <p>Follow Test Case 5 defined in section V1.2.2.6 of G.8261, using Network Traffic Model 2, with network congestion periods of 10 and 100s. This test should be repeated 10 times to verify that the results are consistent.</p> <p><b>Test Case 6e: Routing Changes</b></p> <p>Follow Test Case 6 defined in section V1.2.2.7 of G.8261, using Network Traffic Model 2.</p> <p><b>Test Case 6f: Wander tolerance</b></p> <p>Using the same network configuration as the previous tests but with no network load, apply maximum input jitter and wander, as specified in G.823/G.824 to verify input jitter and wander tolerance.</p> <p>A standard <math>2^{20}-1</math> PRBS pattern (as defined in O.150) should be applied end-to-end during the wander tolerance test to check data integrity (i.e. slips or bit errors) as stated in G.823/G.824.</p>
Units	MTIE measurement in ms. Jitter measurement in ns.
Variables	Type of circuit (DS1, E1, DS3 or E3) as supported by DUT.
Results	Pass or Fail
Remarks	

<sup>1</sup> The tests should also verify compliance with the G.8261 masks for completeness, although these limits cannot be used for determining compliance to MEF8.



## 6.4 DEFECTS, PERFORMANCE MONITORING AND MANAGEMENT

This section describes the testing of Defect behavior, performance monitoring and management statistics, as described in MEF 8, Sections 6.6, 6.7 and 9. It covers requirements R57 to R84, R87 and R88.

### 6.4.1 Misconnection

ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT	
Test Name	<b>Test Case 7:</b> Effect of Stray Frames.
Test Definition ID	MEF8.R57,R60
Reference document	MEF 8
Test Type	Conformance
Test Status	Mandatory
Requirement Description	R57. The CES IWF <b>MUST</b> only accept frames that contain the correct Ethernet destination address field and ECID value for that IWF.  R60. When a stray frame <sup>1</sup> is detected by a Circuit Emulation Inter-working Function (CES IWF), it <b>MUST</b> be discarded.
Test Object	Verify that only genuine CESoETH frames are accepted by the CES IWF, and that all “stray frames” are discarded.
Test-Bed Configuration	Generic Test Bed 2 as shown in Figure 5-3. Network emulator must have the ability to inject stray frames into the data stream (it could be replaced by a CESoETH frame generator and L2 switch if preferred).  Configure the CESoETH IWFs for structure-agnostic emulation of DS1, E1, DS3 or E3 circuits, and the TDM tester to generate a standard 2 <sup>20</sup> -1 PRBS sequence (as defined in O.150).
Test Procedure	TDM tester generates a PRBS sequence to verify data integrity throughout the test. Network emulator injects stray frames into the Ethernet data stream containing a known data pattern (e.g. all-ones, alternating one/zero, all-zeroes).  If IWF accepts a stray frame, this will cause bit errors in the TDM output which will be detected by the TDM tester. If no errors are detected in the TDM output, all stray frames must have been detected and discarded.  If the IWF supports a count of stray frames detected (not a mandatory feature in MEF8), this should be compared against the number of stray frames generated by the network emulator.
Units	Number of stray frames detected, Bit Error Rate expressed as number of errored bits received/total number of bits received
Variables	
Results	Pass or Fail.
Remarks	

<sup>1</sup> A CESoETH frame where the source and/or destination MAC addresses do not agree with the values expected for that ECID.

<b>ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT</b>	
Test Name	<b>Test Case 8:</b> Verification of lost frame detection in the presence of stray frames
Test Definition ID	MEF8.R63
Reference document	MEF 8
Test Type	Conformance
Test Status	Mandatory
Requirement Description	R63. The mechanisms for detection of lost frames (e.g. expected next sequence number) <b>MUST NOT</b> be affected by reception of stray frames.
Test Object	Verify that the mechanisms for detection of lost frames are not affected by reception of stray frames.
Test-Bed Configuration	Generic Test Bed 2 as shown in Figure 5-3. Network emulator must have the ability to corrupt the source and destination addresses of Ethernet frames.  Configure the CESoETH IWFs for structure-agnostic emulation of DS1, E1, DS3 or E3 circuits and the TDM tester to generate a standard $2^{20}-1$ PRBS sequence (as defined in O.150).
Test Procedure	TDM tester generates a circuit for emulation by the DUTs. Network emulator is initially set to forward the frames with minimal delay and no frame loss. Establish that the circuit is working correctly with no data loss.  Set network emulator to corrupt the source and destination address of a known number of individual frames (must take care that the Ethernet FCS is re-calculated, to avoid the corrupted frame being dropped because of an invalid FCS). This creates a stray frame, but also has the effect of dropping a frame from the normal sequence in the same place. This is the condition that R63 of MEF8 is intended to address, where a stray frame could mask detection of a lost frame.  Verify that these corrupted frames are detected and dropped, creating a burst of bit errors in the TDM data. If the DUT supports a count of lost CESoETH frames, verify that the number of lost frames is equal to the number of frames corrupted by the network emulator.  Repeat the test, with the network emulator corrupting short bursts of frames (e.g. 2, 3, 10, 30, 50).
Units	Number of lost frames detected, Number of stray frames detected, Bit Error Rate expressed as number of errored bits received/total number of bits received
Variables	
Results	Pass or Fail.
Remarks	

ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT	
Test Name	<b>Test Case 9:</b> Verification of discarding of out-of-sequence CESoETH frames
Test Definition ID	MEF8.R66
Reference document	MEF 8
Test Type	Conformance
Test Status	Mandatory
Requirement Description	R66. Out-of-sequence CESoETH frames that cannot be re-ordered <b>MUST</b> be discarded, and considered as lost.
Test Object	Verify that CES IWF discards the out-of-sequence frame and recognizes it as being a frame loss.
Test-Bed Configuration	Generic Test Bed 2 as shown in Figure 5-3. Network emulator must have the ability to delay and re-order specific frames.  Configure the CESoETH IWFs for structure-agnostic emulation of DS1, E1, DS3 or E3 circuits with a known jitter buffer size, and the TDM tester to generate a standard $2^{20}-1$ PRBS sequence (as defined in O.150).
Test Procedure	TDM tester generates a circuit for emulation by the DUTs. Network emulator is initially set to forward the frames with minimal delay and no frame loss. Establish that the circuit is working correctly with no data loss.  Set network emulator to delay individual frames by 1ms greater than the jitter buffer size, forcing them to be re-ordered because of the delay. All re-ordered frames should now be dropped, as indicated by bit errors in the TDM data.  Repeat the test, with the network emulator delaying short bursts of frames (e.g. 2, 3, 10).
Units	N/A
Variables	Delay of CESoETH frames.
Results	Pass or Fail.
Remarks	

<b>ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT</b>	
Test Name	<b>Test Case 10:</b> Compensation for Lost CESoETH Frames
Test Definition ID	MEF8.R67
Reference document	MEF 8
Test Type	Conformance
Test Status	Mandatory
Requirement Description	R67. If loss of one or more CESoETH frames is detected by the TDM-bound IWF, it <b>MUST</b> generate exactly one “replacement octet” for every lost octet of TDM data.
Test Object	If this requirement was not met, the effect would be a change in latency in the presence of Ethernet frame loss. Ultimately, this would cause underruns or overruns in the jitter buffer. Therefore the object of this test is to verify that the latency of the TDM circuit remains constant in the presence of Ethernet frame loss.
Test-Bed Configuration	Generic Test Bed 2 as shown in Figure 5-3. Network emulator is required, with the ability to drop Ethernet frames.  Configure the CESoETH IWFs for structure-agnostic emulation of DS1, E1, DS3 or E3 circuits, with externally-supplied timing, such that both IWFs are timed from the same clock.  Configure the TDM tester to measure end-to-end latency of the TDM circuit.
Test Procedure	TDM tester generates a circuit for emulation by the DUTs. Network emulator is initially set to forward the frames with minimal delay and no frame loss. Establish that the circuit is working correctly, and measure the latency of the TDM circuit from end to end.  Set the network emulator to drop 0.1% of frames. Verify that the end-to-end latency remains constant (to within a TDM bit period), even in the presence of packet loss.  Increase the percentage of dropped frames to 1%. Verify that the end-to-end latency still remains constant.  Increase the percentage of dropped frames to 5%. Verify that the end-to-end latency still remains constant.  Repeat test 10 times to prove that the results are consistent.
Units	N/A
Variables	% of dropped frames
Results	Pass or Fail.
Remarks	

### 6.4.2 Late Arriving Frames

The test for the mandatory requirement "R71. A CESoETH IWF MUST discard frames that arrive too late to be played out on the TDM interface" has been intentionally omitted from the Abstract Test suite, because of the fact that some decent implementations of IWF cannot pass tests that validate this requirement.

### 6.4.3 Jitter Buffer Overrun and Underrun Defects

ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT	
Test Name	<b>Test Case 11:</b> Detection of Jitter Buffer Overruns
Test Definition ID	MEF8.R78-R79
Reference document	MEF 8
Test Type	Conformance
Test Status	Mandatory
Requirement Description	R78. A CESoETH IWF MUST detect the Jitter Buffer Overrun conditions. R79. If a CESoETH frame arrives that cannot be stored in the jitter buffer due to a jitter buffer overrun condition, the TDM-bound IWF MUST discard the frame.
Test Object	Verify that a CESoETH IWF detects jitter buffer overruns, and discards the CESoETH frames accordingly.
Test-Bed Configuration	Generic Test Bed 1, as shown in Figure 5-2, with the TDM generator replaced by a loopback (TDM out connected to TDM in).  Configure the CESoETH IWFs for structure-agnostic emulation of DS1, E1, DS3 or E3 circuits, with a known maximum jitter buffer size.  Ethernet Frame Generator/Analyzer is required, with the following capabilities: <ul style="list-style-type: none"> <li>· to generate valid CES stream</li> <li>· analyze the received CES stream packets</li> </ul> <p>Note that it may not be possible to provide all these capabilities in a single piece of equipment, so this may need to be a composed of several separate items, e.g. an Ethernet frame generator, a network emulator and an Ethernet sniffer.</p>

<p>Test Procedure</p>	<p>See Remarks at the bottom of the table for some details/explanations.</p> <p>Ethernet Frame Generator produces a valid structure-agnostic CES stream with the normal payload size towards the DUT at a default frames rate. The payload of the CES stream should contain a predefined pattern (e.g. a 32 bits automatically incremented counter). The DUT will send back the payload received from the IWF due to the external TDM loopback.</p> <p>Ethernet Analyzer captures the received data, and verifies that it receives back the payload which was sent towards the DUT. This will establish that the DUT is working correctly, and that there is end-to-end transmission with no data loss.</p> <p>Ethernet Frame Generator should then increase the rate at which CES frames are sent (reduce the packetization latency) by the factor of <math>N</math>. Ethernet Analyzer shall establish that at some point of time (after the jitter buffer fills up entirely) the DUT starts to replace the payload of at least <math>\frac{N - 1}{N}</math> received packets. The DUT may play up to <math>\frac{1}{N}</math> of valid CES frames.</p> <p>The test shall be continued for a time period of at least 10 seconds.</p> <p>Repeat the test with different values of N.</p>
<p>Units</p>	<p>N/A</p>
<p>Variables</p>	<p>N=2, 3, 4, 5</p>
<p>Results</p>	<p>Pass or Fail.</p>
<p>Remarks</p>	<p>The Jitter Buffer Overrun condition occurs when the jitter buffer at the TDM-bound IWF cannot accommodate the newly arrived valid CESoETH frame in its entirety, e.g. due to insufficient storage space. For example, Jitter buffer overruns will happen if (due to delay variations or a Denial of Service Attack) the frames arrive at a rate higher than the rate at which the frames played out of the jitter buffer. This condition may be an indication that the jitter buffer is incorrectly configured, and either needs to be increased in size, or its “operating point” adjusted to accommodate these earlier packets.</p> <p>Therefore the procedure used to test the overrun behavior is to send CES frames at a rate higher than expected by IWF. The normal packetization for structure-agnostic CES (See MEF-8, R31) is 256 octets for E1, 192 octets for T1. Such frames therefore are sent at a rate 1000 per second (the packetization latency of such CES stream is 1 ms). When testing equipment increases the rate of CES frames sent to DUT, the jitter buffer can no longer accommodate all received frames and shall start dropping them.</p> <p>For example, if the frames arrive at the double of normal rate, the IFW will play the data out of the jitter buffer at a normal rate, so half of arrived packets shall be dropped. There may be vendor specific implementations which can try to bring the operating point back to the middle of the jitter buffer (i.e. recalibrate the jitter buffer). Such implementations may drop more than half of the arriving frames.</p>

<b>ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT</b>	
Test Name	<b>Test Case 12:</b> Verification of CESoETH implementation rule
Test Definition ID	MEF8.R83
Reference document	MEF 8
Test Type	Conformance
Test Status	Mandatory
Requirement Description	R83. CESoETH implementations supporting DS1 circuit using ESF framing <b>MUST NOT</b> change messages carried in the FDL (Facility Data Link), or insert new messages.
Test Object	Verify that CESoETH implementations do not change the messages carried in the facility data link which is the functionality in the ESF framing in the DS1 circuit.
Test-Bed Configuration	Generic Test Bed 2 as shown in Figure 5-3. No network emulator is required, merely a cable connecting the two DUTs directly.  Configure the CESoETH IWFs for structure-agnostic emulation of DS1 circuits.
Test Procedure	TDM tester generates DS1 signal using ESF framing for emulation by the DUTs. Establish that the TDM circuit is working correctly, and that there is end-to-end transmission with no data loss.  Configure the TDM tester to transmit specific, known messages in the FDL of the DS1 circuit. Verify that the messages in the FDL are forwarded correctly with no errors or data loss, and that no extra messages are inserted.
Units	N/A
Variables	
Results	Pass or Fail.
Remarks	

## 7. Tests for Dependent Requirements

There are several optional modes within MEF8, as indicated in Figure 5-1:

- Octet aligned payload for structure-agnostic emulation of DS1
- Structure-aware emulation using structure-locked formatting
- Structure-aware emulation using structure-indicated formatting
- Separate TDM application signaling

This section describes the tests required to verify these optional modes, should they be implemented.



## 7.1 TESTS FOR OCTET ALIGNED PAYLOAD OF DS1 CIRCUITS

ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT	
Test Name	<b>Test Case 13:</b> Octet Aligned Payload for Structure Agnostic Emulation of DS1 Circuits
Test Definition ID	MEF8.R32-R33
Reference document	MEF 8
Test Type	Conformance
Test Status	Dependent (Mandatory for Octet-Aligned Payload support)
Requirement Description	R32. The TDM-bound IWF MUST NOT assume any alignment with the underlying DS1 framing structure. R33. CESoETH implementations supporting octet aligned DS1 MUST support a TDM payload size of 200 octets (including padding).
Test Object	Determine that the attached device operates with octet aligned structure agnostic emulation using the defined default payload size.
Test-Bed Configuration	Generic Test Bed 2 as shown in Figure 5-3. Ethernet sniffer required to monitor CESoETH frames. CESoETH IWFs support the Octet-Aligned Payload option for Structure-Agnostic Encapsulation of DS1 circuits.
Test Procedure	TDM testers generate an unframed DS1 circuit to each IWF. Circuits to contain a standard 2 <sup>20</sup> -1 PRBS pattern (as defined in O.150) to enable data integrity verification. Ethernet sniffer is used to monitor the CESoETH service frames flowing in each direction to verify that: <ul style="list-style-type: none"> <li>· Payload size is 200 octets</li> <li>· Exactly one CESoETH frame is generated for every 193 octets of TDM input (i.e. exactly one frame generated every 1ms)</li> </ul> TDM testers check the received PRBS pattern to verify correct payload transport from end-to-end in both directions. Since this is a “clean” laboratory environment with no impairments applied, there should be zero bit errors detected over a test lasting between ten and thirty minutes. Test repeated several times using structured patterns with embedded framing information.
Units	Payload size in octets Bit Error Rate expressed as the number of errored bits received/total number of bits received
Variables	Framed and unframed patterns.
Results	Pass or Fail
Remarks	

## 7.2 TESTS FOR STRUCTURE-LOCKED ENCAPSULATION

ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT	
Test Name	<b>Test Case 14:</b> Structure Aware Emulation using Structure-Locked Encapsulation
Test Definition ID	MEF8.R34-R36,R39
Reference document	MEF 8
Test Type	Conformance
Test Status	Dependent (Mandatory for Structure-Locked Encapsulation support)
Requirement Description	<p>R34. The timeslots to be placed into the payload need not be contiguous, and the payload may contain any combination of timeslots from the TDM circuit.</p> <p>R35. The timeslots <b>MUST</b> be placed into the payload in the same order that they occur in the TDM circuit.</p> <p>R36. A CESoETH implementation supporting structure-locked encapsulation <b>MUST</b> support values of N from 1 to 24 (where the TDM circuit is DS1) or from 1 to 31 (where the TDM circuit is E1).</p> <p>R39. A CESoETH structure-locked implementation supporting N x 64kbit/s basic service <b>MUST</b> support the following set of configurable packetization latency values:</p> <ul style="list-style-type: none"> <li>a. For N = 5: 1 ms (with the corresponding TDM payload size of 8N octets)</li> <li>b. For N = 4: 4 ms (with the corresponding TDM payload size of 32N octets).</li> <li>c. For N = 1: 8 ms (with the corresponding TDM payload size of 64N octets).</li> </ul>
Test Object	Determine that the attached device operates with structure aware emulation using structure locked encapsulation using a variety of payload configurations.
Test-Bed Configuration	<p>Generic Test Bed 2 as shown in Figure 5-3. Ethernet sniffer required to monitor CESoETH frames.</p> <p>CESoETH IWFs configured for Structure-Locked Encapsulation of either DS1 or E1.</p>

Test Procedure	<p>TDM testers generate framed DS1 or E1 circuits to each IWF with a pattern allowing each timeslot to be uniquely identified (e.g. contain the timeslot number).</p> <p>Configure IWF for structure-locked encapsulation of N x 64kbit/s “basic service”. Configure with different numbers of timeslots in the CESoETH flow, and with default packetization latency as defined in MEF 8 R39. At least the following numbers of timeslots should be picked:</p> <ul style="list-style-type: none"> <li>• 1 timeslot (test for several different positions)</li> <li>• 2 timeslots (test for several different positions and combinations)</li> <li>• 4 timeslots (test for several different positions and combinations)</li> <li>• 5 timeslots (test for several different positions and combinations)</li> <li>• 24 timeslots (DS1) or 31 timeslots (E1)</li> <li>• Several values in between, using combinations of contiguous and non-contiguous timeslots</li> </ul> <p>Ethernet sniffer is used to monitor the CESoETH service frames in each direction, and is used to verify that:</p> <ul style="list-style-type: none"> <li>• The correct timeslots appear in the payload</li> <li>• The timeslots appear in the same order in the Ethernet payload as in the circuit</li> <li>• The CESoETH frames contain the correct payload length according to R39.</li> </ul> <p>Repeat using the other TDM circuit type if supported by the DUT.</p> <p>Repeat using a standard <math>2^{20}-1</math> PRBS pattern (as defined in O.150) in the TDM timeslots, to allow TDM testers to verify data integrity.</p>
Units	N/A
Variables	<p>Number of timeslots per frame, timeslot combinations.</p> <p>Input circuit type.</p> <p>PRBS pattern or timeslot identification.</p>
Results	Pass or Fail.
Remarks	

### 7.3 TESTS FOR STRUCTURE-INDICATED ENCAPSULATION

ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT	
Test Name	<b>Test Case 15:</b> Structure Aware Emulation using Structure-Indicated Encapsulation
Test Definition ID	MEF8.R45
Reference document	MEF 8
Test Type	Conformance
Test Status	Dependent (Mandatory for Structure-Indicated Encapsulation support)
Requirement Description	R45. All compliant implementations that support structure-indicated encapsulation for DS1 and E1 service <b>MUST</b> support 1 AAL1 PDU per frame, and <b>SHOULD</b> support from 2 to 8 AAL1 PDUs per frame.
Test Object	Determine that the attached device operates with structure-indicated encapsulation for DS1 and E1 service using the defined default payload size, and the recommended payload size range.
Test-Bed Configuration	Generic Test Bed 2 as shown in Figure 5-3. Ethernet sniffer required to monitor CESoETH frames.  CESoETH IWFs configured for Structure-Indicated Encapsulation of either DS1 or E1.
Test Procedure	<p>TDM testers generate framed DS1 or E1 circuits to each IWF with a pattern allowing each timeslot to be uniquely identified (e.g. contain the timeslot number).</p> <p>Configure IWF for structure-indicated encapsulation of N x 64kbit/s “basic service”. Configure with different numbers of timeslots in the CESoETH flow, and with one AAL1 PDU per CESoETH frame, as defined in MEF 8 R45. At least the following numbers of timeslots should be picked:</p> <ul style="list-style-type: none"> <li>· 1 timeslot (test for several different positions)</li> <li>· 24 timeslots (DS1) or 31 timeslots (E1)</li> <li>· Several values in between, using combinations of contiguous and non-contiguous timeslots</li> </ul> <p>Ethernet sniffer is used to monitor the CESoETH service frames in each direction, and is used to verify that</p> <ul style="list-style-type: none"> <li>· The correct timeslots appear in the payload</li> <li>· The CESoETH frames contain exactly one AAL1 PDU</li> </ul> <p>Repeat using the other TDM circuit type if supported by the DUT.</p> <p>Repeat using a standard <math>2^{20}-1</math> PRBS pattern (as defined in O.150) in the TDM timeslots, to allow TDM testers to verify data integrity.</p>
Units	N/A
Variables	Number of timeslots per frame, timeslot combinations. Input circuit type. PRBS pattern or timeslot identification.
Results	Pass or Fail
Remarks	

## 7.4 TDM APPLICATION SIGNALING

This section describes the testing of TDM Application Signaling, as described in MEF 8, Section 6.5. It covers requirements R49 to R56.

### 7.4.1 CE Signaling Frames

ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT	
Test Name	<b>Test Case 16:</b> Signaling Frame Format Requirements
Test Definition ID	MEF 8.R49-R51
Reference document	MEF 8
Test Type	Conformance
Test Status	Dependent (Mandatory for TDM Application Signaling support)
Requirement Description	<p>R49. CESoETH data frames and their associated signaling frames <b>MUST</b> have the same:</p> <ol style="list-style-type: none"> <li>a. Destination MAC address</li> <li>b. Ethertype</li> <li>c. Usage of the RTP header (i.e. either both use it or both do not use it)</li> </ol> <p>R50. CESoETH data frames and their associated signaling frames <b>MUST</b> use different ECID Values.</p> <p>R51. CESoETH data frames and their associated signaling frames <b>MUST</b> use a separate sequence number space.</p>
Test Object	Determine that signaling frames use the correct format related to the flow of CES data frames.
Test-Bed Configuration	Generic Test Bed 1 as shown in Figure 5-2. TDM Tester must be capable of generating CAS signaling events.
Test Procedure	<p>TDM Tester sets up a framed TDM circuit, and generates CAS signaling events at frequent intervals. CESoETH IWF is configured for structure-aware operation with generic TDM application signaling as described in MEF8 section 6.5.</p> <p>Ethernet Tester monitors the CESoETH service frames and verifies that both signaling and data frames associated with the same CES flow:</p> <ul style="list-style-type: none"> <li>· use the same destination MAC address</li> <li>· have the proper CESoETH Ethertype</li> <li>· use different ECID values</li> <li>· use different sequence number spaces</li> </ul>
Units	N/A
Variables	None
Results	Pass or Fail
Remarks	

**7.4.2 Channel associated Signaling (CAS) Frames**

<b>ABSTRACT TEST CASES FOR CESoETH IMPLEMENTATION AGREEMENT</b>	
Test Name	<b>Test Case 17: CAS Signaling Frame Format Requirements</b>
Test Definition ID	MEF 8.R53-R55
Reference document	MEF 8
Test Type	Conformance
Test Status	Dependent (Mandatory for TDM Application Signaling support)
Requirement Description	<p>R53. The payload of each signaling frame <b>MUST</b> comprise N 32-bit words (where N is the number of timeslots in the service).</p> <p>R54. The i-th word of the payload <b>MUST</b> contain the current “ABCD” value of the CAS signal corresponding to the i-th timeslot, and <b>MUST</b> be encoded in accordance with RFC 2833, section 3.14, table 6 (see figure below):</p> <div style="text-align: center;"> </div> <p>R55. Signaling frames <b>MUST</b> be sent three times at an interval of 5ms on any of the following events:</p> <ol style="list-style-type: none"> <li>a. Setup of the emulated circuit</li> <li>b. A change in the signaling state of the emulated circuit.</li> <li>c. Loss of Frames defect has been cleared</li> <li>d. Remote loss of Frames indication has been cleared</li> </ol>
Test Object	Determine that a correct number of 32-bit words is forming the CAS Signaling frames, according to the number of time-slots associated with the TDM-CAS flow.
Test-Bed Configuration	Generic Test bed 1 as shown in Figure 5-2. TDM Tester must be capable of generating CAS signaling events.

Test Procedure	<p>TDM Tester sets up a framed TDM circuit, and generates CAS signaling events at frequent intervals. CESoETH IWF is configured for structure-aware operation with generic TDM application signaling as described in MEF8 section 6.5.</p> <p>Ethernet Testers monitors the CESoETH service frames generated by the DUT, and generates a flow of CESoETH frames back to the and verifies that the CAS Signaling frames, associated with the same CES flow:</p> <ul style="list-style-type: none"> <li>· consists of exactly N 32-bit words, where N stands for the number of timeslots in the associated CESoETH service.</li> <li>· contains the correct ABCD code for the CAS signaling change just generated</li> <li>· are sent three times on each of the events listed in R55</li> </ul> <p>Test repeated several times with different signaling events on different timeslots. Also repeated with different values of N in the emulated circuit.</p>
Units	Number of valid frames
Variables	<p>Timeslots used for signaling events</p> <p>Type of signaling event</p> <p>Number of timeslots in emulated circuit (value of N)</p>
Results	Pass or Fail
Remarks	

## 8. Testing Summary

Requirement	Description	Level (mandatory/ dependent/ optional)	Test Case No.	Test reference	Comments
MEF8.R1	ECID attribute	Mandatory	1	MEF8.R1,R17-R18	
MEF8.R2	ECID reserved field – transmit	Optional		None	
MEF8.R3	ECID reserved field – reception	Optional		None	
MEF8.R4	LOF State entry	Mandatory	2	MEF8.R4-R7	
MEF8.R5	LOF State exit	Mandatory	2	MEF8.R4-R7	
MEF8.R6	R bit setting conditions	Mandatory	2	MEF8.R4-R7	
MEF8.R7	R bit change of state detection	Mandatory	2	MEF8.R4-R7	
MEF8.R8	L bit setting conditions	Mandatory	3	MEF8.R8,R10,R14	
MEF8.R9	L bit setting conditions	Optional		None	
MEF8.R10	L bit clearing conditions	Mandatory	3	MEF8.R8,R10,R14	
MEF8.R11	L bit payload suppression	Optional		None	
MEF8.R12	L bit reception actions	Optional		None	
MEF8.R13	L bit reception actions	Optional		None	
MEF8.R14	M field support	Mandatory	3	MEF8.R8,R10,R14	
MEF8.R15	M field support	Optional		None	Depends on DUT capability
MEF8.R16	M field reception	Mandatory	4	MEF8.R16	
MEF8.R17	Sequencing	Mandatory	1	MEF8.R1,R17-R18	
MEF8.R18	Sequencing	Mandatory	1	MEF8.R1,R17-R18	
MEF8.R19	RTP support	Optional		None	
MEF8.R20	RTP support	Optional		None	
MEF8.R21	RTP support	Optional		None	
MEF8.R22	RTP support	Optional		None	
MEF8.R23	RTP support	Optional		None	
MEF8.R24	RTP support	Optional		None	
MEF8.R25	RTP support	Optional		None	
MEF8.R26	RTP support	Optional		None	



Requirement	Description	Level (mandatory/ dependent/ optional)	Test Case No.	Test reference	Comments
MEF8.R27	RTP support	Optional		None	
MEF8.R28	RTP support	Optional		None	
MEF8.R29	RTP support	Optional		None	
MEF8.R30	Payload format	Mandatory	5	MEF8.R30-R31	
MEF8.R31	Default structure-agnostic payload sizes	Mandatory	5	MEF8.R30-R31	
MEF8.R32	Octet-aligned framing	Dependent	13	MEF8.R32-R33	Mandatory if being tested for compliance with octet-aligned payload
MEF8.R33	Octet-aligned framing	Dependent	13	MEF8.R32-R33	
MEF8.R34	Structure-locked encapsulation	Dependent	14	MEF8.R34-R36,R39	Mandatory if being tested for compliance with structure-locked encapsulation
MEF8.R35	Structure-locked encapsulation	Dependent	14	MEF8.R34-R36,R39	
MEF8.R36	Structure-locked encapsulation	Dependent	14	MEF8.R34-R36,R39	
MEF8.R37	Structure-locked encapsulation	Optional		None	
MEF8.R38	Structure-locked encapsulation	Optional		None	
MEF8.R39	Structure-locked encapsulation	Dependent	14	MEF8.R34-R36,R39	
MEF8.R40	Structure-locked with CAS	Optional		None	Support for trunk-specific CAS signaling is optional with structure-locked encapsulation.
MEF8.R41	Structure-locked with CAS	Optional		None	
MEF8.R42	Structure-locked with CAS	Optional		None	
MEF8.R43	Structure-locked with CAS	Optional		None	
MEF8.R44	Structure-locked with CAS	Optional		None	
MEF8.R45	Structure-indicated encap.	Dependent	15	MEF8.R45	
MEF8.R46	Structure-indicated encap.	Optional		None	
MEF8.R47	Synchronization	Mandatory	6a-e	MEF8.R47-R48	
MEF8.R48	Synchronization	Mandatory	6f	MEF8.R47-R48	

Requirement	Description	Level (mandatory/ dependent/ optional)	Test Case No.	Test reference	Comments
MEF8.R49	Generic TDM Signaling	Dependent	16	MEF8.R49-R51	Generic TDM Signaling is an optional means of carrying signaling (e.g. CAS) for structure-aware operation.
MEF8.R50	Generic TDM Signaling	Dependent	16	MEF8.R49-R51	
MEF8.R51	Generic TDM Signaling	Dependent	16	MEF8.R49-R51	
MEF8.R52	Generic TDM Signaling	Optional		None	
MEF8.R53	Generic TDM Signaling	Dependent	17	MEF8.R53-R55	
MEF8.R54	Generic TDM Signaling	Dependent	17	MEF8.R53-R55	
MEF8.R55	Generic TDM Signaling	Dependent	17	MEF8.R53-R55	
MEF8.R56	Generic TDM Signaling	Optional		None	
MEF8.R57	Misconnection Defect	Mandatory	7	MEF8.R57,R60	
MEF8.R58	Misconnection Defect	Optional		None	
MEF8.R59	Misconnection Defect	Optional		None	
MEF8.R60	Misconnection Defect	Mandatory	7	MEF8.R57,R60	
MEF8.R61	Misconnection Alarm	Optional		None	
MEF8.R62	Misconnection Alarm	Optional		None	
MEF8.R63	Lost frame detection	Mandatory	8	MEF8.R63	
MEF8.R64	Re-ordering	Optional		None	
MEF8.R65	Re-ordering	Optional		None	
MEF8.R66	Re-ordering	Mandatory	9	MEF8.R66	
MEF8.R67	Replacement data	Mandatory	10	MEF8.R67	
MEF8.R68	Replacement data	Optional		None	
MEF8.R69	Frame Loss Alarm	Optional		None	
MEF8.R70	Frame Loss Alarm	Optional		None	
MEF8.R71	Late Frames	Mandatory		None	See 6.4.2
MEF8.R72	Late Frames Alarm	Optional		None	
MEF8.R73	Late Frames Alarm	Optional		None	
MEF8.R74	Malformed Frames	Optional		None	
MEF8.R75	Malformed Frames	Optional		None	
MEF8.R76	Malformed Frames Alarm	Optional		None	
MEF8.R77	Malformed Frames Alarm	Optional		None	
MEF8.R78	Jitter Buffer Overrun	Mandatory	11	MEF8.R78-R79	

Requirement	Description	Level (mandatory/ dependent/ optional)	Test Case No.	Test reference	Comments
MEF8.R79	Jitter Buffer Overrun	Mandatory	11	MEF8.R78-R79	
MEF8.R80	Jitter Buffer Overrun	Optional		None	
MEF8.R81	Jitter Buffer Overrun	Optional		None	
MEF8.R82	Facility Data Link	Optional		None	
MEF8.R83	Facility Data Link	Mandatory	12	MEF8.R83	
MEF8.R84	Frame Error Ratio	Optional		None	
MEF8.R85	Bandwidth provisioning	Optional		None	Requirement on MEN
MEF8.R86	MEN Specification	Optional		None	
MEF8.R87	MEN-bound Statistics	Optional		None	
MEF8.R88	TDM-bound Statistics	Optional		None	

**Table 8-1: Requirement Status and Test Summary**

## 9. References

Reference	Reference Details
RFC 2119	“Key words for use in RFCs to Indicate Requirement Levels”, RFC 2119, S. Bradner, March 1997, <a href="http://www.ietf.org/rfc/rfc2119.txt">http://www.ietf.org/rfc/rfc2119.txt</a>
RFC 2833	“RTP Payload for DTMF Digits, Telephony Tones and Telephony Signals”, RFC 2833, H. Schulzrinne, S. Petrack, 2000, <a href="http://www.ietf.org/rfc/rfc2833.txt">http://www.ietf.org/rfc/rfc2833.txt</a>
MEF 3	“Circuit Emulation Service Definitions, Framework and Requirements in Metro Ethernet Networks”, MEF 3, April 13, 2004, <a href="http://www.metroethernetforum.org/PDFs/Standards/MEF3.pdf">http://www.metroethernetforum.org/PDFs/Standards/MEF3.pdf</a>
MEF 8	“Implementation Agreement for the Emulation of PDH Circuits over Metro Ethernet Networks”, MEF 8, October 2004, <a href="http://www.metroethernetforum.org/PDFs/Standards/MEF8.pdf">http://www.metroethernetforum.org/PDFs/Standards/MEF8.pdf</a>
G.823	“The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy”, ITU-T recommendation G.823, March 2000
G.824	“The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy”, ITU-T recommendation G.823, March 2000
G.8261	“Timing and Synchronisation aspects in Packet Networks”, ITU-T recommendation G.8261, June 2006
O.150	“General Requirements for Instrumentation for Performance Measurements on Digital Transmission Equipment”, ITU-T recommendation O.150, May 1996