



# **Technical Specification**

## **MEF 14**

### **Abstract Test Suite**

**for**

### **Traffic Management Phase 1**

**November, 2005**

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## 1. Abstract

This document defines the requirements and corresponding test procedures for Service Performance and Bandwidth Profile Service Attributes that may be specified as part of a Service Level Specification (SLS) for an Ethernet Service. Requirements are derived from Metro Ethernet Forum Technical Committee documents.

## 2. Terminology

<b>All to One Bundling</b>	A UNI attribute in which all CE-VLAN IDs are associated with a single EVC.
<b>Bandwidth Profile</b>	A characterization of ingress Service Frame arrival times and lengths at a reference point and a specification of the disposition of each Service Frame based on its level of compliance with the Bandwidth Profile. In this document the reference point is the UNI.
<b>Broadcast Service Frame</b>	A Service Frame that has the broadcast destination MAC address.
<b>Bundling</b>	A UNI attribute in which more than one CE-VLAN ID can be associated with an EVC.
<b>CBS</b>	Committed Burst Size
<b>CE</b>	Customer Edge
<b>CE-VLAN CoS</b>	Customer Edge VLAN CoS
<b>CE-VLAN ID</b>	Customer Edge VLAN ID
<b>CE-VLAN ID Preservation</b>	An EVC attribute in which the CE-VLAN ID of an egress Service Frame is identical in value to the CE-VLAN ID of the corresponding ingress Service Frame.
<b>CE-VLAN ID/EVC Map</b>	An association of CE-VLAN IDs with EVCs at a UNI.
<b>CE-VLAN Tag</b>	Customer Edge VLAN Tag
<b>CF</b>	Coupling Flag
<b>CIR</b>	Committed Information Rate
<b>Class of Service</b>	A set of Service Frames that have a commitment from the Service Provider to receive a particular level of performance.
<b>Class of Service Identifier</b>	Information derivable from a) the EVC to which the Service Frame is mapped or b) the combination of the EVC to which the Service Frame is mapped and a set of one or more CE-VLAN CoS values.
<b>CM</b>	Color Mode

<b>Color Mode</b>	CM is a Bandwidth Profile parameter. The Color Mode parameter indicates whether the color-aware or color-blind property is employed by the Bandwidth Profile. It takes a value of "color-blind" or "color-aware" only.
<b>Color-aware</b>	A Bandwidth Profile property where a pre-determined level of Bandwidth Profile compliance for each Service Frame is taken into account when determining the level of compliance for each Service Frame.
<b>Color-blind</b>	A Bandwidth Profile property where a pre-determined level of Bandwidth Profile compliance for each Service Frame, if present, is ignored when determining the level of compliance for each Service Frame.
<b>Committed Burst Size</b>	CBS is a Bandwidth Profile parameter. It limits the maximum number of bytes available for a burst of ingress Service Frames sent at the UNI speed to remain CIR-conformant.
<b>Committed Information Rate</b>	CIR is a Bandwidth Profile parameter. It defines the average rate in bits/s of ingress Service Frames up to which the network delivers Service Frames and meets the performance objectives defined by the CoS Service Attribute.
<b>Coupling Flag</b>	CF is a Bandwidth Profile parameter. The Coupling Flag allows the choice between two modes of operations of the rate enforcement algorithm. It takes a value of 0 or 1 only.
<b>Customer Edge</b>	Equipment on the Subscriber side of the UNI.
<b>Customer Edge VLAN CoS</b>	The user priority bits in the IEEE 802.1Q Tag in a Service Frame that is either tagged or priority tagged.
<b>Customer Edge VLAN ID</b>	The identifier derivable from the content of a Service Frame that allows the Service Frame to be associated with an EVC at the UNI.
<b>Customer Edge VLAN Tag</b>	The IEEE 802.1Q Tag in a tagged Service Frame.
<b>EBS</b>	Excess Burst Size
<b>Egress Service Frame</b>	A Service Frame sent from the Service Provider network to the CE.
<b>EIR</b>	Excess Information Rate
<b>E-LAN Service</b>	Ethernet LAN Service
<b>E-Line Service</b>	Ethernet Line Service
<b>Ethernet LAN Service</b>	An Ethernet Service Type distinguished by its use of a Multipoint-to-Multipoint EVC.
<b>Ethernet Line Service</b>	An Ethernet Service Type distinguished by its use of a Point-to-Point EVC.
<b>Ethernet Virtual Connection</b>	An association of two or more UNIs that limits the exchange of Service Frames to UNIs in the Ethernet Virtual Connection.

<b>EVC</b>	Ethernet Virtual Connection
<b>Excess Burst Size</b>	EBS is a Bandwidth Profile parameter. It limits the maximum number of bytes available for a burst of ingress Service Frames sent at the UNI speed to remain EIR-conformant.
<b>Excess Information Rate</b>	EIR is a Bandwidth Profile parameter. It defines the average rate in bits/s of ingress Service Frames up to which the network may deliver Service Frames without any performance objectives.
<b>FD</b>	Frame Delay
<b>FDV</b>	Frame Delay Variation
<b>FLR</b>	Frame Loss Ratio
<b>Frame</b>	Short for Ethernet frame.
<b>Frame Delay</b>	The time required to transmit a Service Frame from source to destination across the metro Ethernet network.
<b>Frame Delay Performance</b>	A measure of the delays experienced by different Service Frames belonging to the same CoS instance.
<b>Frame Delay Variation</b>	The difference in delay of two Service Frames.
<b>Frame Delay Variation Performance</b>	A measure of the variation in the delays experienced by different Service Frames belonging to the same CoS instance.
<b>Frame Loss Ratio Performance</b>	Frame Loss Ratio is a measure of the number of lost frames inside the MEN. Frame Loss Ratio is expressed as a percentage.
<b>Ingress Service Frame</b>	A Service Frame sent from the CE into the Service Provider network.
<b>Layer 2 Control Protocol Service Frame</b>	A Service Frame that is used for Layer 2 control, e.g., Spanning Tree Protocol.
<b>Layer 2 Control Protocol Tunneling</b>	The process by which a Layer 2 Control Protocol Service Frame is passed through the Service Provider network without being processed and is delivered unchanged to the proper UNI(s).
<b>Multicast Service Frame</b>	A Service Frame that has a multicast destination MAC address.
<b>Multipoint-to-Multipoint EVC</b>	An EVC with two or more UNIs. A Multipoint-to-Multipoint EVC with two UNIs is different from a Point-to-Point EVC because one or more additional UNIs can be added to it.
<b>Point-to-Point EVC</b>	An EVC with exactly 2 UNIs.
<b>Service Frame</b>	An Ethernet frame transmitted across the UNI toward the Service Provider or an Ethernet frame transmitted across the UNI toward the Subscriber.
<b>Service Level Agreement</b>	The contract between the Subscriber and Service Provider specifying the agreed to service level commitments and related business agreements.

<b>Service Level Specification</b>	The technical specification of the service level being offered by the Service Provider to the Subscriber.
<b>Service Multiplexing</b>	A UNI service attribute in which the UNI can be in more than one EVC instance.
<b>Service Provider</b>	The organization providing Ethernet Service(s).
<b>SLA</b>	Service Level Agreement
<b>SLS</b>	Service Level Specification
<b>Subscriber</b>	The organization purchasing and/or using Ethernet Services.
<b>UNI</b>	User Network Interface
<b>Unicast Service Frame</b>	A Service Frame that has a unicast destination MAC address.
<b>User Network Interface</b>	The physical demarcation point between the responsibility of the Service Provider and the responsibility of the Subscriber.

### 3. Scope

This document defines the requirements and corresponding test procedures for Service Performance and Bandwidth Profile Service Attributes that may be specified as part of a Service Level Specification (SLS) for an Ethernet Service. As with MEF 9 Abstract Test Suite for Ethernet Services at the UNI [3], the tests in this specification are defined from the point of view of the Subscriber's equipment that is used to access the services.

The requirements defined in this document are based on Sections 6.7 and 7.10 of MEF 10 Ethernet Services Attributes Phase 1 [1]. Section 6.7 of MEF 10 [1] defines three EVC Related Performance Service Attributes: Frame Delay Performance, Frame Delay Variation Performance, and Frame Loss Ratio Performance. Section 7.10 of MEF 10 defines Bandwidth Profile Service Attributes of an Ethernet Service at the UNI. Bandwidth Profiles Service Attributes are defined per Ingress UNI, per EVC, and per Class of Service. Six parameters are applied to Bandwidth Profiles: Committed Information Rate (CIR), Committed Burst Size (CBS), Excess Information Rate (EIR), Excess Burst Size (EBS), Coupling Flag (CF) and Color Mode (CM). In the absence of a standard way to color Service Frames, tests are not defined in relation to CF and CM parameters that may be applied to a Bandwidth Profile. Such tests may be added in the future when Service Frame Coloring is further specified.

When combined with MEF 9 [3], this specification covers all of the EVC and UNI related Service Attributes specified in MEF 10 [1]. Together they provide a comprehensive set of Test Cases to determine the readiness of a Metro Ethernet Network (MEN) to deliver various Ethernet Services, such as Ethernet Line (E-Line) and Ethernet LAN (E-LAN) services when Service Performance and Bandwidth Profile Service Attributes are specified.

Implementation specifications are outside the scope of this document. This document may be updated in the future to reflect new work in the MEF Technical Committee.

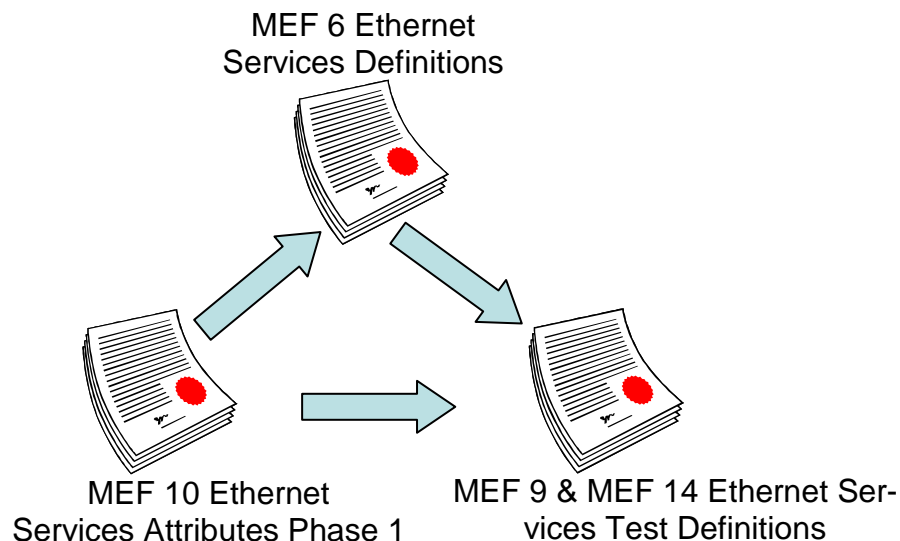
## 4. Compliance Levels

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 [5]. All key words must be in upper case, bold text.

## 5. Introduction

This document completes MEF 9 [3] by adding requirements and test procedures for Service Performance and Bandwidth Profile Service Attributes defined in MEF 10 [1]. As with MEF 9, vendors can refer to the requirements and test procedures defined in this specification in the development and commercial cycles of their products, carriers can use them to ensure that the networks they deploy will have the ability to deliver Ethernet Services that support Service Level Specifications defined by the Technical Committee of the Metro Ethernet Forum and subscribers can attach to the MEN knowing that the Ethernet Services they access satisfy criteria based on accepted requirements and test procedures.

The definition of the requirements a MEN must satisfy to deliver Services to which Traffic and Performance parameters are applied is tightly based on the MEF 10 [1]. The Ethernet Service Definition Framework was created by the Metro Ethernet Forum (MEF) to provide the service attributes and parameters to create an Ethernet service. The relationship between the Ethernet Services Test Definition documents and the two MEF services documents is illustrated in Figure 1.

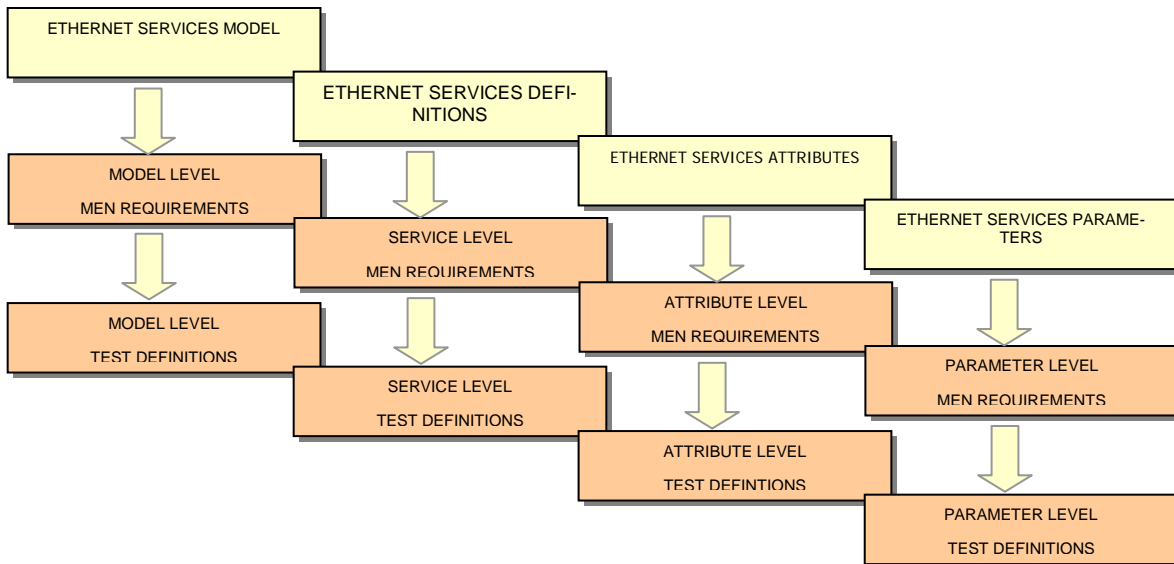


**Figure 1: Relationship between different MEF Services Group documents and the Ethernet Services Test Definition Documents**



The fundamental service constructs defined in MEF 10 [1] are Ethernet Service Types. These have two types of Service Attributes associated with them, those associated with the UNI, and those associated with the EVC. This specification defines requirements and test procedures based on the Performance Service Attributes which are associated with the EVC and on the Bandwidth Profile Service Attributes which are associated with the UNI. MEF 10 [1] also defines the type of parameter values associated with each of these Service Attributes.

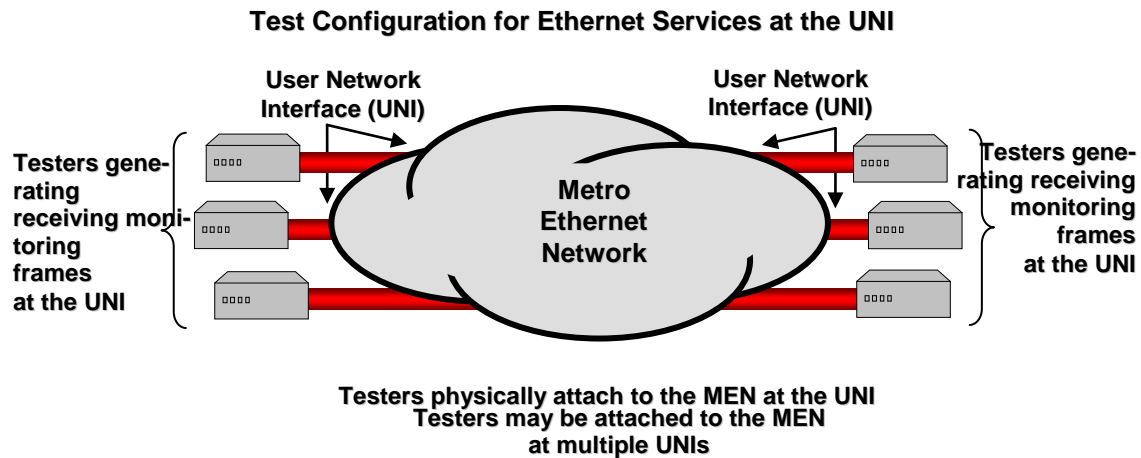
A conceptual schematic of the relationship between the MEF Technical Committee Ethernet Services documents and the derived MEN requirements and correspondingly defined test definitions is represented in Figure 2.



**Figure 2: Relationship between Ethernet Service Documents and Abstract Test Cases for Ethernet Services at the UNI**

## 6. Test Configuration

Although some tests may require very specific test configurations, most tests defined in this document are to be executed by attaching the Ethernet interface or interfaces of a Tester to the Ethernet interface or interfaces at the UNI. Since the UNI is the physical demarcation point which delimits the responsibilities of the Subscriber and the Service Provider, the Tester attached in this way sees a MEN from the point of view of the Subscriber's equipment and can test a MEN's ability to offer Ethernet Services to the Subscriber. We schematically represent the attachment of the Tester to the MEN in Figure 3



**Figure 3: Test Configuration for Ethernet Services at the UNI**

The Test Configuration for each Test Case describes the number of EVCs associating the number of UNIs in the Test Case and the number of CE-VLAN IDs mapped to the EVCs. Testers are attached to all UNIs in the configured EVCs in all Test Cases. CE-VLAN ID/EVC Maps are given for each Test Case.

In this document CE-VLAN ID/EVC Maps for the ingress and egress UNIs as in Figure 4, specific Bandwidth Profile Service Attributes as in Figure 5 and EVC Performance Service Attributes as in Figure 6 are suggested for each Test Case.

INGRESS UNI 'A'		EGRESS UNI 'B'	
CE-VLAN ID	EVC	CE-VLAN ID	EVC
10	EVC <sub>1</sub>	10	EVC <sub>1</sub>
Use of other CE-VLAN IDs is permitted provided that configuration of the CE-VLAN IDs conforms to MEF 10 [Ethernet Services Attributes Phase 1], Section 7.5.1			

**Figure 4: CE-VLAN ID/EVC Maps for the ingress and egress UNIs**

Per Ingress UNI				
UNI	Bandwidth Profile Parameters			
UNI <sub>A</sub>	CIR <sub>A</sub>	CBS <sub>A</sub>	EIR <sub>A</sub>	EBS <sub>A</sub>
Note 1 : (0 < CIR <sub>A</sub> ≤ UNI Speed), (CBS <sub>A</sub> ≥ maximum Service Frame size)				

**Figure 5: Bandwidth Profile Service Attributes**

CoS Identifier	EVC Performance Service Attributes	Performance Objectives
1	Frame Delay (FD) Performance Frame Delay Variation (FDV) Performance Frame Loss Ratio (FLR) Performance	FD <sub>1</sub> FDV <sub>1</sub> FLR <sub>1</sub>

**Figure 6: EVC Performance Service Attributes**

## 7. Template for Abstract Test Cases for Traffic Management

We adopt the following template for the definition of Abstract Test Cases for Management:

ABSTRACT TEST SUITE FOR TRAFFIC MANAGEMENT: PHASE 1																
Test Name	Name derived from reference document															
Test Definition ID	A punctuated alphanumeric string assigned to each defined requirement and test procedure couple using the following convention: 'one to three letter abbreviated source document name'. 'section number' - 'paragraph number in the section from which requirement is derived'. This number always figures as the last number of an ID. Ethernet Services Model=M; Ethernet Services Definitions=S. Example: M.6.1-4															
Reference Document	Reference document and section (and paragraph when useful for clarity)															
Test Type	Functional, Conformance, Interoperability or Performance															
Test Status	Mandatory, optional															
Requirement Description	Brief description of the service requirement that the MEN <b>MUST</b> or <b>SHOULD</b> satisfy															
Test Object	Succinct description of test purpose															
Test Configuration	Succinct description of test bed configuration															
VLAN-ID/EVC Map	<p>A sample VLAN ID/EVC Map is suggested. Variables augment it.</p> <table border="1"> <thead> <tr> <th colspan="2">INGRESS UNI 'A'</th> <th colspan="2">EGRESS UNI 'B'</th> </tr> <tr> <th>CE-VLAN ID</th> <th>EVC</th> <th>CE-VLAN ID</th> <th>EVC</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>EVC<sub>1</sub></td> <td>10</td> <td>EVC<sub>1</sub></td> </tr> </tbody> </table> <p>Use of other CE-VLAN IDs is permitted provided that configuration of the CE-VLAN IDs conforms to MEF 10 [Ethernet Services Attributes Phase 1], Section 7.5.1</p>	INGRESS UNI 'A'		EGRESS UNI 'B'		CE-VLAN ID	EVC	CE-VLAN ID	EVC	10	EVC <sub>1</sub>	10	EVC <sub>1</sub>			
INGRESS UNI 'A'		EGRESS UNI 'B'														
CE-VLAN ID	EVC	CE-VLAN ID	EVC													
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Bandwidth Profile	<table border="1"> <thead> <tr> <th colspan="5">Per Ingress UNI</th> </tr> <tr> <th>UNI</th> <th colspan="4">Bandwidth Profile Parameters</th> </tr> </thead> <tbody> <tr> <td>UNI<sub>A</sub></td> <td>CIR<sub>A</sub></td> <td>CBS<sub>A</sub></td> <td>EIR<sub>A</sub></td> <td>EBS<sub>A</sub></td> </tr> </tbody> </table> <p>Note 1 : (0 &lt; CIR<sub>A</sub> ≤ UNI Speed), (CBS<sub>A</sub> ≥ maximum Service Frame size)</p>	Per Ingress UNI					UNI	Bandwidth Profile Parameters				UNI <sub>A</sub>	CIR <sub>A</sub>	CBS <sub>A</sub>	EIR <sub>A</sub>	EBS <sub>A</sub>
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UNI <sub>A</sub>	CIR <sub>A</sub>	CBS <sub>A</sub>	EIR <sub>A</sub>	EBS <sub>A</sub>												
Service Performance	<table border="1"> <thead> <tr> <th>CoS Identifier</th> <th>EVC Performance Service Attributes</th> <th>Performance Objectives</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>                     Frame Delay (FD) Performance                      Frame Delay Variation (FDV) Performance                      Frame Loss Ratio (FLR) Performance                 </td> <td>                     FD<sub>1</sub>                      FDV<sub>1</sub>                      FLR<sub>1</sub> </td> </tr> </tbody> </table>	CoS Identifier	EVC Performance Service Attributes	Performance Objectives	1	Frame Delay (FD) Performance Frame Delay Variation (FDV) Performance Frame Loss Ratio (FLR) Performance	FD <sub>1</sub> FDV <sub>1</sub> FLR <sub>1</sub>									
CoS Identifier	EVC Performance Service Attributes	Performance Objectives														
1	Frame Delay (FD) Performance Frame Delay Variation (FDV) Performance Frame Loss Ratio (FLR) Performance	FD <sub>1</sub> FDV <sub>1</sub> FLR <sub>1</sub>														
Test Procedure	Succinct description of the test procedure. CE-VLAN ID/EVC Maps are provided for all tests.															
Units	Units can be time units, rates and counts in integers such as milliseconds, frames per second and numbers of valid frames. For the most part units used are defined in RFCs 2285, 2544, 2889.															
Variables	Variables such as number of UNIs, EVCs and CE-VLAN IDs and frame formats and lengths <b>MUST</b> be described.															
Results	Description of the textual, numerical and/or graphical format in which to display test results. Results can be Pass or Fail.															
Remarks	Description of any particular observations that might effect the test result															

## **8. Abstract Test Cases for EVC Related Performance Service Attributes**

In this section we assume familiarity with the MEF 10 Ethernet Services Attributes Phase 1 [1] and, in particular, its section 6.7 which defines EVC Related Performance Service Attributes. Abstract Test Cases based on the EVC Related Performance Service Attributes described in the MEF 10 [1] are defined. There are three Test Cases defined in this section.

Test Case 1: Frame Delay Service Performance

Test Case 2: Frame Delay Variation Service Performance

Test Case 3: Frame Loss Ratio Service Performance

**Test Case 1: Frame Delay Service Performance**

ABSTRACT TEST SUITE FOR TRAFFIC MANAGEMENT: PHASE 1																
Test Name	Frame Delay Service Performance															
Test Definition ID	M.6.7.1															
Reference Document	MEF 10 [Ethernet Services Attributes Phase 1]															
Test Type	Conformance															
Test Status	Mandatory															
Requirement Description	For all Service Frames declared Green and associated with a particular Class of Service Identifier on a Point-to-Point EVC that arrive at the UNI during a time interval $T$ , Frame Delay Performance <b>MUST</b> be less than or equal to the Frame Delay Performance Objective															
Test Object	Verify that for all Service Frames declared Green and associated with a particular Class of Service Identifier on a Point-to-Point EVC that arrive at the UNI during a time interval $T$ , Frame Delay Performance is less than or equal to the Frame Delay Performance Objective															
Test Configuration	At least one EVC associating at least two UNIs is configured and at least one Bandwidth Profile with $CIR > 0$ is associated with at least one of the UNIs. Testers are attached to all UNIs in the configured EVCs															
VLAN-ID/EVC Map	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">INGRESS UNI 'A'</th> <th colspan="2">EGRESS UNI 'B'</th> </tr> <tr> <th>CE-VLAN ID</th> <th>EVC</th> <th>CE-VLAN ID</th> <th>EVC</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>EVC<sub>1</sub></td> <td>10</td> <td>EVC<sub>1</sub></td> </tr> </tbody> </table> <p>Use of other CE-VLAN IDs is permitted provided that configuration of the CE-VLAN IDs conforms to MEF 10 [Ethernet Services Attributes Phase 1], Section 7.5.1.</p>	INGRESS UNI 'A'		EGRESS UNI 'B'		CE-VLAN ID	EVC	CE-VLAN ID	EVC	10	EVC <sub>1</sub>	10	EVC <sub>1</sub>			
INGRESS UNI 'A'		EGRESS UNI 'B'														
CE-VLAN ID	EVC	CE-VLAN ID	EVC													
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CoS Identifier	EVC Performance Service Attributes	Performance Objectives														
1	Frame Delay (FD) Performance	FD <sub>1</sub>														
Test Procedure	Tester offers Service Frames at the ingress UNI into the configured EVCs and measures Frame Delay as the time elapsed from the reception of the first bit of the ingress Service Frame declared Green until the transmission of the last bit of the Service Frame at the egress UNI. Frame Delay Performance is then calculated for a time interval $T$ , as the P-Percentile of the Frame Delay for all Service Frames successfully delivered between the UNI pairs. Service Frames may be offered at an average rate up to CIR <sub>A</sub>															
Units	Time units															
Variables	Bandwidth Profile Parameters CIR <sub>A</sub> , CBS <sub>A</sub> , EIR <sub>A</sub> , EBS <sub>A</sub> , UNIs interface Speed, number of EVCs per UNI, number and values of CE-VLAN IDs, number and values of CoS ID, time interval $T$ , Performance Objective FD <sub>1</sub>															
Results	Pass or fail															
Remarks																

**Test Case 2: Frame Delay Variation Service Performance**

ABSTRACT TEST SUITE FOR TRAFFIC MANAGEMENT: PHASE 1													
Test Name	Frame Delay Variation Service Performance												
Test Definition ID	M.6.7.3												
Reference Document	MEF 10 [Ethernet Services Attributes Phase 1]												
Test Type	Conformance												
Test Status	Mandatory												
Requirement Description	For all Service Frames declared Green and associated with a particular Class of Service Identifier on a Point-to-Point EVC that arrive at the UNI during a time interval $T$ , Frame Delay Variation Performance <b>MUST</b> be less than or equal to the Frame Delay Variation Performance Objective												
Test Object	Verify that for all Service Frames declared Green and associated with a particular Class of Service Identifier on a Point-to-Point EVC that arrive at the UNI during a time interval $T$ , Frame Delay Variation Performance is less than or equal to the Frame Delay Variation Performance Objective												
Test Configuration	At least one EVC associating at least two UNIs is configured and at least one Bandwidth Profile with CIR > 0 is associated with at least one of the UNIs. Testers are attached to all UNIs in the configured EVCs												
VLAN-ID/EVC Map	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">INGRESS UNI 'A'</th> <th colspan="2">EGRESS UNI 'B'</th> </tr> <tr> <th>CE-VLAN ID</th> <th>EVC</th> <th>CE-VLAN ID</th> <th>EVC</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">10</td> <td style="text-align: center;">EVC<sub>1</sub></td> <td style="text-align: center;">10</td> <td style="text-align: center;">EVC<sub>1</sub></td> </tr> </tbody> </table> <p>Use of other CE-VLAN IDs is permitted provided that configuration of the CE-VLAN IDs conforms to MEF 10 [Ethernet Services Attributes Phase 1], Section 7.5.1.</p>	INGRESS UNI 'A'		EGRESS UNI 'B'		CE-VLAN ID	EVC	CE-VLAN ID	EVC	10	EVC <sub>1</sub>	10	EVC <sub>1</sub>
INGRESS UNI 'A'		EGRESS UNI 'B'											
CE-VLAN ID	EVC	CE-VLAN ID	EVC										
10	EVC <sub>1</sub>	10	EVC <sub>1</sub>										
Bandwidth Profile	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="4">Per Ingress UNI</th> </tr> <tr> <th>UNI</th> <th colspan="3">Bandwidth Profile Parameters</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">UNI<sub>A</sub></td> <td style="text-align: center;">CIR<sub>A</sub></td> <td style="text-align: center;">CBS<sub>A</sub></td> <td style="text-align: center;">EIR<sub>A</sub> EBS<sub>A</sub></td> </tr> </tbody> </table> <p>Note 1 : (<math>0 &lt; CIR_A \leq</math> UNI Speed), (<math>CBS_A \geq</math> maximum Service Frame size)</p>	Per Ingress UNI				UNI	Bandwidth Profile Parameters			UNI <sub>A</sub>	CIR <sub>A</sub>	CBS <sub>A</sub>	EIR <sub>A</sub> EBS <sub>A</sub>
Per Ingress UNI													
UNI	Bandwidth Profile Parameters												
UNI <sub>A</sub>	CIR <sub>A</sub>	CBS <sub>A</sub>	EIR <sub>A</sub> EBS <sub>A</sub>										
Service Performance	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>CoS Identifier</th> <th>EVC Performance Service Attributes</th> <th>Performance Objectives</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">Frame Delay Variation (FDV) Performance</td> <td style="text-align: center;">FDV<sub>1</sub></td> </tr> </tbody> </table>	CoS Identifier	EVC Performance Service Attributes	Performance Objectives	1	Frame Delay Variation (FDV) Performance	FDV <sub>1</sub>						
CoS Identifier	EVC Performance Service Attributes	Performance Objectives											
1	Frame Delay Variation (FDV) Performance	FDV <sub>1</sub>											
Test Procedure	<p>Tester offers Service Frames at the ingress UNI into the configured EVCs and measures Frame Delay Variation as the variation in the Frame Delay between a pair of Green Service Frames. Frame Delay Variation Performance is then calculated for a time interval <math>T</math>, as the P-Percentile of the difference between the frame delays of a Service Frame pair that satisfies the following two characteristics:</p> <ol style="list-style-type: none"> <li>The two Service Frames that comprise the pair arrive at the ingress UNI within the time interval <math>T</math></li> <li>The two Service Frames that comprise the pair arrive at the ingress UNI exactly <math>\Delta t</math> time units apart</li> </ol> <p>Service Frames may be offered at an average rate up to CIR<sub>A</sub></p>												
Units	Time units												
Variables	Bandwidth Profile Parameters CIR <sub>A</sub> , CBS <sub>A</sub> , EIR <sub>A</sub> , EBS <sub>A</sub> , UNIs interface Speed, number of EVCs per UNI, number and values of CE-VLAN IDs, number and values of CoS ID, time interval $T$ , Performance Objective FDV <sub>1</sub>												
Results	Pass or fail												
Remarks													

**Test Case 3: Frame Loss Ratio Service Performance**

ABSTRACT TEST SUITE FOR TRAFFIC MANAGEMENT: PHASE 1													
Test Name	Frame Loss Ratio Service Performance												
Test Definition ID	M.6.7.5												
Reference Document	MEF 10 [Ethernet Services Attributes Phase 1]												
Test Type	Conformance												
Test Status	Mandatory												
Requirement Description	For all Service Frames declared Green and associated with a particular Class of Service Identifier on a Point-to-Point EVC that arrive at the UNI during a time interval $T$ , Frame Loss Ratio Performance <b>MUST</b> be less than or equal to the Frame Loss Ratio Performance Objective												
Test Object	Verify that for all Service Frames declared Green and associated with a particular Class of Service Identifier on a Point-to-Point EVC that arrive at the UNI during a time interval $T$ , Frame Loss Ratio Performance is less than or equal to the Frame Loss Ratio Performance Objective												
Test Configuration	At least one EVC associating at least two UNIs is configured and at least one Bandwidth Profile with CIR > 0 is associated with at least one of the UNIs. Testers are attached to all UNIs in the configured EVCs												
VLAN-ID/EVC Map	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">INGRESS UNI 'A'</th> <th colspan="2">EGRESS UNI 'B'</th> </tr> <tr> <th>CE-VLAN ID</th> <th>EVC</th> <th>CE-VLAN ID</th> <th>EVC</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">10</td> <td style="text-align: center;">EVC<sub>1</sub></td> <td style="text-align: center;">10</td> <td style="text-align: center;">EVC<sub>1</sub></td> </tr> </tbody> </table> <p>Use of other CE-VLAN IDs is permitted provided that configuration of the CE-VLAN IDs conforms to MEF 10 [Ethernet Services Attributes Phase 1], Section 7.5.1.</p>	INGRESS UNI 'A'		EGRESS UNI 'B'		CE-VLAN ID	EVC	CE-VLAN ID	EVC	10	EVC <sub>1</sub>	10	EVC <sub>1</sub>
INGRESS UNI 'A'		EGRESS UNI 'B'											
CE-VLAN ID	EVC	CE-VLAN ID	EVC										
10	EVC <sub>1</sub>	10	EVC <sub>1</sub>										
Bandwidth Profile	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="4">Per Ingress UNI</th> </tr> <tr> <th>UNI</th> <th colspan="3">Bandwidth Profile Parameters</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">UNI<sub>A</sub></td> <td style="text-align: center;">CIR<sub>A</sub></td> <td style="text-align: center;">CBS<sub>A</sub></td> <td style="text-align: center;">EIR<sub>A</sub> EBS<sub>A</sub></td> </tr> </tbody> </table> <p>Note 1 : (<math>0 &lt; CIR_A \leq</math> UNI Speed), (<math>CBS_A \geq</math> maximum Service Frame size)</p>	Per Ingress UNI				UNI	Bandwidth Profile Parameters			UNI <sub>A</sub>	CIR <sub>A</sub>	CBS <sub>A</sub>	EIR <sub>A</sub> EBS <sub>A</sub>
Per Ingress UNI													
UNI	Bandwidth Profile Parameters												
UNI <sub>A</sub>	CIR <sub>A</sub>	CBS <sub>A</sub>	EIR <sub>A</sub> EBS <sub>A</sub>										
Service Performance	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>CoS Identifier</th> <th>EVC Performance Service Attributes</th> <th>Performance Objectives</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">Frame Loss Ratio (FLR) Performance</td> <td style="text-align: center;">FLR<sub>1</sub></td> </tr> </tbody> </table>	CoS Identifier	EVC Performance Service Attributes	Performance Objectives	1	Frame Loss Ratio (FLR) Performance	FLR <sub>1</sub>						
CoS Identifier	EVC Performance Service Attributes	Performance Objectives											
1	Frame Loss Ratio (FLR) Performance	FLR <sub>1</sub>											
Test Procedure	Tester offers Service Frames at the ingress UNI into the configured EVCs and over a time interval $T$ counts the number of Service Frames declared Green at the ingress UNI and successfully received at the egress UNI. Frame Loss Ratio Performance is then calculated as the ratio, expressed as a percentage, of the number of Service Frames declared Green not delivered at the egress UNI divided by the total number of such Service Frames. Service Frames may be offered at an average rate up to CIR <sub>A</sub>												
Units	Number of Service Frames												
Variables	Bandwidth Profile Parameters CIR <sub>A</sub> , CBS <sub>A</sub> , EIR <sub>A</sub> , EBS <sub>A</sub> , UNIs interface Speed, number of EVCs per UNI, number and values of CE-VLAN IDs, number and values of CoS ID, time interval $T$ , Performance Objective FLR <sub>1</sub>												
Results	Pass or fail												
Remarks													



## 9. Abstract Test Cases for Bandwidth Profiles Service Attributes

In this section we again assume familiarity with the MEF 10 [1] and, in particular, its section 7.10 which defines Bandwidth Profiles Service Attributes. Abstract Test Cases based on Bandwidth Profiles Service Attributes described in the MEF 10 [1] are defined. There are seven Test Cases defined in this section.

Test Case 4: Bandwidth Profile Rate Enforcement when  $CIR > 0$  and  $EIR = 0$

Test Case 5: Bandwidth Profile Rate Enforcement when  $CIR = 0$  and  $EIR > 0$

Test Case 6: Bandwidth Profile Rate Enforcement when  $CIR > 0$  and  $EIR > 0$

Test Case 7: Bandwidth Profile per Ingress UNI

Test Case 8: Bandwidth Profile per EVC

Test Case 9: Bandwidth Profile per Class of Service

Test Case 10: Multiple Bandwidth Profiles at the UNI

**Test Case 4: Bandwidth Profile Rate Enforcement when CIR > 0 and EIR = 0**

ABSTRACT TEST SUITE FOR TRAFFIC MANAGEMENT: PHASE 1																
Test Name	Bandwidth Profile Rate Enforcement when CIR > 0 and EIR = 0															
Test Definition ID	M.7.10.2.1-2															
Reference Document	MEF 10 [Ethernet Services Attributes Phase 1]															
Test Type	Conformance															
Test Status	Mandatory															
Requirement Description	When a Bandwidth Profile is associated with a UNI, with a CIR > 0 and an EIR = 0, the amount of traffic delivered at the egress UNI <b>MUST NOT</b> exceed the amount of traffic accepted as Green ( $W_G$ ) at the ingress UNI during a time interval $T$ , provided that the ingress traffic is greater than $W_G$															
Test Object	Verify that when a Bandwidth Profile is associated with a UNI, with a CIR > 0 and an EIR = 0, the amount of traffic delivered at the egress UNI does not exceed the amount of traffic accepted as Green ( $W_G$ ) at the ingress UNI during a time interval $T$ , provided that the ingress traffic is greater than $W_G$															
Test Configuration	At least one EVC associating at least two UNIs is configured and at least one Bandwidth Profile is applied at the UNI. Testers are attached to all UNIs in the configured EVCs															
VLAN-ID/EVC Map	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">INGRESS UNI 'A'</th> <th colspan="2">EGRESS UNI 'B'</th> </tr> <tr> <th>CE-VLAN ID</th> <th>EVC</th> <th>CE-VLAN ID</th> <th>EVC</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">10</td> <td style="text-align: center;">EVC<sub>1</sub></td> <td style="text-align: center;">10</td> <td style="text-align: center;">EVC<sub>1</sub></td> </tr> </tbody> </table> <p>Use of other CE-VLAN IDs is permitted provided that configuration of the CE-VLAN IDs conforms to MEF 10 [Ethernet Services Attributes Phase 1], Section 7.5.1</p>	INGRESS UNI 'A'		EGRESS UNI 'B'		CE-VLAN ID	EVC	CE-VLAN ID	EVC	10	EVC <sub>1</sub>	10	EVC <sub>1</sub>			
INGRESS UNI 'A'		EGRESS UNI 'B'														
CE-VLAN ID	EVC	CE-VLAN ID	EVC													
10	EVC <sub>1</sub>	10	EVC <sub>1</sub>													
Bandwidth Profile	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="5">Per Ingress UNI</th> </tr> <tr> <th>UNI</th> <th colspan="4">Bandwidth Profile Parameters</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">UNI<sub>A</sub></td> <td style="text-align: center;">CIR<sub>A</sub></td> <td style="text-align: center;">CBS<sub>A</sub></td> <td style="text-align: center;">EIR<sub>A</sub></td> <td style="text-align: center;">EBS<sub>A</sub></td> </tr> </tbody> </table> <p>Note 1 : (<math>0 &lt; CIR_A &lt; \text{UNI Speed}</math>), (<math>CBS_A \geq \text{maximum Service Frame size}</math>)            Note 2 : (<math>EIR_A = 0</math>) and (<math>EBS_A = 0</math>)</p>	Per Ingress UNI					UNI	Bandwidth Profile Parameters				UNI <sub>A</sub>	CIR <sub>A</sub>	CBS <sub>A</sub>	EIR <sub>A</sub>	EBS <sub>A</sub>
Per Ingress UNI																
UNI	Bandwidth Profile Parameters															
UNI <sub>A</sub>	CIR <sub>A</sub>	CBS <sub>A</sub>	EIR <sub>A</sub>	EBS <sub>A</sub>												
Service Performance	Not Specified															
Test Procedure	<p>Tester offers Service Frames of length <math>\lambda</math> at an average rate greater than <math>CIR_A</math> to the ingress UNI during a time interval <math>T</math> and measures the number of Service Frames delivered at the egress UNI. The amount of traffic delivered at the egress UNI must not exceed <math>W_G</math> where:</p> <ul style="list-style-type: none"> <li><math>W_G</math> is the amount of traffic accepted as Green over the time interval <math>T</math> that should be delivered to the egress UNI</li> </ul>															
Units	Number of valid Service Frames															
Variables	Bandwidth Profile Parameters $CIR_A$ , $CBS_A$ , UNIs interface speed, number of UNIs, number of EVCs per UNI, type of EVC (Point-to-Point and Multipoint-to-Multipoint), number and values of CE-VLAN IDs, time interval $T$ , number and length $\lambda$ of the offered Service Frames															
Results	Pass or fail															
Remarks																

**Test Case 5: Bandwidth Profile Rate Enforcement when CIR = 0 and EIR > 0**

ABSTRACT TEST SUITE FOR TRAFFIC MANAGEMENT: PHASE 1																
Test Name	Bandwidth Profile Rate Enforcement when CIR = 0 and EIR > 0															
Test Definition ID	M.7.10.2.1-2															
Reference Document	MEF 10 [Ethernet Services Attributes Phase 1]															
Test Type	Conformance															
Test Status	Mandatory															
Requirement Description	When a Bandwidth Profile is associated with a UNI, with a CIR = 0 and an EIR > 0, the amount of traffic delivered at the egress UNI <b>MUST NOT</b> exceed the amount of traffic accepted as Yellow ( $W_Y$ ) at the ingress UNI during a time interval $T$ , provided that the ingress traffic is greater than $W_Y$															
Test Object	Verify that when a Bandwidth Profile is associated with a UNI, with a CIR = 0 and an EIR > 0, the amount of traffic delivered at the egress UNI does not exceed the amount of traffic accepted as Yellow ( $W_Y$ ) at the ingress UNI during a time interval $T$ , provided that the ingress traffic is greater than $W_Y$															
Test Configuration	At least one EVC associating at least two UNIs is configured and at least one Bandwidth Profile is applied at the UNI. Testers are attached to all UNIs in the configured EVCs															
VLAN-ID/EVC Map	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">INGRESS UNI 'A'</th> <th colspan="2">EGRESS UNI 'B'</th> </tr> <tr> <th>CE-VLAN ID</th> <th>EVC</th> <th>CE-VLAN ID</th> <th>EVC</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">10</td> <td style="text-align: center;">EVC<sub>1</sub></td> <td style="text-align: center;">10</td> <td style="text-align: center;">EVC<sub>1</sub></td> </tr> </tbody> </table> <p>Use of other CE-VLAN IDs is permitted provided that configuration of the CE-VLAN IDs conforms to MEF 10 [Ethernet Services Attributes Phase 1], Section 7.5.1</p>	INGRESS UNI 'A'		EGRESS UNI 'B'		CE-VLAN ID	EVC	CE-VLAN ID	EVC	10	EVC <sub>1</sub>	10	EVC <sub>1</sub>			
INGRESS UNI 'A'		EGRESS UNI 'B'														
CE-VLAN ID	EVC	CE-VLAN ID	EVC													
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Bandwidth Profile	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="5">Per Ingress UNI</th> </tr> <tr> <th>UNI</th> <th colspan="4">Bandwidth Profile Parameters</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">UNI<sub>A</sub></td> <td style="text-align: center;">CIR<sub>A</sub></td> <td style="text-align: center;">CBS<sub>A</sub></td> <td style="text-align: center;">EIR<sub>A</sub></td> <td style="text-align: center;">EBS<sub>A</sub></td> </tr> </tbody> </table> <p>Note 1 : (CIR<sub>A</sub> = 0) and (CBS<sub>A</sub> = 0)            Note 2 : (0 &lt; EIR<sub>A</sub> &lt; UNI Speed), (EBS<sub>A</sub> ≥ maximum Service Frame size)</p>	Per Ingress UNI					UNI	Bandwidth Profile Parameters				UNI <sub>A</sub>	CIR <sub>A</sub>	CBS <sub>A</sub>	EIR <sub>A</sub>	EBS <sub>A</sub>
Per Ingress UNI																
UNI	Bandwidth Profile Parameters															
UNI <sub>A</sub>	CIR <sub>A</sub>	CBS <sub>A</sub>	EIR <sub>A</sub>	EBS <sub>A</sub>												
Service Performance	Not Specified															
Test Procedure	<p>Tester offers Service Frames of length <math>\lambda</math> at an average rate greater than EIR<sub>A</sub> to the ingress UNI during a time interval <math>T</math> and measures the number of Service Frames delivered at the egress UNI. The amount of traffic delivered at the egress UNI must not exceed <math>W_Y</math> where:</p> <ul style="list-style-type: none"> <li><math>W_Y</math> is the amount of traffic accepted as Yellow over the time interval <math>T</math> that may be delivered to the egress UNI</li> </ul>															
Units	Number of valid Service Frames															
Variables	Bandwidth Profile Parameters EIR <sub>A</sub> , EBS <sub>A</sub> , UNIs interface speed, number of UNIs, number of EVCs per UNI, type of EVC (Point-to-Point and Multipoint-to-Multipoint), number and values of CE-VLAN IDs, time interval $T$ , number and length $\lambda$ of the offered Service Frames															
Results	Pass or fail															
Remarks																

**Test Case 6: Bandwidth Profile Rate Enforcement when CIR > 0 and EIR > 0**

ABSTRACT TEST SUITE FOR TRAFFIC MANAGEMENT: PHASE 1																															
Test Name	Bandwidth Profile Rate Enforcement when CIR > 0 and EIR > 0																														
Test Definition ID	M.7.10.2.1-2																														
Reference Document	MEF 10 [Ethernet Services Attributes Phase 1]																														
Test Type	Conformance																														
Test Status	Mandatory																														
Requirement Description	When a Bandwidth Profile is associated with a UNI, with a CIR > 0 and an EIR > 0, the amount of traffic delivered at the egress UNI <b>MUST NOT</b> exceed the amount of traffic accepted as Green ( $W_G$ ) plus the amount of traffic accepted as Yellow ( $W_Y$ ) at the ingress UNI during a time interval $T$ , provided that the ingress traffic is greater than ( $W_G + W_Y$ )																														
Test Object	Verify that when a Bandwidth Profile is associated with a UNI, with a CIR > 0 and an EIR > 0, the amount of traffic delivered at the egress UNI does not exceed the amount of traffic accepted as Green ( $W_G$ ) plus the amount of traffic accepted as Yellow ( $W_Y$ ) at the ingress UNI during a time interval $T$ , provided that the ingress traffic is greater than ( $W_G + W_Y$ )																														
Test Configuration	At least one EVC associating at least two UNIs is configured and at least one Bandwidth Profile is applied at the UNI. Testers are attached to all UNIs in the configured EVCs																														
VLAN-ID/EVC Map	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">INGRESS UNI 'A'</th> <th colspan="2">EGRESS UNI 'B'</th> </tr> <tr> <th>CE-VLAN ID</th> <th>EVC</th> <th>CE-VLAN ID</th> <th>EVC</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">10</td> <td style="text-align: center;">EVC<sub>1</sub></td> <td style="text-align: center;">10</td> <td style="text-align: center;">EVC<sub>1</sub></td> </tr> </tbody> </table> <p>Use of other CE-VLAN IDs is permitted provided that configuration of the CE-VLAN IDs conforms to MEF 10 [Ethernet Services Attributes Phase 1], Section 7.5.1</p>	INGRESS UNI 'A'		EGRESS UNI 'B'		CE-VLAN ID	EVC	CE-VLAN ID	EVC	10	EVC <sub>1</sub>	10	EVC <sub>1</sub>																		
INGRESS UNI 'A'		EGRESS UNI 'B'																													
CE-VLAN ID	EVC	CE-VLAN ID	EVC																												
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Bandwidth Profile	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="5">Per Ingress UNI</th> </tr> <tr> <th>UNI</th> <th colspan="4">Bandwidth Profile Parameters</th> </tr> <tr> <th>UNI<sub>A</sub></th> <th>CIR<sub>A</sub></th> <th>CBS<sub>A</sub></th> <th>EIR<sub>A</sub></th> <th>EBS<sub>A</sub></th> </tr> </thead> <tbody> <tr> <td colspan="5">Note 1 : (0 &lt; CIR<sub>A</sub> &lt; UNI Speed), (CBS<sub>A</sub> ≥ maximum Service Frame size)</td> </tr> <tr> <td colspan="5">Note 2 : (0 &lt; EIR<sub>A</sub> &lt; UNI Speed), (EBS<sub>A</sub> ≥ maximum Service Frame size)</td> </tr> <tr> <td colspan="5">Note 3 : (CIR<sub>A</sub> + EIR<sub>A</sub> &lt; UNI Speed)</td> </tr> </tbody> </table>	Per Ingress UNI					UNI	Bandwidth Profile Parameters				UNI <sub>A</sub>	CIR <sub>A</sub>	CBS <sub>A</sub>	EIR <sub>A</sub>	EBS <sub>A</sub>	Note 1 : (0 < CIR <sub>A</sub> < UNI Speed), (CBS <sub>A</sub> ≥ maximum Service Frame size)					Note 2 : (0 < EIR <sub>A</sub> < UNI Speed), (EBS <sub>A</sub> ≥ maximum Service Frame size)					Note 3 : (CIR <sub>A</sub> + EIR <sub>A</sub> < UNI Speed)				
Per Ingress UNI																															
UNI	Bandwidth Profile Parameters																														
UNI <sub>A</sub>	CIR <sub>A</sub>	CBS <sub>A</sub>	EIR <sub>A</sub>	EBS <sub>A</sub>																											
Note 1 : (0 < CIR <sub>A</sub> < UNI Speed), (CBS <sub>A</sub> ≥ maximum Service Frame size)																															
Note 2 : (0 < EIR <sub>A</sub> < UNI Speed), (EBS <sub>A</sub> ≥ maximum Service Frame size)																															
Note 3 : (CIR <sub>A</sub> + EIR <sub>A</sub> < UNI Speed)																															
Service Performance	Not Specified																														
Test Procedure	<p>Tester offers Service Frames of length <math>\lambda</math> at an average rate greater than <math>CIR_A + EIR_A</math> to the ingress UNI during a time interval <math>T</math> and measures the number of Service Frames delivered at the egress UNI. The amount of traffic delivered at the egress UNI must not exceed (<math>W_G + W_Y</math>) where:</p> <ul style="list-style-type: none"> <li>· <math>W_G</math> is the amount of traffic accepted as Green over the time interval <math>T</math> that should be delivered to the egress UNI</li> <li>· <math>W_Y</math> is the amount of traffic accepted as Yellow over the time interval <math>T</math> that may be delivered to the egress UNI</li> </ul>																														
Units	Number of valid Service Frames																														
Variables	Bandwidth Profile Parameters $CIR_A, CBS_A, EIR_A, EBS_A$ , UNIs interface speed, number of UNIs, number of EVCs per UNI, type of EVC (Point-to-Point and Multipoint-to-Multipoint), number and values of CE-VLAN IDs, time interval $T$ , number and length $\lambda$ of the offered Service Frames																														
Results	Pass or fail																														
Remarks																															

**Test Case 7: Bandwidth Profile per Ingress UNI**

ABSTRACT TEST SUITE FOR TRAFFIC MANAGEMENT: PHASE 1																					
Test Name	Bandwidth Profile per Ingress UNI																				
Test Definition ID	M.7.10.3																				
Reference Document	MEF 10 [Ethernet Services Attributes Phase 1]																				
Test Type	Conformance																				
Test Status	Mandatory																				
Requirement Description	When a per Ingress UNI Bandwidth Profile is associated with a UNI, the Bandwidth Profile <b>MUST</b> be applied to all ingress Service Frames at that UNI																				
Test Object	Verify that when a per Ingress UNI Bandwidth Profile is associated with a UNI, the Bandwidth Profile is applied to all ingress Service Frames at that UNI																				
Test Configuration	At least two EVCs associating at least two UNIs are configured such that each associated UNI is in at least two EVCs and at least one CE-VLAN ID is mapped per EVC. A per Ingress UNI Bandwidth Profile is associated with at least one of the UNIs. Testers are attached to all UNIs in the configured EVCs																				
VLAN-ID/EVC Map	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">INGRESS UNI 'A'</th> <th colspan="2">EGRESS UNI 'B'</th> </tr> <tr> <th>CE-VLAN ID</th> <th>EVC</th> <th>CE-VLAN ID</th> <th>EVC</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>EVC<sub>1</sub></td> <td>10</td> <td>EVC<sub>1</sub></td> </tr> <tr> <td>12</td> <td>EVC<sub>2</sub></td> <td>12</td> <td>EVC<sub>2</sub></td> </tr> </tbody> </table> <p>Use of other CE-VLAN IDs is permitted provided that configuration of the CE-VLAN IDs conforms to MEF 10 [Ethernet Services Attributes Phase 1], Section 7.5.1</p>	INGRESS UNI 'A'		EGRESS UNI 'B'		CE-VLAN ID	EVC	CE-VLAN ID	EVC	10	EVC <sub>1</sub>	10	EVC <sub>1</sub>	12	EVC <sub>2</sub>	12	EVC <sub>2</sub>				
INGRESS UNI 'A'		EGRESS UNI 'B'																			
CE-VLAN ID	EVC	CE-VLAN ID	EVC																		
10	EVC <sub>1</sub>	10	EVC <sub>1</sub>																		
12	EVC <sub>2</sub>	12	EVC <sub>2</sub>																		
Bandwidth Profile	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="5">Per Ingress UNI</th> </tr> <tr> <th>UNI</th> <th colspan="4">Bandwidth Profile Parameters</th> </tr> <tr> <th>UNI<sub>A</sub></th> <th>CIR<sub>A</sub></th> <th>CBS<sub>A</sub></th> <th>EIR<sub>A</sub></th> <th>EBS<sub>A</sub></th> </tr> </thead> <tbody> <tr> <td colspan="5">Note 1 : (0 &lt; CIR<sub>A</sub> &lt; UNI Speed), (CBS<sub>A</sub> ≥ maximum Service Frame size)</td> </tr> </tbody> </table>	Per Ingress UNI					UNI	Bandwidth Profile Parameters				UNI <sub>A</sub>	CIR <sub>A</sub>	CBS <sub>A</sub>	EIR <sub>A</sub>	EBS <sub>A</sub>	Note 1 : (0 < CIR <sub>A</sub> < UNI Speed), (CBS <sub>A</sub> ≥ maximum Service Frame size)				
Per Ingress UNI																					
UNI	Bandwidth Profile Parameters																				
UNI <sub>A</sub>	CIR <sub>A</sub>	CBS <sub>A</sub>	EIR <sub>A</sub>	EBS <sub>A</sub>																	
Note 1 : (0 < CIR <sub>A</sub> < UNI Speed), (CBS <sub>A</sub> ≥ maximum Service Frame size)																					
Service Performance	Not Specified																				
Test Procedure	<p>Tester offers Service Frames of length <math>\lambda</math> into the configured EVCs at the ingress UNI and verifies that over a time interval <math>T</math> at least one Service Frame from each of the EVCs is delivered at the associated egress UNIs. Service Frames are offered at equal average rates into each of the configured EVCs at the ingress UNI, at an aggregate average rate greater than the CIR<sub>A</sub>. Tester also verifies that the amount of traffic delivered at the egress UNI does not exceed (<math>W_G + W_Y</math>) where:</p> <ul style="list-style-type: none"> <li><math>W_G</math> is the amount of traffic accepted as Green over the time interval <math>T</math> that should be delivered to the egress UNI</li> <li><math>W_Y</math> is the amount of traffic accepted as Yellow over the time interval <math>T</math> that may be delivered to the egress UNI</li> </ul>																				
Units	Number of valid Service Frames																				
Variables	Bandwidth Profile Parameters CIR <sub>A</sub> , CBS <sub>A</sub> , EIR <sub>A</sub> , EBS <sub>A</sub> , UNIs interface speed, number of UNIs, number of EVCs per UNI, type of EVC (Point-to-Point and Multipoint-to-Multipoint), number and values of CE-VLAN IDs, time interval $T$ , number and length $\lambda$ of the offered Service Frames																				
Results	Pass or fail																				
Remarks																					

**Test Case 8: Bandwidth Profile per EVC**

ABSTRACT TEST SUITE FOR TRAFFIC MANAGEMENT: PHASE 1																	
Test Name	Bandwidth Profile per EVC																
Test Definition ID	M.7.10.4																
Reference Document	MEF 10 [Ethernet Services Attributes Phase 1]																
Test Type	Conformance																
Test Status	Mandatory																
Requirement Description	When a UNI is associated with a per EVC Bandwidth Profile, the Bandwidth Profile <b>MUST</b> be applied to all ingress Service Frames at the UNI on that EVC																
Test Object	Verify that when a UNI is associated with a per EVC Bandwidth Profile, the Bandwidth Profile is applied to all ingress Service Frames at the UNI on that EVC																
Test Configuration	At least two EVCs associating at least two UNIs are configured such that each associated UNI is in at least two of the same EVCs and at least one CE-VLAN ID is mapped per EVC. A per EVC Bandwidth Profile is associated with at least one of the UNIs. Testers are attached to all UNIs in the configured EVCs																
VLAN-ID/EVC Map	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">INGRESS UNI 'A'</th> <th colspan="2">EGRESS UNI 'B'</th> </tr> <tr> <th>CE-VLAN ID</th> <th>EVC</th> <th>CE-VLAN ID</th> <th>EVC</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>EVC<sub>1</sub></td> <td>10</td> <td>EVC<sub>1</sub></td> </tr> <tr> <td>12</td> <td>EVC<sub>2</sub></td> <td>12</td> <td>EVC<sub>2</sub></td> </tr> </tbody> </table> <p>Use of other CE-VLAN IDs is permitted provided that configuration of the CE-VLAN IDs conforms to MEF 10 [Ethernet Services Attributes Phase 1], Section 7.5.1</p>	INGRESS UNI 'A'		EGRESS UNI 'B'		CE-VLAN ID	EVC	CE-VLAN ID	EVC	10	EVC <sub>1</sub>	10	EVC <sub>1</sub>	12	EVC <sub>2</sub>	12	EVC <sub>2</sub>
INGRESS UNI 'A'		EGRESS UNI 'B'															
CE-VLAN ID	EVC	CE-VLAN ID	EVC														
10	EVC <sub>1</sub>	10	EVC <sub>1</sub>														
12	EVC <sub>2</sub>	12	EVC <sub>2</sub>														
Bandwidth Profile	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="4">Per EVC</th> </tr> <tr> <th>EVC</th> <th colspan="3">Bandwidth Profile Parameters</th> </tr> </thead> <tbody> <tr> <td>EVC<sub>1</sub></td> <td>CIR<sub>1</sub></td> <td>CBS<sub>1</sub></td> <td>EIR<sub>1</sub> EBS<sub>1</sub></td> </tr> <tr> <td>EVC<sub>2</sub></td> <td>CIR<sub>2</sub></td> <td>CBS<sub>2</sub></td> <td>EIR<sub>2</sub> EBS<sub>2</sub></td> </tr> </tbody> </table> <p>Note 1 : (CIR<sub>1</sub> = 0), (CBS<sub>1</sub> = 0) and (EIR<sub>1</sub> = 0) and (EBS<sub>1</sub> = 0)            Note 2 : (0 &lt; CIR<sub>2</sub> &lt; UNI Speed), (CBS<sub>2</sub> ≥ maximum Service Frame size)            Note 3 : (ΣCIR &lt; UNI Speed)</p>	Per EVC				EVC	Bandwidth Profile Parameters			EVC <sub>1</sub>	CIR <sub>1</sub>	CBS <sub>1</sub>	EIR <sub>1</sub> EBS <sub>1</sub>	EVC <sub>2</sub>	CIR <sub>2</sub>	CBS <sub>2</sub>	EIR <sub>2</sub> EBS <sub>2</sub>
Per EVC																	
EVC	Bandwidth Profile Parameters																
EVC <sub>1</sub>	CIR <sub>1</sub>	CBS <sub>1</sub>	EIR <sub>1</sub> EBS <sub>1</sub>														
EVC <sub>2</sub>	CIR <sub>2</sub>	CBS <sub>2</sub>	EIR <sub>2</sub> EBS <sub>2</sub>														
Service Performance	Not Specified																
Test Procedure	<p>Tester offers Service Frames of length <math>\lambda</math> into the configured EVCs at the ingress UNI during a time interval <math>T</math>, at an aggregate average rate in excess of the sum of the CIRs of all the configured EVCs and measures the number of Service Frames delivered at the egress UNI. For EVC<sub>1</sub>, the amount of traffic delivered at the egress UNI must be 0 and for every other configured EVC, the amount of traffic delivered at the egress UNI must not exceed (<math>W_G + W_Y</math>) where:</p> <ul style="list-style-type: none"> <li>· <math>W_G</math> is the amount of traffic accepted as Green over the time interval <math>T</math> that should be delivered to the egress UNI</li> <li>· <math>W_Y</math> is the amount of traffic accepted as Yellow over the time interval <math>T</math> that may be delivered to the egress UNI</li> </ul>																
Units	Number of valid Service Frames																
Variables	Bandwidth Profile Parameters CIR <sub>2</sub> , CBS <sub>2</sub> , EIR <sub>2</sub> , EBS <sub>2</sub> , UNIs interface speed, number of UNIs, number of EVCs per UNI, type of EVC (Point-to-Point and Multipoint-to-Multipoint), number and values of CE-VLAN IDs, time interval $T$ , number and length $\lambda$ of the offered Service Frames																
Results	Pass or fail																
Remarks																	

**Test Case 9: Bandwidth Profile per Class of Service**

ABSTRACT TEST SUITE FOR TRAFFIC MANAGEMENT: PHASE 1																
Test Name	Bandwidth Profile per Class of Service															
Test Definition ID	M.7.10.5															
Reference Document	MEF 10 [Ethernet Services Attributes Phase 1]															
Test Type	Conformance															
Test Status	Mandatory															
Requirement Description	When a UNI is associated with a per Class of Service Bandwidth Profile, the Bandwidth Profile <b>MUST</b> be applied to all ingress Service Frames at the UNI with that specific Class of Service Identifier															
Test Object	Verify that when a UNI is associated with a per Class of Service Bandwidth Profile, the Bandwidth Profile is applied to all ingress Service Frames at the UNI with that specific Class of Service Identifier															
Test Configuration	At least one EVC associating at least two UNIs is configured and at least one CE-VLAN ID is mapped per EVC. A per Class of Service Bandwidth Profile is associated with at least one of the UNIs. At least two CoS Identifiers are used to identify the Class of Service applicable to the Service Frames offered at the UNI. Testers are attached to all UNIs in the configured EVCs															
VLAN-ID/EVC Map	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">INGRESS UNI 'A'</th> <th colspan="2">EGRESS UNI 'B'</th> </tr> <tr> <th>CE-VLAN ID</th> <th>EVC</th> <th>CE-VLAN ID</th> <th>EVC</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>EVC<sub>1</sub></td> <td>10</td> <td>EVC<sub>1</sub></td> </tr> </tbody> </table> <p>Use of other CE-VLAN IDs is permitted provided that configuration of the CE-VLAN IDs conforms to MEF 10 [Ethernet Services Attributes Phase 1], Section 7.5.1</p>	INGRESS UNI 'A'		EGRESS UNI 'B'		CE-VLAN ID	EVC	CE-VLAN ID	EVC	10	EVC <sub>1</sub>	10	EVC <sub>1</sub>			
INGRESS UNI 'A'		EGRESS UNI 'B'														
CE-VLAN ID	EVC	CE-VLAN ID	EVC													
10	EVC <sub>1</sub>	10	EVC <sub>1</sub>													
Bandwidth Profile	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="4">Per Class of Service</th> </tr> <tr> <th>EVC</th> <th>CoS Identifier</th> <th>CE-VLAN CoS</th> <th>Bandwidth Profile Parameters</th> </tr> </thead> <tbody> <tr> <td rowspan="2">EVC<sub>1</sub></td> <td>1</td> <td>1</td> <td>CIR<sub>11</sub> CBS<sub>11</sub> EIR<sub>11</sub> EBS<sub>11</sub></td> </tr> <tr> <td>2</td> <td>7</td> <td>CIR<sub>12</sub> CBS<sub>12</sub> EIR<sub>12</sub> EBS<sub>12</sub></td> </tr> </tbody> </table> <p>Note 1 : (CIR<sub>11</sub> = 0), (CBS<sub>11</sub> = 0) and (EIR<sub>11</sub> = 0) and (EBS<sub>11</sub> = 0)            Note 2 : (0 &lt; CIR<sub>12</sub> &lt; UNI Speed), (CBS<sub>12</sub> ≥ maximum Service Frame size)            Note 3 : (ΣCIR &lt; UNI Speed)</p>	Per Class of Service				EVC	CoS Identifier	CE-VLAN CoS	Bandwidth Profile Parameters	EVC <sub>1</sub>	1	1	CIR <sub>11</sub> CBS <sub>11</sub> EIR <sub>11</sub> EBS <sub>11</sub>	2	7	CIR <sub>12</sub> CBS <sub>12</sub> EIR <sub>12</sub> EBS <sub>12</sub>
Per Class of Service																
EVC	CoS Identifier	CE-VLAN CoS	Bandwidth Profile Parameters													
EVC <sub>1</sub>	1	1	CIR <sub>11</sub> CBS <sub>11</sub> EIR <sub>11</sub> EBS <sub>11</sub>													
	2	7	CIR <sub>12</sub> CBS <sub>12</sub> EIR <sub>12</sub> EBS <sub>12</sub>													
Service Performance	Not Specified															
Test Procedure	<p>Tester offers Service Frames of length <math>\lambda</math> into the configured EVCs at the ingress UNI during a time interval <math>T</math>, at an aggregate average rate in excess of the sum of the CIRs of all the configured CoS IDs and measures the number of Service Frames delivered at the egress UNI. For CoS ID 1, the amount of traffic delivered at the egress UNI must be 0 and for every other configured CoS ID, the amount of traffic delivered at the egress UNI must not exceed (<math>W_G + W_Y</math>) where:</p> <ul style="list-style-type: none"> <li><math>W_G</math> is the amount of traffic accepted as Green over the time interval <math>T</math> that should be delivered to the egress UNI</li> <li><math>W_Y</math> is the amount of traffic accepted as Yellow over the time interval <math>T</math> that may be delivered to the egress UNI</li> </ul>															
Units	Number of valid Service Frames															
Variables	Bandwidth Profile Parameters CIR <sub>12</sub> , CBS <sub>12</sub> , EIR <sub>12</sub> , EBS <sub>12</sub> , UNIs interface Speed, number of UNIs, number of EVCs per UNI, number of CoS Identifiers per EVC, type of EVC (Point-to-Point and Multipoint-to-Multipoint), number and values of CE-VLAN IDs, number and values of CE-VLAN CoS, time interval $T$ , number and length $\lambda$ of the offered Service Frames															
Results	Pass or fail															
Remarks																



**Test Case 10: Multiple Bandwidth Profiles at the UNI**

ABSTRACT TEST SUITE FOR TRAFFIC MANAGEMENT: PHASE 1																																												
Test Name	Multiple Bandwidth Profiles at the UNI																																											
Test Definition ID	M.7.10.6																																											
Reference Document	MEF 10 [Ethernet Services Attributes Phase 1]																																											
Test Type	Conformance																																											
Test Status	Optional																																											
Requirement Description	Multiple models of Bandwidth Profile application <b>MAY</b> exist simultaneously at the UNI																																											
Test Object	Verify that multiple models of Bandwidth Profile application can exist simultaneously at the UNI																																											
Test Configuration	At least two EVCs associating at least two UNIs are configured such that each associated UNI is in at least two of the same EVCs and at least one CE-VLAN ID is mapped per EVC. A per EVC Bandwidth Profile and a per Class of Service Bandwidth Profile are associated with at least one of the UNIs. Testers are attached to all UNIs in the configured EVCs																																											
VLAN-ID/EVC Map	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2">INGRESS UNI 'A'</th> <th colspan="2">EGRESS UNI 'B'</th> </tr> <tr> <th>CE-VLAN ID</th> <th>EVC</th> <th>CE-VLAN ID</th> <th>EVC</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>EVC<sub>1</sub></td> <td>10</td> <td>EVC<sub>1</sub></td> </tr> <tr> <td>12</td> <td>EVC<sub>2</sub></td> <td>12</td> <td>EVC<sub>2</sub></td> </tr> </tbody> </table> <p>Use of other CE-VLAN IDs is permitted provided that configuration of the CE-VLAN IDs conforms to MEF 10 [Ethernet Services Attributes Phase 1], Section 7.5.1</p>	INGRESS UNI 'A'		EGRESS UNI 'B'		CE-VLAN ID	EVC	CE-VLAN ID	EVC	10	EVC <sub>1</sub>	10	EVC <sub>1</sub>	12	EVC <sub>2</sub>	12	EVC <sub>2</sub>																											
INGRESS UNI 'A'		EGRESS UNI 'B'																																										
CE-VLAN ID	EVC	CE-VLAN ID	EVC																																									
10	EVC <sub>1</sub>	10	EVC <sub>1</sub>																																									
12	EVC <sub>2</sub>	12	EVC <sub>2</sub>																																									
Bandwidth Profile	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="4">Per EVC</th> </tr> <tr> <th>EVC</th> <th colspan="3">Bandwidth Profile Parameters</th> </tr> </thead> <tbody> <tr> <td>EVC<sub>1</sub></td> <td>CIR<sub>1</sub></td> <td>CBS<sub>1</sub></td> <td>EIR<sub>1</sub> EBS<sub>1</sub></td> </tr> <tr> <td colspan="4">Note 1 : (0 &lt; CIR<sub>1</sub> &lt; UNI Speed), (CBS<sub>1</sub> ≥ maximum Service Frame size)</td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="4">Per Class of Service</th> </tr> <tr> <th>EVC</th> <th>CoS Identifier</th> <th>CE-VLAN CoS</th> <th>Bandwidth Profile Parameters</th> </tr> </thead> <tbody> <tr> <td rowspan="2">EVC<sub>2</sub></td> <td>1</td> <td>1</td> <td>CIR<sub>21</sub> CBS<sub>21</sub> EIR<sub>21</sub> EBS<sub>21</sub></td> </tr> <tr> <td>2</td> <td>7</td> <td>CIR<sub>22</sub> CBS<sub>22</sub> EIR<sub>22</sub> EBS<sub>22</sub></td> </tr> <tr> <td colspan="4">Note 2 : (CIR<sub>21</sub> = 0), (CBS<sub>21</sub> = 0) and (EIR<sub>21</sub> = 0), (EBS<sub>21</sub> = 0)</td> </tr> <tr> <td colspan="4">Note 3 : (0 &lt; CIR<sub>22</sub> &lt; UNI Speed), (CBS<sub>22</sub> ≥ maximum Service Frame size)</td> </tr> <tr> <td colspan="4">Note 4 : (ΣCIR &lt; UNI Speed)</td> </tr> </tbody> </table>	Per EVC				EVC	Bandwidth Profile Parameters			EVC <sub>1</sub>	CIR <sub>1</sub>	CBS <sub>1</sub>	EIR <sub>1</sub> EBS <sub>1</sub>	Note 1 : (0 < CIR <sub>1</sub> < UNI Speed), (CBS <sub>1</sub> ≥ maximum Service Frame size)				Per Class of Service				EVC	CoS Identifier	CE-VLAN CoS	Bandwidth Profile Parameters	EVC <sub>2</sub>	1	1	CIR <sub>21</sub> CBS <sub>21</sub> EIR <sub>21</sub> EBS <sub>21</sub>	2	7	CIR <sub>22</sub> CBS <sub>22</sub> EIR <sub>22</sub> EBS <sub>22</sub>	Note 2 : (CIR <sub>21</sub> = 0), (CBS <sub>21</sub> = 0) and (EIR <sub>21</sub> = 0), (EBS <sub>21</sub> = 0)				Note 3 : (0 < CIR <sub>22</sub> < UNI Speed), (CBS <sub>22</sub> ≥ maximum Service Frame size)				Note 4 : (ΣCIR < UNI Speed)			
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EVC	Bandwidth Profile Parameters																																											
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Per Class of Service																																												
EVC	CoS Identifier	CE-VLAN CoS	Bandwidth Profile Parameters																																									
EVC <sub>2</sub>	1	1	CIR <sub>21</sub> CBS <sub>21</sub> EIR <sub>21</sub> EBS <sub>21</sub>																																									
	2	7	CIR <sub>22</sub> CBS <sub>22</sub> EIR <sub>22</sub> EBS <sub>22</sub>																																									
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Note 4 : (ΣCIR < UNI Speed)																																												
Service Performance	Not Specified																																											
Test Procedure	<p>Tester offers Service Frames of length <math>\lambda</math> into the configured EVCs at the ingress UNI during a time interval <math>T</math>, at an aggregate average rate in excess of the sum of the CIRs of all the configured EVCs and CoS IDs and measures the number of Service Frames delivered at the egress UNI. For CoS ID 1, the amount of traffic delivered at the egress UNI must be 0 and for every other configured EVC and CoS ID, the amount of traffic delivered at the egress UNI must not exceed (<math>W_G + W_Y</math>) where:</p> <ul style="list-style-type: none"> <li>• <math>W_G</math> is the amount of traffic accepted as Green over the time interval <math>T</math> that should be delivered to the egress UNI</li> <li>• <math>W_Y</math> is the amount of traffic accepted as Yellow over the time interval <math>T</math> that may be delivered to the egress UNI</li> </ul>																																											
Units	Number of valid Service Frames																																											
Variables	Bandwidth Profile Parameters CIR <sub>1</sub> , CBS <sub>1</sub> , EIR <sub>1</sub> , EBS <sub>1</sub> , CIR <sub>22</sub> , CBS <sub>22</sub> , EIR <sub>22</sub> , EBS <sub>22</sub> , UNIs interface Speed, number of UNIs, number of EVCs per UNI, number of CoS Identifiers per EVC, type of EVC (Point-to-Point and Multipoint-to-Multipoint), number and values of CE-VLAN IDs, number and values of CE-VLAN CoS, time interval $T$ , number and length $\lambda$ of the offered Service Frames																																											
Results	Pass or fail																																											
Remarks																																												



## 10. References

Reference	Reference Details
[1] Ethernet Services Attributes Phase 1	MEF 10 [Ethernet Services Attributes Phase 1]
[2] Services Definitions	MEF 6 [Ethernet Services Definitions]
[3] Abstract Test Suite for Ethernet Services at the UNI	MEF 9 [Abstract Test Suite for Ethernet Services at the UNI]
[4] IEEE 802.3 – 2002	Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications, 8 March 2002. (Normative)
[5] RFC 2119	RFC 2119, “Key words for use in RFCs to Indicate Requirement Levels”, S. Bradner, <a href="http://www.ietf.org/rfc/rfc2119.txt">http://www.ietf.org/rfc/rfc2119.txt</a> (Normative)
[6] RFC 2285	RFC 2285, “Benchmarking Terminology for LAN Switching Devices”, R. Mandeville, <a href="http://www.ietf.org/rfc/rfc2285.txt">http://www.ietf.org/rfc/rfc2285.txt</a>
[7] RFC 2544	RFC 2544, “Benchmarking Methodology for Network Interconnect Devices”, S. Bradner, J. McQuaid, <a href="http://www.ietf.org/rfc/rfc2544.txt">http://www.ietf.org/rfc/rfc2544.txt</a>
[8] RFC 2889	RFC 2889, “Benchmarking Methodology for LAN Switching Devices”, R. Mandeville, J. Perser, <a href="http://www.ietf.org/rfc/rfc2889.txt">http://www.ietf.org/rfc/rfc2889.txt</a>