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

All to One Bundling	A UNI attribute in which all CE-VLAN IDs are associated with a single EVC.
Bandwidth Profile	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.
Broadcast Service Frame	A Service Frame that has the broadcast destination MAC address.
Bundling	A UNI attribute in which more than one CE-VLAN ID can be associated with an EVC.
CBS	Committed Burst Size
CE	Customer Edge
CE-VLAN CoS	Customer Edge VLAN CoS
CE-VLAN ID	Customer Edge VLAN ID
CE-VLAN ID Preservation	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.
CE-VLAN ID/EVC Map	An association of CE-VLAN IDs with EVCs at a UNI.
CE-VLAN Tag	Customer Edge VLAN Tag
CF	Coupling Flag
CIR	Committed Information Rate
Class of Service	A set of Service Frames that have a commitment from the Service Provider to receive a particular level of performance.
Class of Service Identifier	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.
CM	Color Mode

Color Mode	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.
Color-aware	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.
Color-blind	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.
Committed Burst Size	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.
Committed Information Rate	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.
Coupling Flag	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.
Customer Edge	Equipment on the Subscriber side of the UNI.
Customer Edge VLAN CoS	The user priority bits in the IEEE 802.1Q Tag in a Service Frame that is either tagged or priority tagged.
Customer Edge VLAN ID	The identifier derivable from the content of a Service Frame that allows the Service Frame to be associated with an EVC at the UNI.
Customer Edge VLAN Tag	The IEEE 802.1Q Tag in a tagged Service Frame.
EBS	Excess Burst Size
Egress Service Frame	A Service Frame sent from the Service Provider network to the CE.
EIR	Excess Information Rate
E-LAN Service	Ethernet LAN Service
E-Line Service	Ethernet Line Service
Ethernet LAN Service	An Ethernet Service Type distinguished by its use of a Multipoint-to-Multipoint EVC.
Ethernet Line Service	An Ethernet Service Type distinguished by its use of a Point-to-Point EVC.
Ethernet Virtual Connection	An association of two or more UNIs that limits the exchange of Service Frames to UNIs in the Ethernet Virtual Connection.

EVC	Ethernet Virtual Connection
Excess Burst Size	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.
Excess Information Rate	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.
FD	Frame Delay
FDV	Frame Delay Variation
FLR	Frame Loss Ratio
Frame	Short for Ethernet frame.
Frame Delay	The time required to transmit a Service Frame from source to destination across the metro Ethernet network.
Frame Delay Performance	A measure of the delays experienced by different Service Frames belonging to the same CoS instance.
Frame Delay Variation	The difference in delay of two Service Frames.
Frame Delay Variation Performance	A measure of the variation in the delays experienced by different Service Frames belonging to the same CoS instance.
Frame Loss Ratio Performance	Frame Loss Ratio is a measure of the number of lost frames inside the MEN. Frame Loss Ratio is expressed as a percentage.
Ingress Service Frame	A Service Frame sent from the CE into the Service Provider network.
Layer 2 Control Protocol Service Frame	A Service Frame that is used for Layer 2 control, e.g., Spanning Tree Protocol.
Layer 2 Control Protocol Tunneling	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).
Multicast Service Frame	A Service Frame that has a multicast destination MAC address.
Multipoint-to-Multipoint EVC	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.
Point-to-Point EVC	An EVC with exactly 2 UNIs.
Service Frame	An Ethernet frame transmitted across the UNI toward the Service Provider or an Ethernet frame transmitted across the UNI toward the Subscriber.
Service Level Agreement	The contract between the Subscriber and Service Provider specifying the agreed to service level commitments and related business agreements.

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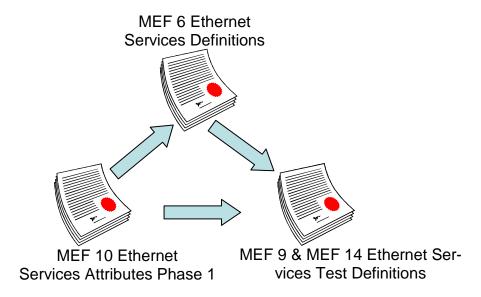

Figure 1: Relationship between different MEF Services Group documents and the Ethernet Services Test Definition Documents

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.
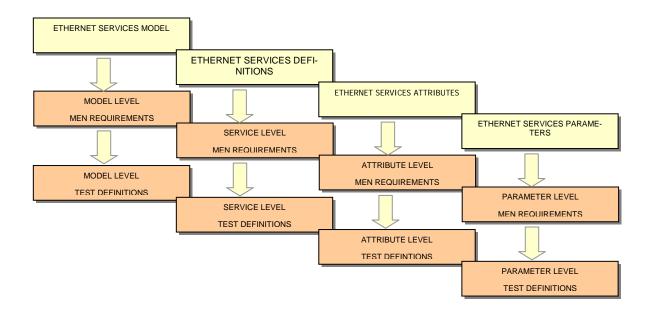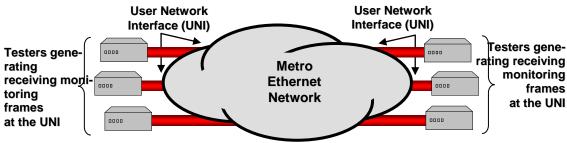

Figure 2: Relationship between Ethernet Service Documents and Abstract Test Cases for Ethernet Services at the UNI

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_1	10	EVC_1
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_A	CIR_A CBS_A EIR_A EBS_A
Note 1 : $(0 < CIR_A \leq$ UNI Speed), $(CBS_A \geq$ 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_1 FDV_1 FLR_1

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 **MUST** or **SHOULD** satisfy
Test Object	Succinct description of test purpose
Test Configuration	Succinct description of test bed configuration
VLAN-ID/EVC Map	A sample VLAN ID/EVC Map is suggested. Variables augment it. See table below
Bandwidth Profile	See table below
Service Performance	See table below
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 **MUST** 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

VLAN-ID/EVC Map:

INGRESS UNI 'A'		EGRESS UNI 'B'	
CE-VLAN ID	**EVC**	**CE-VLAN ID**	**EVC**
10	EVC_1	10	EVC_1

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

Bandwidth Profile:

Per Ingress UNI	
UNI	**Bandwidth Profile Parameters**
UNI_A	CIR_A CBS_A EIR_A EBS_A

Note 1 : ($0 < CIR_A \le$ UNI Speed), ($CBS_A \ge$ maximum Service Frame size)

Service Performance:

CoS Identifier	EVC Performance Service Attributes	Performance Objectives
1	Frame Delay (FD) Performance Frame Delay Variation (FDV) Performance Frame Loss Ratio (FLR) Performance	FD_1 FDV_1 FLR_1

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 **MUST** 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><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><tr><td>10</td><td>EVC_1</td><td>10</td><td>EVC_1</td></tr></table> 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.
Bandwidth Profile	<table><tr><th colspan="2">Per Ingress UNI</th></tr><tr><th>UNI</th><th>Bandwidth Profile Parameters</th></tr><tr><td>UNI_A</td><td>CIR_A CBS_A EIR_A EBS_A</td></tr></table> Note 1 : $(0 < CIR_A \le$ UNI Speed), $(CBS_A \ge$ maximum Service Frame size)
Service Performance	<table><tr><th>CoS Identifier</th><th>EVC Performance Service Attributes</th><th>Performance Objectives</th></tr><tr><td>1</td><td>Frame Delay (FD) Performance</td><td>FD_1</td></tr></table>
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_A
Units	Time units
Variables	Bandwidth Profile Parameters CIR_A, CBS_A, EIR_A, EBS_A, 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_1
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 **MUST** 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	(see table below)
Bandwidth Profile	(see table below)
Service Performance	(see table below)
Test Procedure	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 *T,* as the P-Percentile of the difference between the frame delays of a Service Frame pair that satisfies the following two characteristics: 1. The two Service Frames that comprise the pair arrive at the ingress UNI within the time interval *T* 2. The two Service Frames that comprise the pair arrive at the ingress UNI exactly *Δt* time units apart. Service Frames may be offered at an average rate up to CIR_A
Units	Time units
Variables	Bandwidth Profile Parameters CIR_A, CBS_A, EIR_A, EBS_A, 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_1
Results	Pass or fail
Remarks	

VLAN-ID/EVC Map:

INGRESS UNI 'A'		EGRESS UNI 'B'	
CE-VLAN ID	**EVC**	**CE-VLAN ID**	**EVC**
10	EVC_1	10	EVC_1

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.

Bandwidth Profile:

Per Ingress UNI	
UNI	**Bandwidth Profile Parameters**
UNI_A	CIR_A CBS_A EIR_A EBS_A

Note 1 : (0 < CIR_A ≤ UNI Speed), (CBS_A ≥ maximum Service Frame size)

Service Performance:

CoS Identifier	EVC Performance Service Attributes	Performance Objectives
1	Frame Delay Variation (FDV) Performance	FDV_1

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 **MUST** 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

INGRESS UNI 'A'			EGRESS UNI 'B'	
CE-VLAN ID	**EVC**		**CE-VLAN ID**	**EVC**
10	EVC_1		10	EVC_1

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.

Bandwidth Profile

Per Ingress UNI	
UNI	**Bandwidth Profile Parameters**
UNI_A	CIR_A CBS_A EIR_A EBS_A

Note 1 : (0 < CIR_A ≤ UNI Speed), (CBS_A ≥ maximum Service Frame size)

Service Performance

CoS Identifier	EVC Performance Service Attributes	Performance Objectives
1	Frame Loss Ratio (FLR) Performance	FLR_1

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_A
Units	Number of Service Frames
Variables	Bandwidth Profile Parameters CIR_A, CBS_A, EIR_A, EBS_A, 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_1
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 **MUST 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 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

INGRESS UNI 'A'		EGRESS UNI 'B'	
CE-VLAN ID	**EVC**	**CE-VLAN ID**	**EVC**
10	EVC_1	10	EVC_1

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

Bandwidth Profile

Per Ingress UNI	
UNI	**Bandwidth Profile Parameters**
UNI_A	CIR_A CBS_A EIR_A EBS_A

Note 1 : (0 < CIR_A < UNI Speed), (CBS_A ≥ maximum Service Frame size)
Note 2 : (EIR_A = 0) and (EBS_A = 0)

Service Performance	Not Specified
Test Procedure	Tester offers Service Frames of length λ at an average rate greater than CIR_A to the ingress UNI during a time interval T and measures the number of Service Frames delivered at the egress UNI. The amount of traffic delivered at the egress UNI must not exceed W_G where: · W_G is the amount of traffic accepted as Green over the time interval T that should be delivered to the egress UNI
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 λ 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 **MUST 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 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

INGRESS UNI 'A'		EGRESS UNI 'B'	
CE-VLAN ID	EVC	CE-VLAN ID	EVC
10	EVC_1	10	EVC_1

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

Bandwidth Profile

Per Ingress UNI	
UNI	Bandwidth Profile Parameters
UNI_A	CIR_A CBS_A EIR_A EBS_A

Note 1 : ($CIR_A = 0$) and ($CBS_A = 0$)
Note 2 : ($0 < EIR_A <$ UNI Speed), ($EBS_A \geq$ maximum Service Frame size)

Service Performance	Not Specified
Test Procedure	Tester offers Service Frames of length λ at an average rate greater than EIR_A to the ingress UNI during a time interval T and measures the number of Service Frames delivered at the egress UNI. The amount of traffic delivered at the egress UNI must not exceed W_Y where: · W_Y is the amount of traffic accepted as Yellow over the time interval T that may be delivered to the egress UNI
Units	Number of valid Service Frames
Variables	Bandwidth Profile Parameters 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 λ 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 **MUST 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 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

INGRESS UNI 'A'		EGRESS UNI 'B'	
CE-VLAN ID	EVC	CE-VLAN ID	EVC
10	EVC_1	10	EVC_1

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

Bandwidth Profile

Per Ingress UNI	
UNI	Bandwidth Profile Parameters
UNI_A	CIR_A CBS_A EIR_A EBS_A

Note 1 : (0 < CIR_A < UNI Speed), ($CBS_A \geq$ maximum Service Frame size)
Note 2 : (0 < EIR_A < UNI Speed), ($EBS_A \geq$ maximum Service Frame size)
Note 3 : ($CIR_A + EIR_A$ < UNI Speed)

Service Performance	Not Specified
Test Procedure	Tester offers Service Frames of length λ at an average rate greater than $CIR_A + EIR_A$ to the ingress UNI during a time interval T and measures the number of Service Frames delivered at the egress UNI. The amount of traffic delivered at the egress UNI must not exceed $(W_G + W_y)$ where: · W_G is the amount of traffic accepted as Green over the time interval T that should be delivered to the egress UNI · W_Y is the amount of traffic accepted as Yellow over the time interval T that may be delivered to the egress UNI
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 λ 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 **MUST** 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

INGRESS UNI 'A'			EGRESS UNI 'B'	
CE-VLAN ID	**EVC**		**CE-VLAN ID**	**EVC**
10	EVC_1		10	EVC_1
12	EVC_2		12	EVC_2

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

Bandwidth Profile

Per Ingress UNI	
UNI	**Bandwidth Profile Parameters**
UNI_A	CIR_A CBS_A EIR_A EBS_A

Note 1 : (0 < CIR_A < UNI Speed), (CBS_A ≥ maximum Service Frame size)

Service Performance	Not Specified
Test Procedure	Tester offers Service Frames of length λ into the configured EVCs at the ingress UNI and verifies that over a time interval T 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_A. Tester also verifies that the amount of traffic delivered at the egress UNI does not exceed $(W_G + W_Y)$ where: · W_G is the amount of traffic accepted as Green over the time interval T that should be delivered to the egress UNI · W_Y is the amount of traffic accepted as Yellow over the time interval T that may be delivered to the egress UNI
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 λ 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 **MUST** 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	(see table below)
Bandwidth Profile	(see table below)
Service Performance	Not Specified
Test Procedure	Tester offers Service Frames of length λ into the configured EVCs at the ingress UNI during a time interval T, 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_1, 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 $(W_G + W_Y)$ where: · W_G is the amount of traffic accepted as Green over the time interval T that should be delivered to the egress UNI · W_Y is the amount of traffic accepted as Yellow over the time interval T that may be delivered to the egress UNI
Units	Number of valid Service Frames
Variables	Bandwidth Profile Parameters CIR_2, CBS_2, EIR_2, EBS_2, 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 λ of the offered Service Frames
Results	Pass or fail
Remarks	

VLAN-ID/EVC Map:

INGRESS UNI 'A'		EGRESS UNI 'B'	
CE-VLAN ID	EVC	CE-VLAN ID	EVC
10	EVC_1	10	EVC_1
12	EVC_2	12	EVC_2

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

Bandwidth Profile:

Per EVC	
EVC	Bandwidth Profile Parameters
EVC_1	CIR_1 CBS_1 EIR_1 EBS_1
EVC_2	CIR_2 CBS_2 EIR_2 EBS_2

Note 1 : $(CIR_1 = 0)$, $(CBS_1 = 0)$ and $(EIR_1 = 0)$ and $(EBS_1 = 0)$
Note 2 : $(0 < CIR_2 < UNI\ Speed)$, $(CBS_2 \geq maximum\ Service\ Frame\ size)$
Note 3 : $(\sum CIR < UNI\ Speed)$

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 **MUST** 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

INGRESS UNI 'A'		EGRESS UNI 'B'	
CE-VLAN ID	EVC	CE-VLAN ID	EVC
10	EVC_1	10	EVC_1

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

Bandwidth Profile

Per Class of Service			
EVC	CoS Identifier	CE-VLAN CoS	Bandwidth Profile Parameters
EVC_1	1	1	CIR_{11} CBS_{11} EIR_{11} EBS_{11}
	2	7	CIR_{12} CBS_{12} EIR_{12} EBS_{12}

Note 1 : (CIR_{11} = 0), (CBS_{11} = 0) and (EIR_{11} = 0) and (EBS_{11} = 0)
Note 2 : (0 < CIR_{12} < UNI Speed), (CBS_{12} ≥ maximum Service Frame size)
Note 3 : ($\sum CIR$ < UNI Speed)

Service Performance	Not Specified
Test Procedure	Tester offers Service Frames of length λ into the configured EVCs at the ingress UNI during a time interval T, 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 $(W_G + W_Y)$ where: · W_G is the amount of traffic accepted as Green over the time interval T that should be delivered to the egress UNI · W_Y is the amount of traffic accepted as Yellow over the time interval T that may be delivered to the egress UNI
Units	Number of valid Service Frames
Variables	Bandwidth Profile Parameters CIR_{12}, CBS_{12}, EIR_{12}, EBS_{12}, 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 λ 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 **MAY** 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

INGRESS UNI 'A'		EGRESS UNI 'B'	
CE-VLAN ID	**EVC**	**CE-VLAN ID**	**EVC**
10	EVC_1	10	EVC_1
12	EVC_2	12	EVC_2

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

Bandwidth Profile

Per EVC

EVC	Bandwidth Profile Parameters
EVC_1	CIR_1 CBS_1 EIR_1 EBS_1

Note 1 : $(0 < CIR_1 < $ UNI Speed$)$, $(CBS_1 \geq$ maximum Service Frame size$)$

Per Class of Service

EVC	CoS Identifier	CE-VLAN CoS	Bandwidth Profile Parameters
EVC_2	1	1	CIR_{21} CBS_{21} EIR_{21} EBS_{21}
	2	7	CIR_{22} CBS_{22} EIR_{22} EBS_{22}

Note 2 : $(CIR_{21} = 0)$, $(CBS_{21} = 0)$ and $(EIR_{21} = 0)$, $(EBS_{21} = 0)$
Note 3 : $(0 < CIR_{22} < $ UNI Speed$)$, $(CBS_{22} \geq$ maximum Service Frame size$)$
Note 4 : $(\sum CIR < $ UNI Speed$)$

Service Performance	Not Specified
Test Procedure	Tester offers Service Frames of length λ into the configured EVCs at the ingress UNI during a time interval T, 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 $(W_G + W_Y)$ where: · W_G is the amount of traffic accepted as Green over the time interval T that should be delivered to the egress UNI · W_Y is the amount of traffic accepted as Yellow over the time interval T that may be delivered to the egress UNI
Units	Number of valid Service Frames
Variables	Bandwidth Profile Parameters CIR_1, CBS_1, EIR_1, EBS_1, CIR_{22}, CBS_{22}, EIR_{22}, EBS_{22}, 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 λ 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, http://www.ietf.org/rfc/rfc2119.txt (Normative)
[6] RFC 2285	RFC 2285, "Benchmarking Terminology for LAN Switching Devices", R. Mandeville, http://www.ietf.org/rfc/rfc2285.txt
[7] RFC 2544	RFC 2544, "Benchmarking Methodology for Network Interconnect Devices", S. Bradner, J. McQuaid, http://www.ietf.org/rfc/rfc2544.txt
[8] RFC 2889	RFC 2889, "Benchmarking Methodology for LAN Switching Devices", R. Mandeville, J. Perser, http://www.ietf.org/rfc/rfc2889.txt