Technical Specification

MEF 48

Carrier Ethernet Service Activation Testing (SAT)

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1 List of Contributing Members

The following members of the MEF participated in the development of this document and have requested to be included in this list.

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2 Abstract

This document specifies the requirements and use cases for Carrier Ethernet Service Activation Testing (SAT) for E-Access services (Access Ethernet Private Line (Access EPL) and Access Ethernet Virtual Private Line (Access EVPL)) as defined in MEF 33 [20]. Service Activation Testing encompasses those business processes for testing MEF services to ensure that the service is configured as specified and meets the defined Service Acceptance Criteria (SAC). Service Activation Testing occurs after the Operator Virtual Connection (OVC) for an E-Access service [20] has been provisioned and before the service is deployed to the customer.

3 Terminology and Acronyms

This section defines the terms used in this document. In many cases, the normative definitions to terms are found in other documents. In these cases, the third column is used to provide the reference that is controlling, in other MEF or external documents.

Term	Definition	Reference
Access EPL	Access Ethernet Private Line	MEF 33 [20]
Access EVPL	Access Ethernet Virtual Private Line	MEF 33 [20]
AP	Access Provider	MEF 33 [20]
Bandwidth Profile	A Bandwidth Profile is a characterization of the lengths and arrival times for Service Frames at a reference point.	MEF 10.3 [13]
BWP	Bandwidth Profile	MEF 10.3 [13]
Carrier Ethernet Network	A network from a Service Provider or Network Operator supporting the MEF service and architecture models.	MEF 12.2 [14]
CBS	Committed Burst Size	MEF 10.3 [13]
CEN	Carrier Ethernet Network	MEF 12.2 [14]
CF	Coupling Flag	MEF 10.3 [13]
CIR	Committed Information Rate	MEF 10.3 [13]
CM	Color Mode	MEF 10.3 [13]
Collector Test Function	A logical function for collecting Ethernet test measurements.	This document
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.	MEF 10.3 [13]
Color-aware	A Bandwidth Profile property where a predetermined level of Bandwidth Profile compliance for each Service Frame is taken into account when determining the level of compliance for each Service Frame.	MEF 10.3 [13]
Color-blind	A Bandwidth Profile property where a predetermined level of Bandwidth Profile compliance for each Service Frame, if present, is ignored when determining the level of compliance for each Service Frame.	MEF 10.3 [13]
Committed Burst Size	CBS is a Bandwidth Profile parameter. It limits the maximum number of bytes available for a burst of Service Frames sent at the UNI speed to remain CIR-conformant.	MEF 10.3 [13]
Committed Information Rate	CIR is a Bandwidth Profile parameter. It defines the average rate in bits/s of Service Frames up to which the network delivers Service Frames and meets the performance objectives defined the CoS Service Attribute.	MEF 10.3 [13]
CoS	Class of Service or Classes of Service	MEF 23.1 [17]
CoS Performance Objective	Performance objective specified for a CoS Label or CoS Name.	MEF 23.1 [17]
CTF	Collector Test Function	This document

Term	Definition	Reference
Coupling Flag	CF is a Bandwidth Profile parameter. The Coupling Flag allows the choice between two modes of operation of the rate enforcement algorithm. It takes a value of 0 or 1 only.	MEF 10.3 [13]
CPO	CoS Performance Objective	MEF 23.1 [17]
Double-tagged Frames	IEEE 802.1ad Ethernet frames with two tags. The outer tag is an S-Tag, the inner tag is a C-Tag.	MEF 37 [22]
Dual-Ended	A type of process where a MEP sends measurement information to a peer MEP that will perform the calculations.	MEF 35 [21]
E-Access	Ethernet Access	MEF 33 [20]
EBS	Excess Burst Size	MEF 10.3 [13]
EFD	ETH Flow Domain	MEF 12.2 [14]
Egress Bandwidth Profile	A service attribute that specifies the length and arrival time characteristics of egress Service Frames at the egress UNI.	MEF 10.3 [13]
EIR	Excess Information Rate	MEF 10.3 [13]
EMIX	Ethernet Mix	ITU-T Y.1564 [11]
ENNI	External Network Network Interface	MEF 4 [12]
ENNI Frame	The first bit of the Destination Address to the last bit of the Frame Check Sequence of the Ethernet frame transmitted across the ENNI.	MEF 26.1 [18]
EPCF	ETH Provider Conditioning Function	MEF 12.2 [14]
ESCF	ETH Subscriber Conditioning Function	MEF 12.2 [14]
ETE	Ethernet Test Equipment	MEF 46 [23]
ETE-A	Ethernet Test Equipment-Application	MEF 46 [23]
ETE-I	Ethernet Test Equipment-Instrument	MEF 46 [23]
ETE-TH	Ethernet Test Equipment-Test Head	MEF 46 [23]
ETH	Ethernet Layer or Ethernet Services Layer	MEF 4 [12]
ETH Flow Domain	An ETH Flow Domain (EFD) is a topological component of the ETH Layer formally defined by the set of ETH flow points, including termination flow points, made available for the purpose of transferring information within a given administrative portion of the ETH Layer network.	MEF 12.2 [14]
ETH Provider Conditioning Function	The ETH Provider Conditioning Function (EPCF) is the processing entity of the ETH Layer responsible for classification, filtering, metering, marking, policing, scheduling, shaping and, in general, conditioning flow(s) between two CENs.	MEF 12.2 [14]

Term	Definition	Reference
ETH Subscriber Conditioning Function	The ETH Subscriber Conditioning Function (ESCF) is the processing entity of the ETH Layer responsible for classification, filtering, metering, marking, policing, scheduling, shaping and, in general, conditioning the subscriber flow into and out of a Service Provider EFD at a UNI-N.	MEF 12.2 [14]
Ethernet Equipment	A Network Element or Ethernet Test Equipment, with ETH functions, installed or used in a CEN.	MEF 46 [23]
Ethernet Mix	An Ethernet traffic pattern consisting of a preset mixture of Ethernet test frame sizes used to emulate real-world traffic scenarios in a testing environment.	ITU-T Y.1564 [11]
Ethernet Services Layer	The Ethernet Services Layer, also referred to as the ETH Layer, is responsible for the instantiation of Ethernet MAC oriented connectivity services and the delivery of Ethernet service frames presented across well-defined internal and external interfaces and associated reference points. The ETH layer is also responsible for all service-aware aspects associated with Ethernet MAC flows including operations, administration, maintenance and provisioning capabilities required to support such Ethernet connectivity services.	MEF 4 [12]
Ethernet Test Equipment	A general term to include an Ethernet Test Equipment-Application, Ethernet Test Equipment-Test Head and/or Ethernet Test Equipment-Instrument.	MEF 46 [23]
Ethernet Test Equipment-Application	Functionality resident in a Network Element, which may include a Generator Test Function, a Collector Test Function, and/or Latching Loopback Function that enables the Network Element to perform Service Activation Testing and activate/deactivate loopback devices.	MEF 46 [23]
Ethernet Test Equipment-Instrument	A portable, external Ethernet testing equipment not permanently installed in the network, which may include a Generator Test Function, a Collector Test Function, and/or Latching Loopback Function that enables the ETE to perform Service Activation Testing and activate/deactivate loopback devices.	MEF 46 [23]
Ethernet Test Equipment-Test Head	An external Ethernet testing equipment permanently installed in the network, which may include a Generator Test Function, a Collector Test Function, and/or Latching Loopback Function that enables the ETE to perform Service Activation Testing and activate/deactivate loopback devices. It is not involved in the forwarding path of services.	MEF 46 [23]

Term	Definition	Reference
Ethernet Test Support System	A function that coordinates test activity at Ethernet Test Equipment or Network Elements.	MEF 46 [23]
Ethernet Virtual Connection	An association of two or more UNIs that limits the exchange of Service Frames to UNIs in the Ethernet Virtual Connection.	MEF 10.3 [13]
ETSS	Ethernet Test Support System	This document
EVC	Ethernet Virtual Connection	MEF 10.3 [13]
Excess Burst Size	EBS is a Bandwidth Profile parameter. It limits the maximum number of bytes available for a burst of Service Frames sent at the UNI speed to remain EIR-conformant.	MEF 10.3 [13]
Excess Information Rate	EIR is a Bandwidth Profile parameter. It defines the average rate in bits/s of Service Frames up to which the network may deliver Service Frames but without any performance objectives.	MEF 10.3 [13]
External Network Network Interface	A reference point representing the boundary between two Operator MENs that are operated as separate administrative domains.	MEF 4 [12]
FD	Frame Delay	MEF 10.3 [13]
FDR	Frame Delay Range	MEF 10.3 [13]
FLR	Frame Loss Ratio	MEF 10.3 [13]
Frame Delay	The time required to transmit a Service Frame from ingress UNI to egress UNI.	MEF 10.3 [13]
Frame Delay Performance	A measure of the delays experienced by different Service Frames belonging to the same CoS instance.	MEF 10.3 [13]
Frame Delay Range	The difference between the Frame Delay Performance values corresponding to two different percentiles.	MEF 10.3 [13]
Generator Test Function	A logical function for generating and transmitting Ethernet Frames which can include test frames.	This document
GTF	Generator Test Function	This document
IFDV	Inter-Frame Delay Variation	MEF 10.3 [13]
IMIX	Internet Mix	RFC 6985 [8]
Information Rate	The average bit rate of Frames at the measurement point starting with the first MAC address bit and ending with the last FCS bit. Note: Frames can be Service Frames [13] or ENNI Frames [18].	ITU-T Y.1564 [11]
Inter-Frame Delay Variation	The difference in delay of two Service Frames belonging to the same CoS instance.	MEF 10.3 [13]
Ingress Bandwidth Profile	A characterization of ingress Service Frame arrival times and lengths at the ingress UNI and a specification of disposition of each Service Frame based on its level of compliance with the characterization.	MEF 10.3 [13]

Term	Definition	Reference
Internet MIX	A traffic pattern consisting of a preset mixture of IP-Layer packet sizes used to emulate real-world traffic scenarios in a testing environment.	RFC 6985 [8]
IR	Information Rate	ITU-T Y.1564 [11]
IR_{SC}	Information Rate Service Configuration	This document
L2CP	Layer 2 Control Protocol	MEF L2CP [24]
Latching Loopback	A configured function within an Ethernet Equipment where frames are returned to the entity which sent them.	MEF 46 [23]
Layer 2 Control Protocol Service Frame	A Service Frame that is used for Layer 2 control, e.g., Spanning Tree Protocol.	MEF 10.3 [13]
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).	MEF 10.3 [13]
LL	Latching Loopback	MEF 46 [23]
LLF	Latching Loopback Function	MEF 46 [23]
MAC	Media Access Control	IEEE 802.3 [2]
MAC DA	Media Access Control Destination Address	IEEE 802.3 [2]
MAC SA	Media Access Control Source Address	IEEE 802.3 [2]
Maintenance Entity Group	A Maintenance Entity Group (MEG) consists of the Maintenance Entities that belong to the same service inside a common OAM domain.	MEF 17 [16]
Mean Frame Delay	The arithmetic mean or average of delays experienced by different Service or ENNI Frames belonging to the same CoS Frame Set.	MEF 33 [20]
ME-NE	Metro Ethernet Network Element	MEF 15 [15]
MEF Service Activation Testing Process	A business process for testing MEF services to ensure that the service is configured according to the specification and will work to agreed performance levels (e.g., SLAs). This process occurs before the service is deployed to the customer.	This document
MEG	Maintenance Entity Group	MEF 17 [16]
MEG End Point	A MEG End Point (MEP) is a provisioned OAM reference point which can initiate and terminate proactive OAM frames. A MEP can also initiate and react to diagnostic OAM frames.	MEF 17 [16]
MEG Intermediate Point	MEG Intermediate Point (MIP) is a provisioned OAM reference point which is capable to react to diagnostic OAM frames initiated by MEPs. A MIP does not initiate proactive or diagnostic OAM frames.	MEF 17 [16]
MEP	MEG End Point	MEF 17 [16]

Term	Definition	Reference
Metro Ethernet Network Element	A Network Element supporting Metro Ethernet services.	MEF 15 [15]
MFD	Mean Frame Delay	MEF 33 [20]
MIP	MEG Intermediate Point	MEF 17 [16]
MTU	Maximum Transmission Unit	MEF 10.3 [13]
N/A	Not Applicable	This document
N/D	Not Defined	This document
One-way	A measurement performed in the Forward or Backward direction. For example from MEP A to MEP B or from MEP B to MEP A.	MEF 35 [21]
Operator Virtual Connection	Operator Virtual Connection, an association of OVC End Points.	MEF 26.1 [18]
OVC End Point	An association of an OVC with a specific External Interface i.e., UNI, ENNI	MEF 26.1 [18]
OVC	Operator Virtual Connection	MEF 26.1 [18]
OVC EP	OVC End Point	MEF 26.1 [18]
SAC	Service Acceptance Criteria	ITU-T Y.1564 [11]
SAMP	Service Activation Measurement Point	This document
SAT	Service Activation Testing	MEF 46 [23]
Service Acceptance Criteria	A set of criteria used to ensure that a service meets its functionality and quality requirement and that the service is ready to operate when it has been deployed.	ITU-T Y.1564 [11]
Service Activation Measurement Point	A Service Activation Measurement Point is a reference point in the network, placed at the ingress of an ETH Subscriber/Provider Conditioning Function in the case of a Generator Test Function or at the egress of an ETH Subscriber/Provider Conditioning Function in the case of a Collector Test Function, at which performance reference events can be observed and measured during the Service Activation Testing process.	This document
Service Activation Testing	The process of executing a collection of test procedures to be applied to a given traffic entity (e.g., EVC, OVC, etc.) in order to collect behavioral information about the traffic and compare this with predefined expectations.	This document
Service Activation Test Methodology	A methodology for performing Ethernet Service turn-up testing using defined benchmark tests while measuring various performance parameters.	ITU-T Y.1564 [11]
Service Activation Test Record	A report of test results for a new Ethernet Service. The results show if the service met the applicable performance objectives or Service Acceptance Criteria.	This document

Term	Definition	Reference
Service Configuration and Activation	A high level business process which encompasses operational processes for the allocation, implementation, configuration, activation and testing of specific services to meet customer requirements.	TMF GB921 [27]
Service Frame	An Ethernet frame transmitted across the UNI toward the Service Provider or an Ethernet frame transmitted across the UNI toward the Subscriber.	MEF 10.3 [13]
Service Level Agreement	The contract between the Subscriber or Operator and Service Provider specifying the agreed to service level commitments and related business agreements.	MEF 10.3 [13]
Service Level Specification	The technical specification of the service level being offered by the Service Provider to the Subscriber.	MEF 10.3 [13]
Service Measurement Point	A Service Measurement Point is a well-defined point in the network at which performance reference events can be observed and measured.	This document
SLA	Service Level Agreement	MEF 10.3 [13]
SLS	Service Level Specification	MEF 10.3 [13]
SMP	Service Measurement Point	This document
SP	Service Provider	MEF 10.3 [13]
TAF	Transport Adaptation Function	MEF 4 [12]
ToD	Time-of-Day	MEF 35 [21]
Test Head Connection Point	A Test Head Connection Point is a reference point in a ME-NE, placed at the location of a ENNI ETE-A SAMP providing the test connectivity to an ETE-TH or ETE-I.	This document
THCP	Test Head Connection Point	This document
Traffic Conditioning Point	A Traffic Conditioning Point corresponds to an ESCF.	MEF 17 [16]
TrCP	Traffic Conditioning Point	MEF 17 [16]
Two-way	A measurement of the performance of frames that flow from the Controller MEP to Responder MEP and back again.	MEF 35 [21]
ULR	Utilized Line Rate	ITU-T Y.1564 [11]
UML	Unified Modeling Language	OMG UML [26]
UNI	User Network Interface	MEF 10.3 [13]
UNI-C	User Network Interface-Client	MEF 4 [12]
UNI-Client	The UNI-C is a compound architectural component of a CEN that represents all of the functions required to connect a subscriber to a CEN.	MEF 4 [12]
UNI-N	User Network Interface-Network	MEF 4 [12]
UNI-Network	The UNI-N is a compound architectural component of a CEN that represents all of the functions required to connect a CEN to a CEN subscriber.	MEF 4 [12]

Term	Definition	Reference
Unified Modeling Language	The Unified Modeling Language (UML) is a unified model for object oriented analysis and design.	OMG UML [26]
Use Case	In the UML, a use case represents one particular type of a system's behavior based on stimuli from an external source (i.e., an actor). A system may have several use cases which define all its behavior.	OMG UML [25]
User Network Interface	The physical demarcation point between the responsibility of the Service Provider and the responsibility of the Subscriber.	MEF 10.3 [13]
Utilized Line Rate	The average bit rate of the Ethernet line at the measurement point, including the bits a) allocable to the minimum-duration period of each Inter-Packet gap (but not the number of bits allocable to the part of each Inter-Packet gap longer than the minimum), b) in the preamble, c) in the start of frame delimiter and d) in the Ethernet Service Frame starting with the first MAC address bit and ending with the last FCS bit.	ITU-T Y.1564 [11]

Table 1 – Terminology and Acronyms

4 Scope

This document defines the requirements and use cases for out-of-service testing performed on MEF 33 services [20], also known as E-Access services, prior to the services being delivered to customers and placed in-service. Use cases include testing an Access Provider's (AP) OVC by the AP as well as by the Service Provider (SP), as illustrated in the MEF service view in Figure 1. The document is based on E-Access services [20] definitions, which uses service attributes and parameters defined in MEF 26.1 [18] and MEF 10.3 [13]. This document also references International Telecommunication Union - Telecommunication Standardization Sector (ITU-T) Recommendation Y.1564 [11] for the basic Service Activation Testing methodology and test procedures to be used for Service Configuration and Service Performance testing, while extending these test procedures for E-Access service attributes and parameters [20]. With the procedures defined in this document, Service Providers and Access Providers can work together in a standardized fashion to activate configured services.

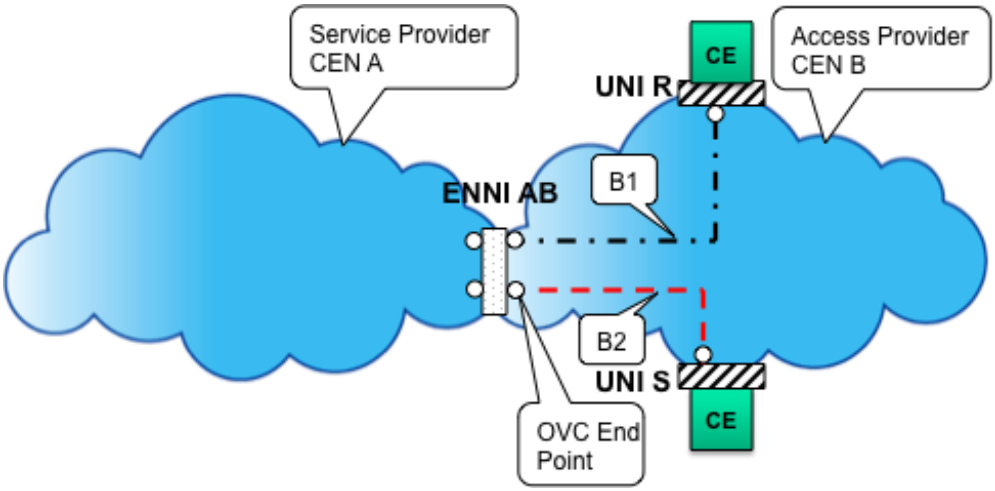


Figure 1 – E-Access Service View for SAT

5 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.

Items that are **REQUIRED** (contain the words **MUST** or **MUST NOT**) are labeled as **[Rx]** for required. Items that are **RECOMMENDED** (contain the words **SHOULD** or **SHOULD NOT**) are labeled as **[Dx]** for desirable. Items that are **OPTIONAL** (contain the words **MAY** or **OPTIONAL**) are labeled as **[Ox]** for optional**.**

A paragraph preceded by **[CR*a*]<** specifies a conditional mandatory requirement that **MUST** be followed if the condition(s) following the "<" have been met. For example, "**[CR1]<**[D38]" indicates that Conditional Mandatory Requirement 1 must be followed if Desirable Requirement 38 has been met. A paragraph preceded by **[CD*b*]<** specifies a Conditional Desirable Requirement that **SHOULD** be followed if the condition(s) following the "<" have been met. A paragraph preceded by **[CO*c*]<** specifies a Conditional Optional Requirement that **MAY** be followed if the condition(s) following the "<" have been met.

6 Numerical Prefix Conventions

This document uses the prefix notation to indicate multiplier values as shown in Table 2.

Decimal		Binary	
Symbol	Value	Symbol	Value
k	**10^3**	**Ki**	**2^{10}**
M	**10^6**	**Mi**	**2^{20}**
G	**10^9**	**Gi**	**2^{30}**
T	**10^{12}**	**Ti**	**2^{40}**
P	**10^{15}**	**Pi**	**2^{50}**
E	**10^{18}**	**Ei**	**2^{60}**
Z	**10^{21}**	**Zi**	**2^{70}**
Y	**10^{24}**	**Yi**	**2^{80}**

Table 2 – Numerical Prefix Conventions

7 Introduction

When a Service Provider contracts with an Access Provider to connect to a customer location, testing should be performed to verify that the E-Access service [20] meets the Service Provider and customer expectations. This testing, across the multi-Carrier Ethernet Network (CEN) environment, ensures that the allocated network resources have been configured properly (e.g., connectivity is established and the configurable service parameters are correct) and that the service meets the applicable Service Acceptance Criteria (SAC). The SAT Record created as a result of the test would be used as a birth certificate for the service. It can be referred to in the future if there is ever a question about the level of performance that was attained, or if it can be helpful in troubleshooting a subsequent performance problem.

The following definition is provided in MEF 15 [15] from a resource management perspective (e.g., resources participating in providing the Ethernet service):

"Once the equipment has been installed and the software and initial installation configuration data has been loaded, Service Activation must be performed. Service Activation ensures that the Metro Ethernet Network Element (ME-NE) receives the data necessary in order to use resources to provide the intended network service."

The TeleManagement Forum defines several business processes related to Service Activation Testing. They define two phases to Service Activation Testing:

- Configuration Verification
- Performance Verification

Configuration Verification testing is of short duration and ideal for connectivity, Committed Information Rate (CIR) and Excess Information Rate (EIR) configuration and Service Acceptance Criteria (SAC) evaluation prior to Performance Verification. This type of testing could be performed by a technician who is onsite installing and configuring a User Network Interface (UNI) Ethernet demarcation device, but is not limited to this scenario.

Performance Verification testing requires longer duration, on the order of 15 minutes to 1 day, to ensure that all the elements of the network as well as existing active services have had sufficient time to show any problems that could occur. Performance Verification focuses on measuring attributes such as Frame Delay (FD), Frame Loss Ratio (FLR), Inter-Frame Delay Variation (IFDV), and Information Rate (IR), and characterizing each service while simultaneously running all services at once.

Service Configuration tests and Service Performance tests pass or fail on the basis of whether or not the service meets its SAC during each test. These criteria are allowable limits for each of the measured parameters in the test, and are carefully selected to give the Service Provider and Access Provider confidence that a service that passes its Service Activation Testing according to the established SAC will be a satisfactory service that will meet its Class of Service Performance Objectives (CPOs). Some differences may exist between the Service Acceptance Criteria and the Class of Service Performance Objectives. For instance, the measurement definitions and measured parameters may be slightly different at Service Activation than they are for performance monitoring, so it may be impossible to select exactly equal limits. Second, an SP and an AP may wish to choose SAC that are slightly more stringent than the CPOs, to help ensure a low likelihood of performance problems occurring for the activated service.

Test results and data from both the Configuration Verification testing and the Performance Verification testing are inputs into the creation of the SAT Record. Creating a concise performance report as a baseline facilitates future performance comparisons.

This document uses and extends test processes and procedures based on an Ethernet test methodology defined by ITU-T Y.1564 [11]. However, it should be clarified that this document is specific to MEF services, service attributes and parameters and defines specific requirements, use cases, test procedures, measurement points, and test topologies relevant to the services defined in MEF 33 [20].

Prior to ITU-T Y.1564 [11], the only methodology widely used to assess the performance of Ethernet-based network services was Internet Engineering Task Force's (IETF) "Benchmarking Methodology for Network Interconnect Devices", also known as RFC 2544 [6]. RFC 2544 [6] was created to evaluate the performance characteristics of network devices in the lab. It was widely adapted to provide performance metrics of Ethernet-based network services as there was no other methodology available to measure the attributes defined in RFC 1242 [4].

With its capability to measure throughput, latency, frame loss, and burstability (back-to-back test), RFC 2544 [6] could arguably be used to provide performance metrics. However, to do so would be to use RFC 2544 [6] beyond its intended scope. The IETF as also issued an applicability statement for the use of RFC 2544 [7] as a methodology for Ethernet service activation testing. The statement can be found in RFC 6815 [7].

ITU-T Y.1564 [11] fills the methodological gap for measurement of operational Ethernet network services. Also, Ethernet-based services have evolved to include more features and complexities than those covered by the RFC 2544 [6] scope. The RFC 2544 [6] benchmarking methodology is not applicable to Ethernet service activation testing because:

- IETF RFC 2544 [6] does not consider multiple time durations for tests, as are often performed in operational networks with time-varying impairments. Its procedures find the absolute performance limit of a network element in a laboratory environment rather than verify that a service is delivered to the agreed level.

- Latency is measured in a limited way, on only one frame every two minutes, and only at maximum transmitted load with no loss rate, which is very likely much higher than the agreed upon committed information rate.

- It does not provide for the verification of configuration and performance of CIR and EIR, all important components of the Bandwidth Profile.

- Finally, important Ethernet service attributes, such as frame delay variation, are not part of the methodology.

For these reasons, ITU-T Y.1564 [11] was chosen as the base for this technical specification.

7.1 Terminology and SAT Use Case

This section highlights the Service Activation Testing (SAT) use case based on the E-Access service type [20]. This section also provides terminology definitions of the different components defined within this document, which may be used in SAT topologies, requirements and processes. A fundamental understanding of the terms and concepts will be necessary for later sections of the document.

An Ethernet Test Equipment-Instrument (ETE-I) is a portable, external Ethernet testing device not permanently installed in the network that may include a Generator Test Function (GTF) and Collector Test Function (CTF) and/or Latching Loopback function (LLF) that enables the ETE-I to perform Service Activation Testing and activate/deactivate loopback devices. The Ethernet Test Equipment-Instrument may be remotely connected to a UNI-N, and includes the necessary logical and physical test functions to perform Service Activation Testing at that UNI-N.

An Ethernet Test Equipment-Application (ETE-A) includes functionality resident in a Network Element that may include a Generator Test Function and a Collector Test Function and/or Latching Loopback function that enables the Network Element to perform Service Activation Testing and activate/deactivate loopback devices. For example, the Ethernet Test Equipment-Application may reside at an External Network Network Interface - Network (ENNI-N) or UNI-N. In the scenario presented in Figure 2, a technician at the AP's UNI is not necessary since the logical testing functions reside in the ME-NE.

An Ethernet Test Equipment-Test Head (ETE-TH) is an Ethernet Test Equipment (ETE) installed in the network for performing Service Activation Testing that includes a Generator Test Function, Collector Test Function and/or Latching Loopback function that enables the ETE-TH to perform Service Activation Testing and activate/deactivate loopback devices.

ETE is a general term to include an Ethernet Test Equipment-Application, Ethernet Test Equipment-Test Head and/or Ethernet Test Equipment-Instrument.

Figure 2 illustrates a SAT use case where a Service Provider A is using an Ethernet Test Equipment-Test Head placed within its network. The ETE-TH is not involved in the forwarding path of services. In this scenario, Service Provider A wishes to test the E-Access service [20] from the ENNI-N of Service Provider A to the UNI-N of Access Provider B and use the Ethernet Test Support System to control the fixed Ethernet Test Equipment-Test Head, which is dedicated for Ethernet testing. An Ethernet Test Support System in Service Provider A's back office (e.g., Service Provider A is offering the end-to-end MEF service) may control the testing, with direct access to the Ethernet Test Equipment-Test Head at Service Activation Measurement Point (SAMP) A, via in-band management access to the Ethernet Test Equipment-Application at SAMP B. The in-band management access definitions to the ETE-A at the remote end is beyond the scope of this specification.

An Ethernet Test Support System is a back office or Operational Support System (OSS) that coordinates test activity at Ethernet Test Equipment-Test Heads or Network Elements, and includes storage of SAT Records. However, since this Service Provider has no out-of-band management access to the UNI-N Network Element located at SAMP B, it may invoke an in-band Latching Loopback (LL) to facilitate the testing process by looping all test traffic within that Network Element.

SAMP C in Figure 2 is located at the Access Providers ENNI-N and would be used to connect an ETE-TH and test the E-Access service [20] from an Access Provider's perspective.

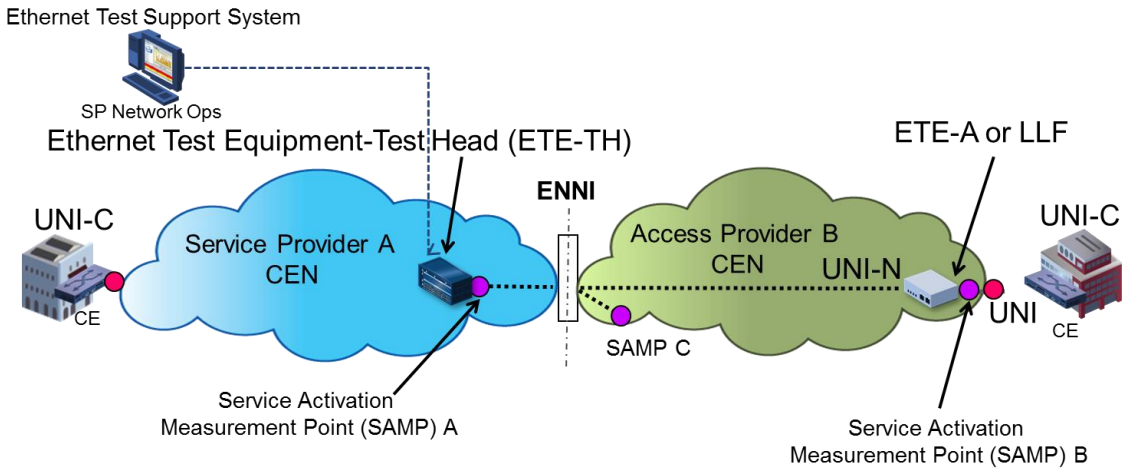


Figure 2 – Example of SAT Use Case for E-Access Service

7.2 Aspect of Service Testing Framework

Service Activation Testing, Service Monitoring, and Service Troubleshooting business processes contribute to an overall Service Testing framework as the Venn diagram in Figure 3 highlights. The process comparisons are discussed below.

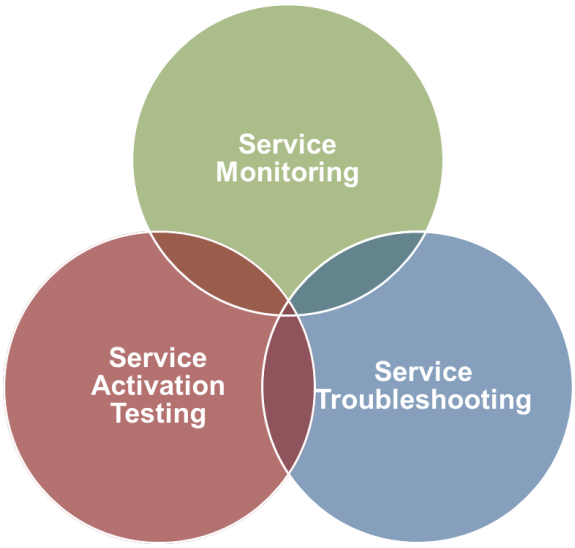


Figure 3 – Service Testing Venn Diagram

Service Activation Testing, as part of the Service Testing framework, can be viewed as a process to validate that the Access EPL or Access EVPL service [20] is behaving as per the Service Definition. The SAT methodology will verify the configuration, validate the performance of the different service attributes and provide a SAT Record (also known as birth certificate). Service Activation Testing is performed as the Access EPL or Access EVPL service [20] is provision and before releasing to the Service Provider.

Service Monitoring can be viewed as a process within Service Testing and separate from Service Activation Testing. This includes the Fault Management and Performance Monitoring use cases defined in MEF 30.1 [19] and MEF 35 [21] where an Ethernet service is deployed to a customer and the service is "in-service" and carrying customer traffic. Service Monitoring encompasses those 24x7 business processes measuring Service Level Agreement (SLA) conformance and service health on an ongoing proactive basis. Service Monitoring also has to be sensitive to customer traffic loads to avoid disrupting customer bandwidth needs. Service Monitoring employs Maintenance Entity Groups (MEGs), MEG Intermediate Points (MIPs) and MEG End Points (MEPs) as defined in MEF 17 [16].

Service Troubleshooting can be viewed as an on-demand process, encompassing both Service Monitoring processes as well as Service Activation Testing processes, to diagnose and correct faults in the service (due to service outages or service degradation). If Service Monitoring detects network or service error/fault conditions, Service Activation Testing can be performed (as part of troubleshooting the service problems with the affected customer) while the problematic service is taken out-of-service and the customer traffic is halted.

8 Service Measurement Points and Functions

This section defines the functions, architecture, requirements and use cases for the Service Activation Measurement Points in performing Service Activation Testing for E-Access services [20].

A Service Measurement Point (SMP) is a well-defined point in the network at which performance reference events can be observed and measured. Different types of Service Measurement Points may exist, through specialization defined in OMG UML [26], as shown in Figure 4 and described with examples in the paragraphs below.

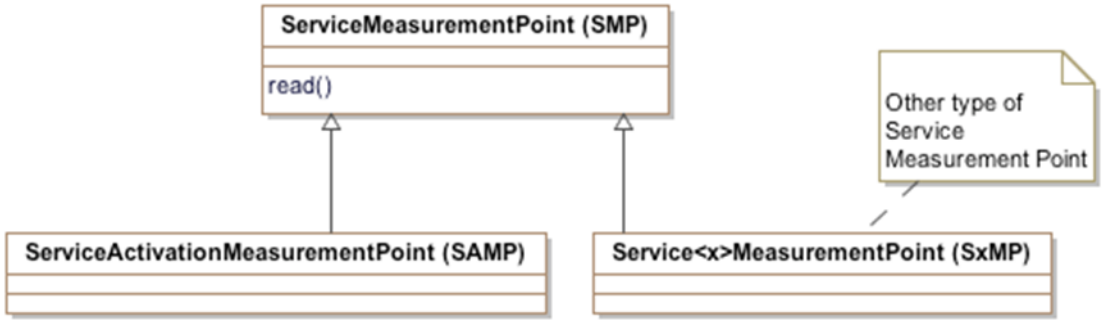


Figure 4 – Service Measurement Point Specialization

A Generator Test Function is a logical function for generating and transmitting Ethernet frames, which can include synthetic test frames. Similarly, a Collector Test Function is a logical function for collecting Ethernet test frames that are being used to perform measurements. A SAMP, which is a specialization of a Service Measurement Point, is a reference point in the network. A SAMP enables SAT to perform measurements on the service under test.

Other types of measurement points may exist outside of the context of SAT and these are denoted in Figure 4 as Service<x>Measurement Point.

8.1 Service Activation Measurement Point Location

The figures found in this section represent some of the different test topologies that can be used to perform SAT within the CEN architecture. Depending on whether the ETE is an Instrument, Test Head or Application (inside an ME-NE) performing the test functions, the SAMP will be at a physical point in the network or at a logical point inside of the ME-NE.

Refer to Figure 5, Figure 6 and Figure 7 in the following section for an illustration of the locations of SAMPs for SAT. The Access Provider and Service Provider (depending on the use case) will need to associate the SAMPs so that there is connectivity between the ETEs testing the service.

8.1.1 Service Activation Measurement Point Locations and Use Cases

This section illustrates the use cases of the SAMP at different locations for the E-Access service type [20] in a single or multi-CEN environment. Figure 5, Figure 6 and Figure 7 illustrate the location of a SAMP or Test Head Connection Point (THCP) within a ME-NE. Figure 8 and Figure 9 represent four use cases with the internal and external logical functions and SAMP as references.

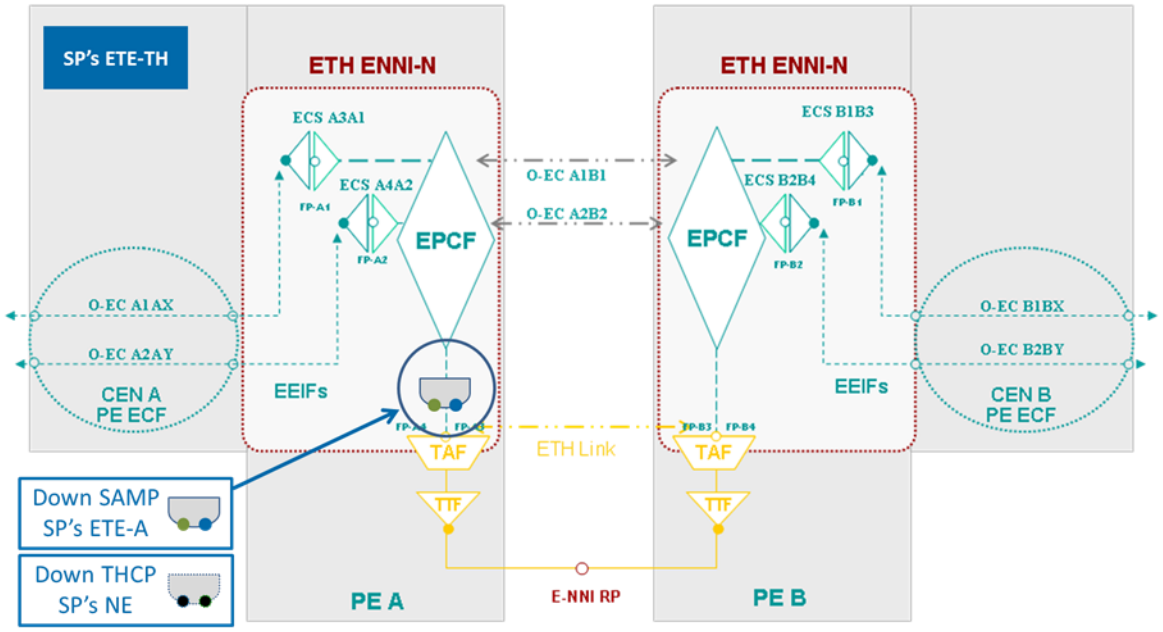


Figure 5 – SAMP Location at the Service Provider's ENNI

Figure 5 demonstrates the location of a SAMP (or THCP) within an SP's ENNI-N. This SAMP would be downward facing to test with an upward SAMP located at the AP's UNI-N. Figure 6 shows the location of a SAMP (or THCP) within an AP's ENNI-N. This SAMP would be upward facing to test to an upward SAMP located at the AP's UNI-N. Finally, Figure 7 illustrates the location of a SAMP within an AP's UNI-N. This SAMP would be upward facing to test to a SAMP located at the ENNI-N.

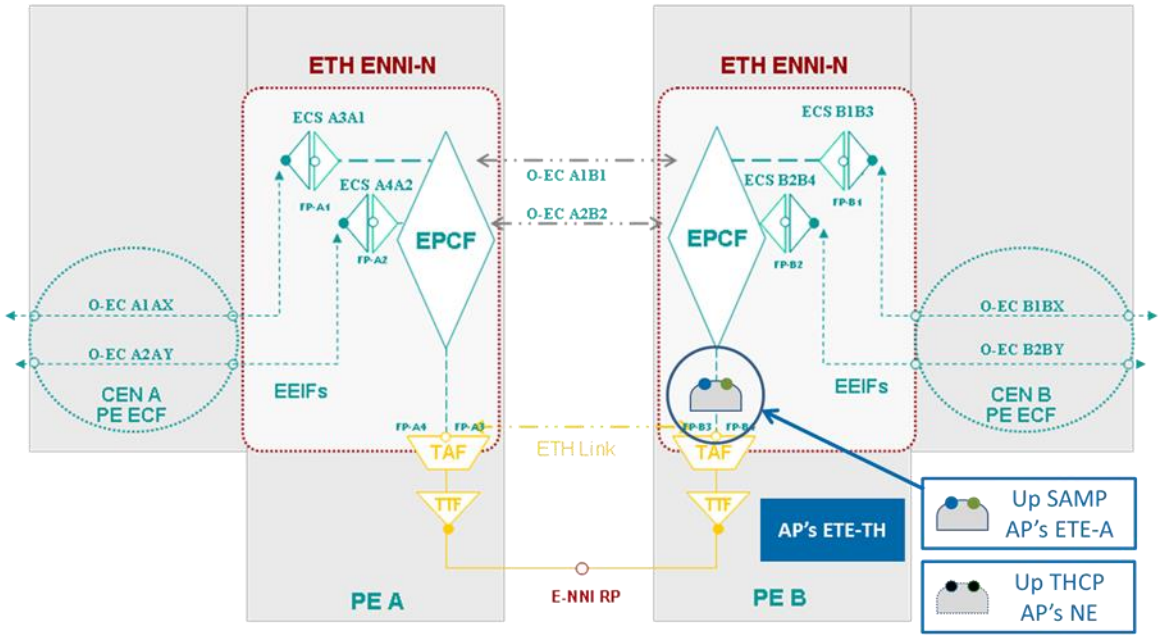


Figure 6 – SAMP Location at the Access Provider's ENNI

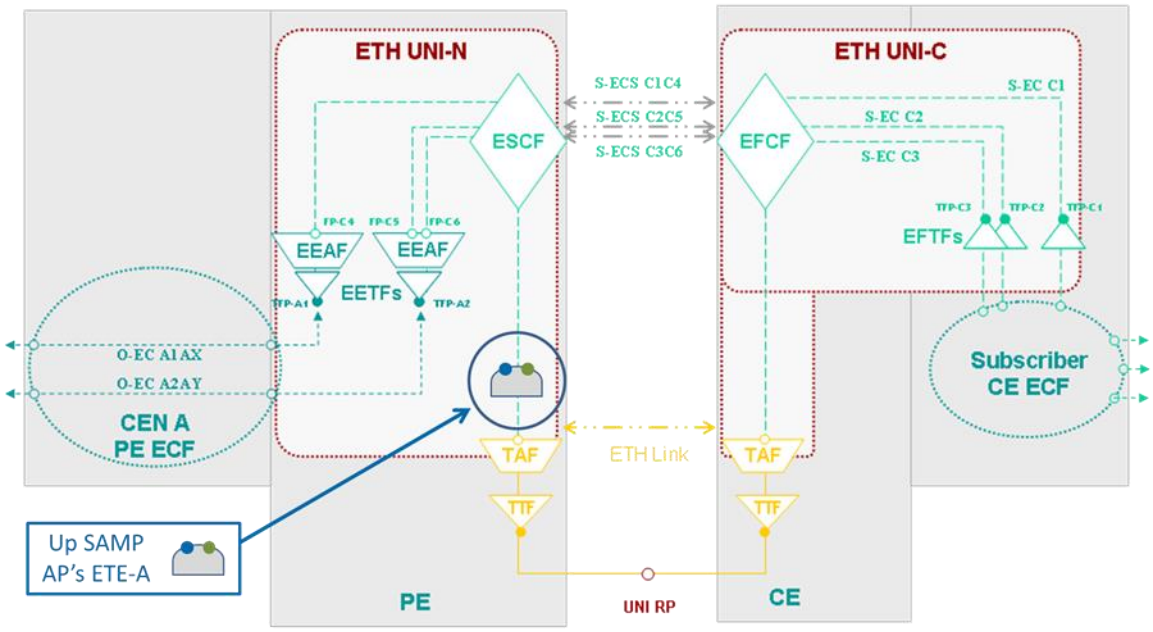


Figure 7 – SAMP Location at the Access Provider's UNI

As shown in Figure 5, Figure 6 and Figure 7, the location of SAMPs (up and down) is in an ETE in relation to the ETH Layer Functional Elements [14]. An up SAMP, in a ME-NE, generates and collects traffic that crosses the ETH Ethernet Virtual Connection (EVC) Adaptation and/or Termination Functions [14]. A down SAMP, in a ME-NE, generates and collects traffic that crosses the ETH Adaptation and/or Termination Functions [14]. An ETE-TH and ETE-I need to only supports down SAMPs, i.e., send/receive test traffic out of the port on the ETE-TH or ETE-I. On the other hand, an ETE-A can support up or down SAMPs.

[R1] When using an ETE-A at a SP's ENNI-N, the down SAMP for GTF and CTF **MUST** behave as if located between the ETH Provider Conditioning Function (EPCF) and Transport Adaptation Function (TAF).

[R2] When using an ETE-A at an AP's ENNI-N, the up SAMP for GTF and CTF **MUST** behave as if located between the EPCF and TAF.

[R3] When using an ETE-TH or ETE-I, the Test Head Connection Points for the E-Access service [20] under test at the ENNI-N **MUST** behave as if located between the EPCF and TAF.

[R4] When using an ETE-A at the AP's UNI-N the up SAMP for GTF and CTF **MUST** be located between the ETH Subscriber Conditioning Function (ESCF) and TAF.

[R5] When using an ETE-TH or ETE-I at the AP's UNI-N the down SAMP for GTF and CTF **MUST** be associated with the OVC End Point for the E-Access service [20] under test.

Use Case A in Figure 8 provides an example of an internal Service Activation Measurement Point using an Ethernet Test Equipment-Application at the ENNI-N of the Access Provider's CEN and at the Access Provider’s UNI-N to perform Service Activation Testing.

Use Case B in Figure 8 provides an example of an external Service Activation Measurement Point using an Ethernet Test Equipment-Test Head within the Service Provider’s CEN and an internal Service Activation Measurement Point using an Ethernet Test Equipment-Application at the Access Provider’s UNI-N to perform Service Activation Testing. In this use case, the external SAMP on the ETE-TH is connected to the Test Head Connection Point in the ENNI-N.

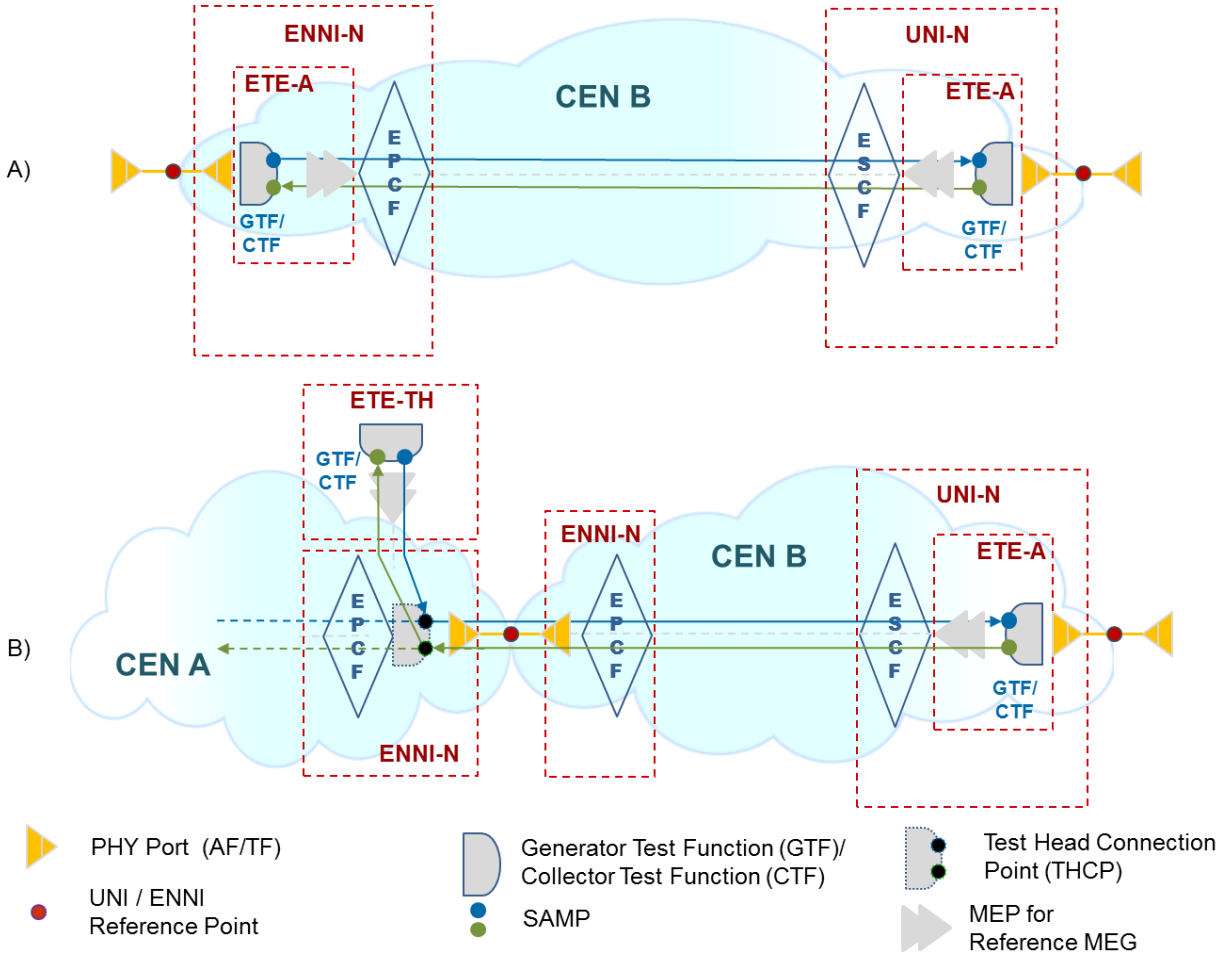


Figure 8 – Service Activation Measurement Points Use Cases A & B

Use Case C in Figure 9 provides an example of an internal Service Activation Measurement Point using an Ethernet Test Equipment-Application at the ENNI-N of the Access Provider's CEN and an Ethernet Test Equipment-Instrument at the Access Provider's UNI-N to perform Service Activation Testing. Use Case C in Figure 9 shows the use of an Ethernet Test Equipment-Instrument at the UNI-C while the customer equipment is unplugged. In this case the Service Activation Measurement Point becomes the UNI-C itself, and the service is measured exactly as it is delivered to the customer. This choice of measurement point, however, temporarily takes the UNI and any services configured on the UNI out-of-service for the customer while the tests are made.

Use Case D in Figure 9 provides an example of an external Service Activation Measurement Point using an Ethernet Test Equipment-Test Head within the Access Provider's CEN and a UNI-N which has a Latching Loopback Function to loop back test traffic. Use case D in Figure 9 has a Latching Loopback Function (LLF) at the AP's UNI-N to loop back test traffic. An AP's ETE-TH supporting a GTF is used to transmit test traffic. At the AP's UNI-N, the test traffic is looped back towards the CTF in the ETE-TH. As there is no GTF or CTF required where the LLF is located, there is no SAMP at the UNI-N associated with the loopback.

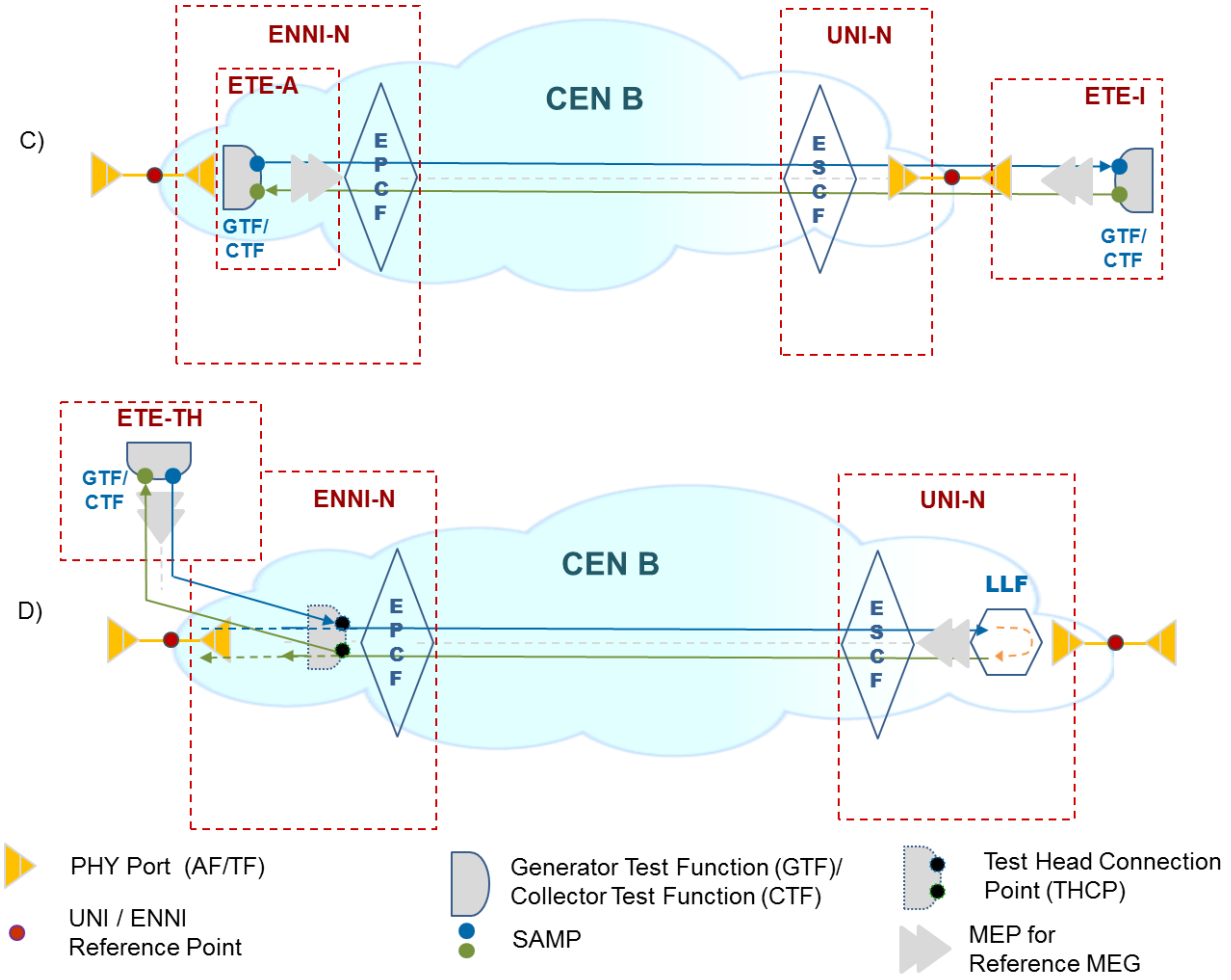


Figure 9 – Service Activation Measurement Points Use Cases C & D

8.1.2 Loopback Considerations

Operators who consider using loopback topologies should be advised that the use of loopback is not appropriate when testing for configuration of ingress Bandwidth Profile (BWP) either at the ENNI or at the UNI of the AP. The test traffic may not have adequate Information Rate to test for proper configuration when testing to a LLF. Additionally, significant measurement degradation could take place due to frames transmitted at the CIR experiencing large IFDV. Burst test procedures are generally only meaningful at the ESCF when directly connected to a GTF through a SAMP. See Appendix A for more information on this subject.

9 Service Attributes

This section lists the relevant service attributes that an SP and AP can verify using the procedures specified in this document for Service Activation Testing of an E-Access service [20]. The attributes are as specified in MEF 10.3 [13] and MEF 26.1 [18]. See Section 8 in this document for test topologies.

The SAT by an SP assumes that an AP has configured the values for the attributes of the specific Access EPL or Access EVPL [20] service per the service agreement. When doing SAT, it is assumed that the SP can use the AP to help test the E-Access Service [20]. These attributes are per UNI, per OVC End Point (OVC EP) at UNI, per OVC, per OVC EP at ENNI and per ENNI, as specified in MEF 33 [20]. The AP performs SAT to verify that E-Access service [20] (Access EPL or Access EVPL) behavior is conformant to the service agreement.

9.1 E-Access Service Attributes

This section lists, in different tables, the services attributes as found in MEF 33 [20]. Each table found below lists service attributes by category and provides information on how this service attribute is handled during SAT. This shown for both SP and AP. A service attribute can be tested and its result reported in the SAT Record (Test), the configuration value of the service attribute can be reported in the SAT Record (Report) or the service attribute is neither tested nor reported during SAT (N/A).

Each table also provides information on whom of the SP and/or AP is responsible to test or report on the service attributes and if it is mandatory or optional to test this service attribute.

A column entitled "Test Procedure" references the procedure used to test the different service attributes.

9.1.1 UNI Service Attributes

Table 3 provides a list of the E-Access UNI service attributes [20].

[R6] The Service Provider **MUST** report UNI service attributes as specified in Table 3.

[R7] The Access Provider **MUST** report UNI service attributes as specified in Table 3.

	Service Provider		Access Provider		Test Procedure	Comments
UNI Service Attribute	**Report/ Test**	**SP Req**	**Report/ Test**	**AP Req**		
UNI Identifier	Report	Mandatory	Report	Mandatory	-	-
Physical Medium	N/A	-	Report	Mandatory	-	-
Speed	N/A	-	Report	Mandatory	-	-
Auto-Negotiation	N/A	-	Report	Mandatory	-	See Note 1

Mode	N/A	-	Report	Mandatory	-	-
MAC Layer	N/A	-	N/A	-	-	See Note 2
UNI MTU Size	N/A	-	Report	Mandatory	-	See Note 3
CE-VLAN ID for untagged and priority tagged Frames	N/A	-	N/A	-	-	-
Maximum number of OVCs per UNI	N/A	-	N/A	-	-	-
Maximum number of CE-VLAN IDs per OVC (Access EVPL only)	N/A	-	N/A	-	-	-
Ingress Bandwidth Profile per UNI	N/A	-	N/A	-	-	-
Egress Bandwidth Profile per UNI	N/A	-	N/A	-	-	-
Note 1: Auto-Negotiation is not a UNI service attribute defined in MEF 33 [20] but important to Service Providers. Note 2: MAC Layer is defined in MEF 33 [20] but not directly tested in SAT. Requirement [R26] defines the test traffic to be IEEE 802.3 [2] compliant. Note 3: The SP and AP will be testing the OVC Maximum Transmission Unit (MTU) Size.						

Table 3 – UNI Service Attributes

9.1.2 OVC per UNI Service Attributes

Table 4 provides a list of the E-Access OVC per UNI service attributes [20].

[R8] The Service Provider **MUST** test and/or report OVC per UNI service attributes as specified in Table 4.

[R9] The Access Provider **MUST** test and/or report OVC per UNI service attributes as specified in Table 4.

	Service Provider		Access Provider		Test Procedure	Comments
OVC per UNI Service Attribute	**Report/ Test**	**SP Req**	**Report/ Test**	**AP Req**		
UNI OVC Identifier	Report	Mandatory	Report	Mandatory	-	-
OVC End Point Map	Report	Mandatory	Report	Mandatory	-	See Note 1
Class of Service Identifier for Service Frames	Test	Mandatory	Test	Mandatory	10.3.3	See Note 2
Ingress Bandwidth Profile per OVC End Point at a UNI	Test	Mandatory	Test	Mandatory	10.3.5	-
Ingress Bandwidth Profile per Class of Service Identifier at a UNI	N/A	-	N/A	-	-	-
Egress Bandwidth Profile per OVC End Point at a UNI	N/A	-	N/A	-	-	-
Egress Bandwidth Profile per Class of Service Identifier at a UNI	N/A	-	N/A	-	-	-
Note 1: OVC End Point Map attribute reporting is only valid for Access EVPL. Note 2: Class of Service Identifier for Service Frame is tested as part of CE-VLAN CoS ID Value preservation.						

Table 4 – OVC per UNI Service Attributes

9.1.3 OVC Service Attributes

Table 5 provides a list of the E-Access OVC service attributes [20].

[R10] The Service Provider **MUST** test and/or report the Mandatory OVC service attributes as specified in Table 5.

[O1] The Service Provider **MAY** test and report the Optional OVC service attributes as specified in Table 5.

[R11] The Access Provider **MUST** test and/or report OVC service attributes as specified in Table 5.

OVC Service Attribute	Service Provider		Access Provider		Test Procedure	Comments
	Report/ Test	SP Req	Report/ Test	AP Req		
OVC Identifier	Report	Mandatory	Report	Mandatory	-	-
OVC Type	N/A	-	N/A	-	-	-
OVC End Point List	N/A	-	N/A	-	-	-
Maximum Number of UNI OVC End Points	N/A	-	N/A	-	-	-
Maximum Number ENNI OVC End Points	N/A	-	N/A	-	-	-
OVC Maximum Transmission Unit Size	Test	Mandatory	Test	Mandatory	10.3.1	-
CE-VLAN ID Preservation	N/A	Mandatory	Test	Mandatory	10.3.2	-
CE-VLAN CoS ID Value Preservation	N/A	Mandatory	Test	Mandatory	10.3.3	-
S-VLAN ID Preservation	N/A	-	N/A	-	-	-
S-VLAN CoS ID Value Preservation	N/A	-	N/A	-	-	-
Color Forwarding	N/A	-	Report	Mandatory	-	See Note 1
Service Level Specification	N/A	-	N/A	-	-	See Note 2
Unicast Frame Delivery	Test	Optional	Test	Mandatory	10.3.4	-
Multicast Frame Delivery	Test	Optional	Test	Mandatory	10.3.4	-
Broadcast Frame Delivery	Test	Optional	Test	Mandatory	10.3.4	-
Note 1: Color Forwarding is a reportable OVC service attribute. A Color Forwarding test methodology is for further study. Note 2: Service Level Specification will not be tested, SAC to be used as a mean to determine valid performance attributes.						

Table 5 – OVC Service Attributes

9.1.4 OVC End Point per ENNI Service Attributes

Table 6 provides a list of the E-Access OVC End Point per ENNI service attributes [20].

[R12] The Service Provider **MUST** test and/or report the OVC End Point per ENNI service attributes as specified in Table 6.

[R13] The Access Provider **MUST** test and report OVC End Point per ENNI service attributes as specified in Table 6.

	Service Provider		Access Provider		Test Procedure	Comments
OVC End Point per ENNI Service Attribute	**Report/ Test**	**SP Req**	**Report/ Test**	**AP Req**		
OVC End Point Identifier	N/A	-	Report	Mandatory	-	See Note 1
Class of Service Identifier for ENNI Frames	Test	Mandatory	Test	Mandatory	10.3.3	-
Ingress Bandwidth Profile per OVC End Point	Test	Mandatory	Test	Mandatory	10.3.5	See Note 2
Ingress Bandwidth Profile per ENNI Class of Service Identifier	N/A	-	N/A	-	-	-
Egress Bandwidth Profile per End Point	N/A	-	N/A	-	-	-
Egress Bandwidth Profile per ENNI Class of Service Identifier	N/A	-	N/A	-	-	-
Note 1: OVC End Point Identifier is specific to an AP network, and is therefore not relevant to an SP. Note 2: The ingress CIR for an OVC at the ENNI should be greater than the corresponding ingress CIR at the UNI due to the presence of the added S-VLAN tag (4 bytes) at the ENNI. As an example, if the average frame size was 200 bytes, the CIR should be increased by 2%.						

Table 6 – OVC End Point per ENNI Service Attributes

9.1.5 ENNI Service Attributes

There are no ENNI service attributes to be configured for a SAT since it is assumed that the ENNI is already supporting other services. The SP and AP have to ensure that ENNI Frames have the appropriate S-tag value as specified for the E-Access service [20] being tested during SAT. Table 7 provides a list of the E-Access ENNI service attributes [20].

[R14] The Service Provider **MUST** report ENNI service attributes as specified in Table 7.

[R15] The Access Provider **MUST** report ENNI service attributes as specified in Table 7.

ENNI Service Attribute	Service Provider		Access Provider		Test Procedure	Comments
	Report/ Test	SP Req	Report/ Test	AP Req		
Operator ENNI Identifier	N/A		Report	Mandatory	-	-
Physical Layer	N/A		N/A		-	-
Frame Format	N/A		N/A		-	-
Number of Links	N/A		N/A		-	-
Protection Mechanism	N/A		N/A		-	-
ENNI Maximum Transmission Unit Size	N/A		N/A		-	-
End Point Map	Report	Mandatory	Report	Mandatory	-	-
Maximum Number of OVCs	N/A		N/A		-	-
Maximum Number of OVC End Points per OVC	N/A		N/A		-	-

Table 7 – ENNI Service Attributes

9.2 Performance Service Attributes

This section defines the MEF performance service attributes that are tested and reported by an SP or an AP during Service Activation Testing (e.g., Frame Delay Performance, Frame Loss Ratio Performance, etc.). These performance service attributes are listed in Table 8.

[R16] The Service Provider **MUST** test and report the performance service attributes as specified in Table 8.

[R17] The Access Provider **MUST** test and report the performance service attributes as specified in Table 8.

[R18] The Service Provider and Access Provider **MUST** agree on testing and reporting Frame Delay Performance or Mean Frame Delay Performance.

[R19] The Service Provider and Access Provider **MUST** agree on testing and reporting Frame Delay Range Performance or Inter-Frame Delay Variation Performance.

Performance Service Attribute	Service Provider		Access Provider		Test Procedure	Comments
	Report/ Test	SP Req	Report/ Test	AP Req		
Frame Delay Performance	Test	Mandatory	Test	Mandatory	-	See Note 1
Frame Delay Range Performance	Test	Mandatory	Test	Mandatory	-	See Note 2
Mean Frame Delay Performance	Test	Mandatory	Test	Mandatory	-	See Note 1
Inter-Frame Delay Variation Performance	Test	Mandatory	Test	Mandatory	-	See Note 2
Frame Loss Ratio Performance	Test	Mandatory	Test	Mandatory	-	-
Note 1: Frame Delay (FD) Performance and Mean Frame Delay (MFD) Performance form a pair for which this Technical Specification requires support for at least one. Additional information can be found in Section 6.7 of MEF 23.1 [17].						
Note 2: Frame Delay Range Performance and Inter-Frame Delay Variation Performance form a pair for which this Technical Specification requires support for at least one. Additional information can be found in Section 6.7 of MEF 23.1 [17].						

Table 8 – Performance Service Attributes

9.3 Ingress Bandwidth Profile Parameters

This section defines the MEF ingress Bandwidth Profile that might be tested and reported by an SP or an AP during Service Activation Testing (e.g., CIR, EIR, etc.). These parameters are listed in Table 9. Table 9 also lists the test procedure or reference used to test the ingress Bandwidth Profile.

As there is currently no standardized test methodology to measure the Committed Burst Size (CBS) and Excess Burst Size (EBS) as part of Service Activation Testing, these tests are deemed optional and are left to the Service Provider and Access Provider to decide if they are required.

As noted in Table 9, the test methodologies found in this document are defined for a Coupling Flag equal to the value "0". A test methodology for Coupling Flag (CF) value of "1" is not defined in this document and is for further study.

[R20] The Service Provider **MUST** test and report the Mandatory Bandwidth Profile service attributes as specified in Table 9.

[O2] The Service Provider **MAY** test and report the Optional OVC service attributes as specified in Table 9.

[R21] The Access Provider **MUST** test and report the Mandatory Bandwidth Profile service attributes as specified in Table 9.

[O3] The Access Provider **MAY** test and report the Optional OVC service attributes as specified in Table 9.

Bandwidth Profile Service Attribute	Service Provider		Access Provider		Test Procedure	Comments
	Report/ Test	SP Req	Report/ Test	AP Req		
Committed Information Rate (CIR)	Test	Mandatory	Test	Mandatory	10.3.5	-
Committed Burst Size (CBS)	Test	Optional	Test	Optional	N/D	See Note 1
Excess Information Rate (EIR)	Test	Mandatory	Test	Mandatory	10.3.5	-
Excess Burst Size (EBS)	Test	Optional	Test	Optional	N/D	See Note 1
Coupling Flag (CF)	N/A	-	N/A	-	-	See Note 2
Color Mode (CM)	See Note 3	-	See Note 3	-	-	

Note 1: CBS and EBS testing are optional as per [O11].

Note 2: The test methodologies found in this document are defined for CF = 0.

Note 3: The test methodologies found in this document address color-blind (CM=0) and color-aware (CM=1) values.

Table 9 – Parameters for Bandwidth Profile Service Attributes

10 Service Activation Testing Methodology

The goal of the testing methodology during Service Activation Testing is to validate the Service Configuration (UNI and/or OVC) and to verify the Service Performance. The validation is performed by sending predefined test traffic and verifying that the behavior is according to the Service Definition. The following sections provide the methodology to perform this validation. To remove complexity from this technical specification, the test methodology presented in this section is for testing between two ETEs. Although testing from an ETE to an LLF is a valid use case, it is a subset of the methodology.

Figure 10 below provides a summary view of the SAT methodology. The figure does not provide the description of the methodology in case of test failures and errors. The detailed methodology involving test failures and errors will be addressed in later figures, when appropriate.

The methodology described in Figure 10 is comprised of processes and apply to both Service Providers and Access Providers.

The first step of the process is to set up the test architecture by ensuring connectivity between the two ETEs. Section 8.1 of this document provides a view of the different use cases for Service Activation Testing.

The next sets of processes for Service Activation Testing are the Service Configuration (Section 10.3) and Service Performance (Section 10.4) tests. A technician or automated testing application in the back office ought to have the granularity and flexibility to run individual tests identified in this section, or run the full set of tests in sequence. For example, a single test from the set of Service Configuration tests could be run for the service under test.

The last sets of processes are used to return the service to the pre-test state and to complete the test report.

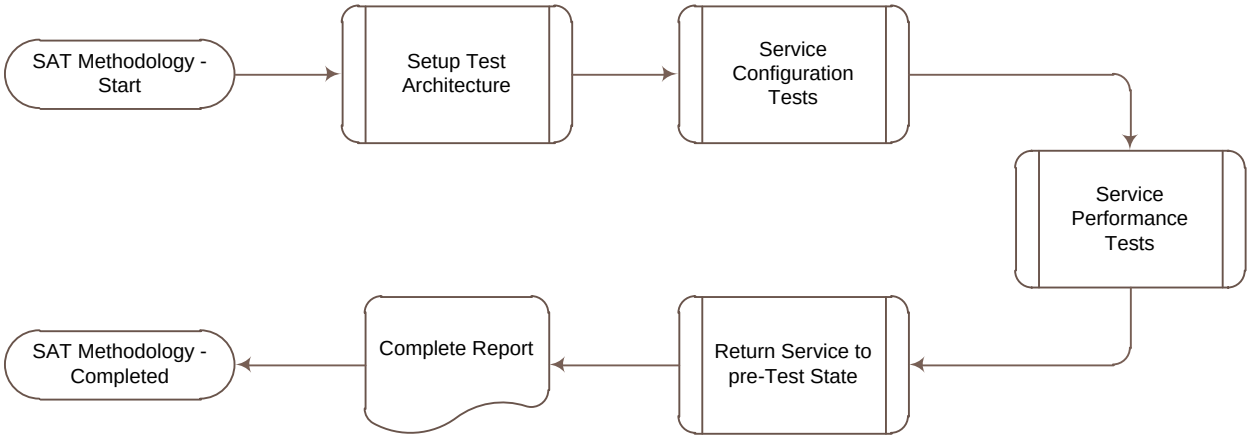


Figure 10 – Service Activation Test Methodology

10.1 Common Test Methodology Requirements

This section captures the common testing parameters and requirements applicable to Service Configuration tests and Service Performance tests. Section 10.1.1 provides the common ETE requirements related to the attributes that need to be tested and the different parameters that are configured.

Section 10.1.2 provides the requirements related to the Ethernet frames used in SAT. Finally, Section 10.1.3 offers a description of one-way versus two-way performance measurement in the context of SAT.

10.1.1 Common Ethernet Test Equipment Requirement

This section provides the common Ethernet Test Equipment requirement to perform SAT. The following requirements relate to the measurement and calculation of E-Access performance service attributes [20].

[R22] The Ethernet Test Equipment **MUST** measure the FD, FLR and IR.

[O4] The Ethernet Test Equipment **MAY** use Utilized Line Rate (ULR) in replacement of IR.

[R23] The Ethernet Test Equipment **MUST** calculate the MFD, Frame Delay Range (FDR) and IFDV.

[R24] The Ethernet Test Equipment **MUST** measure/calculate the E-Access service attributes [20] for color-blind and color-aware mode when applicable.

The MEF 10.3 [13] performance metrics of FD, FDR, and IFDV are all defined in terms of the p-Percentile of Frame Delay or Inter-Frame Delay Variation. Direct computation of percentiles would be resource intensive, requiring significant storage and computation. The Appendix C of

MEF 35 [21] describes a method for determining whether performance objectives are met using bins for FD and IFDV. The methodology to measure and calculate the E-Access performance service attributes [20] is beyond the scope of this specification.

The goal for SAT is to reproduce Service and ENNI Frame behavior to ensure that the E-Access service [20] performs as per the Service Level Specification (SLS). For this reason, test traffic should be sent in both directions (ETE_1 to ETE_2 and ETE_2 to ETE_1) as per the test configuration schematic presented in Table 11 and Table 12.

[R25] SAT **MUST** be performed in both directions simultaneously.

10.1.2 Test Frame Format and Size

The test frame format and size is an important part of SAT as test frames need to reproduce the behavior of Service and ENNI Frames. This section will list the requirements for the format and size of test frames.

[R26] The ETE **MUST** use IEEE 802.3 framing to perform SAT on the E-Access services [20].

[R27] The ETE **MUST** generate and process CE-VLAN ID, CE-VLAN CoS ID, S-VLAN ID and S-VLAN CoS ID as specified for C-TAG and S-TAG in IEEE Std 802.1Q™-2011 sections 9.5 and 9.6 [3].

[R28] The ETE **MUST** generate or process frames such that ENNI Frames have a color indication as specified in MEF 23.1 [17].

[R29] The ETE **MUST** generate or process frames such that ENNI Frame Format is as specified in MEF 26.1 [18].

The frame size used for the Service Configuration and Service Performance tests can be constant or a distribution of multiple frame sizes.

[R30] The ETE **MUST** support the capability to send a single constant test frame size.

[R31] The ETE **MUST** support the capability to configure the test frame size.

This default frame size refers to the total size in octets including the MAC DA through the FCS of an untagged service frame at UNI and excludes the preamble and IPG. A tagged service frame will have 4 more bytes than an untagged Service Frame. Also, the ENNI Frame will have 4 more bytes than an untagged/tagged Service Frame at UNI.

A predefined distribution of multiple frames sizes is referred to as Ethernet Mix (EMIX). This name is similar to the name applied to the variable size patterns assigned in IP-layer testing by different vendors, Internet Mix (IMIX). The EMIX definition found in this technical specification draws upon ITU-T Y.1564 [11] and section 4 of RFC 6985 [8]. EMIX is used to emulate real-world traffic scenarios in a testing environment.

The EMIX pattern is specified in the following format:

EMIX – 123456… x

where each number is replaced by the letter corresponding to the size of the test frame at that position in the sequence. Table 10 gives the letter encoding for standard frame size [6] (64, 128, 256, 512, 1024, 1280, and 1518 bytes), UNI MTU and User defined test frame sizes.

a	b	c	d	e	f	g	h	u
64	128	256	512	1024	1280	1518	MTU	User defined

Table 10 – Ethernet Test Frame Sizes and Size Designations

EMIX patterns are to be specified by the size designator for each frame in the repeating pattern from Table 10. For example, an eight-frame repeating pattern can be specified as follows:

EMIX – abcdefgh = 64, 128, 256, 512, 1024, 1280, 1518, MTU

[D1] EMIX variable test frame size pattern **SHOULD** be used as part of the Service Configuration and Service Performance tests.

[CR1]<[D1]If an EMIX variable test frame size pattern is used, the repeating sequence of sizes **MUST** support at least 8 frame sizes.

[CD1]<[D1]If an EMIX variable test frame size pattern is used, the repeating sequence of sizes **SHOULD** support at least 32 frame sizes.

[CR2]<[D1] The variable frame size pattern **MUST** be repeated as long as necessary during the test procedure from the first to last frame sizes starting at the beginning of each test procedure.

[CD2]<[D1] The EMIX default pattern **SHOULD** be the sequence of sizes: EMIX – abcdefgh.

10.1.3 One-way vs two-way Performance Measurement

The SAT definitions of one-way and two-way performance measurement are based on the MEF 35 [21] definitions, with adjustments for SAT to change the reference point from a MEP to an ETE connected to a SAMP.

One-way performance measurement, in the context of SAT, is defined as a measurement performed in the Forward or Backward direction. For example, using Figure 2, the Forward direction is presented from SAMP A located at the ENNI-N to SAMP B at the UNI-N. Using the

same Figure 2, the Backward direction is from SAMP B to SAMP A. A one-way measurement provides a measurement in a single direction only.

Two-way measurement, in the context of SAT, is defined as a measurement performed in the Forward direction and then in the Backward direction. As an example, using Figure 2, a two-way measurement is from SAMP A located at the ENNI-N to SAMP B at the UNI-N and back to SAMP A. A two-way measurement provides a round-trip measurement.

Wherever possible, one-way performance measurement is performed by the ETEs. The test is considered passed if both directions meet the pass/fail limits (SAC), or failed if either direction fails the SAC. One-way delay is difficult to measure and therefore one-way delay may be approximated from two-way measurements. However these techniques are beyond the scope of this document.

[D2] The ETE **SHOULD** perform one-way performance measurement.

[R32] The ETE **MUST** perform two-way performance measurement.

MEF 26.1 [18] defines performance as one-way metrics for the OVC. These metrics are most accurately measured using one-way measurements. In case one-way measurements cannot be executed, the performance could be approximated using two-way measurements, and reported as approximations of the one-way objective. Under no conditions should one-way metrics derived from two–way measurements be reported as one-way metrics.

[R33] The method of measuring the metric (e.g., one-way, two-way) **MUST** be reported with the measurements.

10.2 Service Acceptance Criteria Limits

As described in Section 7, the Service Acceptance Criteria apply to the Service Configuration and Service Performance tests and provide pass or fail criteria on the basis of whether or not the service meets it's SAC during each test, and this per service attribute and per direction. These criteria are allowable limits for each of the measured service attributes in the test, and are carefully selected to give the Service Provider and Access Provider confidence that a service that passes its Service Activation Testing, according to the established SAC, will be a satisfactory service that will meet its Class of Service Performance Objectives (CPOs) for the customer. As already stated in this document, some differences may exist between the Service Acceptance Criteria and the Class of Service Performance Objectives.

SAT Service Acceptance Criteria (SAC) are not equivalent to CPOs. CPOs are based on performance of in-service OVCs over a 30-day time period; while SAC values are based on measuring test frames transmitted for a limited time period, e.g., normally < 24 hours, before an OVC is placed in-service. Due to this difference, the values contained in MEF 23.1 [17] for CPOs are not directly applicable to SAC for an OVC[1].

[1] SP and AP can choose to use CPOs as defined in MEF 23.1 [17] for SAC. If they choose to make them more stringent (which they should), they are not going against SAT. SAC as defined in SAT are just configurable pass/fail criteria. The values for SAC are beyond the scope of this document.

[R34] The Service Acceptance Criteria (SAC) **MUST** be agreed upon by the Service Provider and the Access Provider.

10.3 Service Configuration Tests

The objectives of the Service Configuration tests are to validate that the service is configured as defined and consistent with E-Access services [20]. Figure 11 and Figure 12 provide a summary view of the Service Configuration Testing process for the AP (Figure 11) and SP (Figure 12).

The Service Configuration tests for the AP are composed of 5 sub-processes that are designed to ensure that the service is configured and documented correctly. These sub-processes are OVC MTU size test, CE-VLAN ID Preservation test, CE VLAN CoS ID Preservation test, Broadcast/Unicast/Multicast Frame Delivery tests and Bandwidth Profile (BWP) tests. Each of these sub-processes will be explained in details below.

The Service Configuration tests for the SP are composed of 5 sub-processes. These sub-processes are OVC MTU size test, CE-VLAN ID Preservation test, CE VLAN CoS ID Preservation test, Broadcast/Unicast/Multicast Frame Delivery tests and Bandwidth Profile (BWP) tests. The main difference between the SP and AP processes is the Frame Delivery tests that are optional in the case of the SP processes.

Each sub-section below provides information on which service attributes are tested and reported, or only reported, for SPs and APs, as described in Section 9.

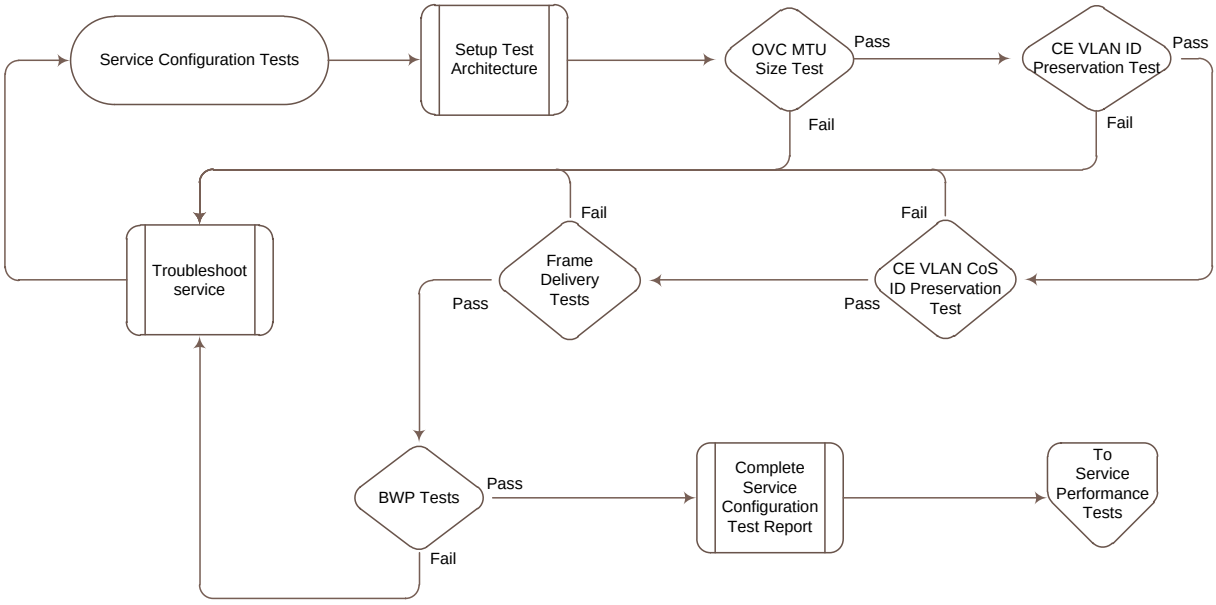


Figure 11 – Service Configuration Test Process for Access Providers

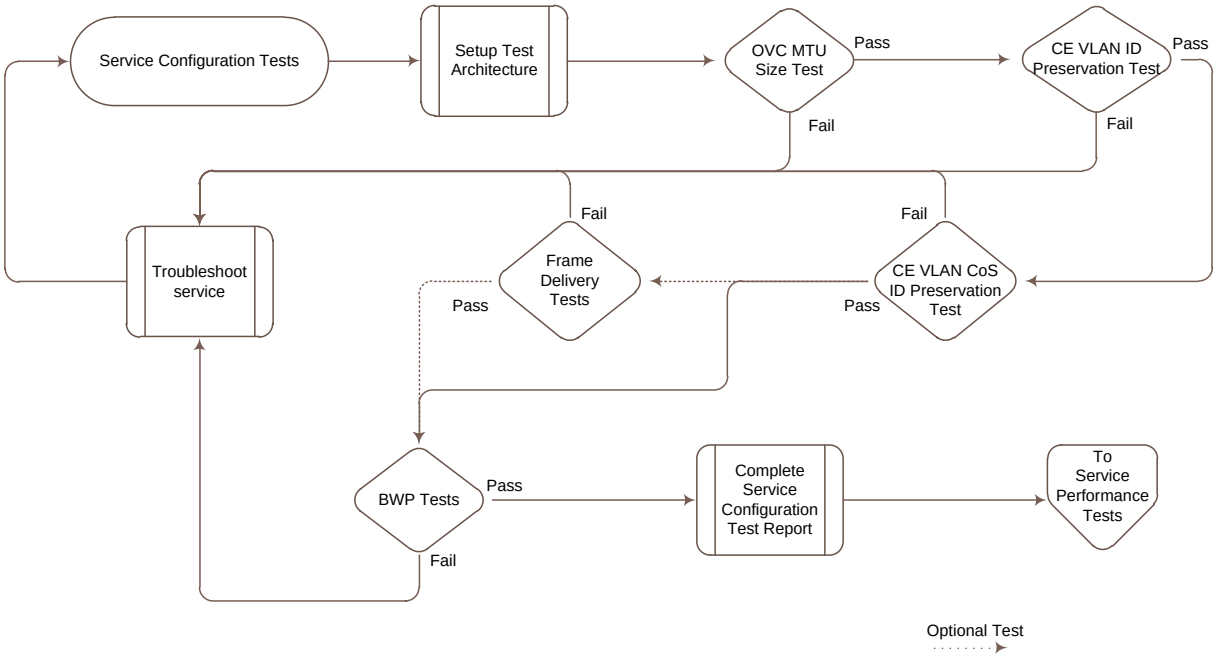
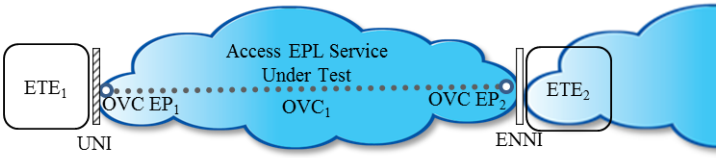


Figure 12 – Service Configuration Test Process for Service Providers

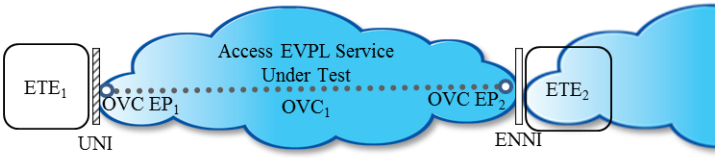
For each sub-section, a series of tables are added to clarify the methodology used to test each service attribute. The following two tables provide a high level view of the common test requirements for Access EPL (Table 11) and Access EVPL (Table 12) services [20].

Service Activation Test Methodology – Common Test Requirements – Access EPL	
Test Configuration	An OVC associating one OVC EP at the UNI and one OVC EP at the ENNI is configured as per the Service Definition. All CE-VLAN ID values are mapped to the OVC EP at the UNI and a specific S-VLAN ID is mapped to the OVC EP at the ENNI.
Test Configuration Schematic	Access Provider Test Configuration:  Service Provider Test Configuration:  Note 1: The ETE_1 or ETE_2 shown in the Test Configuration Schematic could be replaced by an LLF as an alternative configuration. An example of such configuration can be found in Figure 9 D). Refer for section 8.1.2 for additional considerations.

<table>
<tr><td>End Point Maps</td><td>
<table>
<tr><th colspan="2">Map at UNI</th></tr>
<tr><td>CE-VLAN ID</td><td>OVC End Point</td></tr>
<tr><td>1,2…4095</td><td>OVC EP_1</td></tr>
</table>
<table>
<tr><th colspan="2">Map at ENNI</th></tr>
<tr><td>S-VLAN ID</td><td>OVC End Point</td></tr>
<tr><td>As per Service Definition</td><td>OVC EP_2</td></tr>
</table>
</td></tr>
<tr><td>Bandwidth Profile</td><td>
<table>
<tr><th colspan="2">Ingress Bandwidth Profile per OVC EP at UNI</th></tr>
<tr><td>OVC End Point</td><td>Parameters</td></tr>
<tr><td>OVC EP_1</td><td>CIR_1 CBS_1 EIR_1 EBS_1 CF_1 CM_1</td></tr>
<tr><td colspan="2">Note 1: CIR_1 CBS_1 EIR_1 EBS_1 CF_1 CM_1 as per Service Definition</td></tr>
</table>
<table>
<tr><th colspan="2">Ingress Bandwidth Profile per OVC EP at ENNI</th></tr>
<tr><td>OVC End Point</td><td>Parameters</td></tr>
<tr><td>OVC EP_2</td><td>CIR_2 CBS_2 EIR_2 EBS_2 CF_2 CM_2</td></tr>
<tr><td colspan="2">Note 1: CIR_2 CBS_2 EIR_2 EBS_2 CF_2 CM_2 as per Service Definition</td></tr>
</table>
</td></tr>
</table>

Table 11 – SAT Methodology – Common Test Requirements for Access EPL Services

<table>
<tr><th colspan="2">Service Activation Test Methodology – Common Test Requirements – Access EVPL</th></tr>
<tr><td>Test Configuration</td><td>An OVC associating one OVC EP at the UNI and one OVC EP at the ENNI is configured as per the Service Definition. One or more CE-VLAN ID is mapped to the OVC EP at the UNI and a specific S-VLAN ID is mapped to the OVC EP at the ENNI.</td></tr>
<tr><td>Test Configuration Schematic</td><td>Access Provider Test Configuration:
 

Service Provider Test Configuration:
 

Note 1: The ETE_1 or ETE_2 shown in the Test Configuration Schematic could be replaced by an LLF as an alternative configuration. An example of such configuration can be found in Figure 9 D). Refer for section 8.1.2 for additional considerations.</td></tr>
</table>

<table>
<tr><td>End Point Maps</td><td>
<table>
<tr><th colspan="2">Map at UNI</th></tr>
<tr><td>CE-VLAN ID</td><td>OVC End Point</td></tr>
<tr><td>As per Service Definition</td><td>OVC EP_1</td></tr>
</table>
<table>
<tr><th colspan="2">Map at ENNI</th></tr>
<tr><td>S-VLAN ID</td><td>OVC End Point</td></tr>
<tr><td>As per Service Definition</td><td>OVC EP_2</td></tr>
</table>
</td></tr>
<tr><td>Bandwidth Profile</td><td>
<table>
<tr><th colspan="2">Ingress Bandwidth Profile per OVC EP at UNI</th></tr>
<tr><td>OVC End Point</td><td>Parameters</td></tr>
<tr><td>OVC EP_1</td><td>CIR_1 CBS_1 EIR_1 EBS_1 CF_1 CM_1</td></tr>
<tr><td colspan="2">Note 1: CIR_1 CBS_1 EIR_1 EBS_1 CF_1 CM_1 as per Service Definition</td></tr>
</table>
<table>
<tr><th colspan="2">Ingress Bandwidth Profile per OVC EP at ENNI</th></tr>
<tr><td>OVC End Point</td><td>Parameters</td></tr>
<tr><td>OVC EP_2</td><td>CIR_2 CBS_2 EIR_2 EBS_2 CF_2 CM_2</td></tr>
<tr><td colspan="2">Note 1: CIR_2 CBS_2 EIR_2 EBS_2 CF_2 CM_2 as per Service Definition</td></tr>
</table>
</td></tr>
</table>

Table 12 – SAT Methodology – Common Test Requirements for Access EVPL Services

For the Service Configuration tests (excluding the BWP tests of section 10.3.5), a time duration for a test is defined as T_{SC} (Time Service Configuration).

[R35] The T_{SC} **MUST** be configurable from at least 1 second up to 60 seconds.

10.3.1 OVC MTU Size Test

The Maximum Transmission Unit (MTU) size specifies the maximum frame length in bytes allowed at an External Interface. The MTU is part of several attribute specifications. For example, the OVC (defined in MEF 26.1 section 7.2.10 [18]) has an MTU attribute which needs to be validated.

[R36] The Access Provider **MUST** test the OVC MTU size as per the methodology defined in Table 13.

[R37] The Service Provider **MUST** test the OVC MTU size as per the methodology defined in Table 13.

Table 13 below defines the test methodology to perform OVC MTU size test. This methodology explains how the OVC MTU size test is used to test an Access EPL and Access EVPL services [20].

Service Activation Test Methodology	
Test Name	OVC Maximum Transmission Unit size test
Test Type	Service Activation
Service Type	Access EPL and Access EVPL
Test Status	Mandatory for Access Provider and Service Provider
Test Object	Verify that for an Access EPL or Access EVPL service, the OVC Maximum Transmission Unit size is an integer number of bytes ≥ 1526.
Test Procedure	**Access EPL Service:** • ETE_1 offers C-tagged Service Frames with CE-VLAN ID equal to 65 and frame size equal to the OVC_1 MTU size at UNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_2 verifies that the Service Frames offered at the UNI are received double-tagged with S-VLAN ID equal to the S-VLAN ID as defined in the Service Definition at the ENNI configured in OVC_1 and validates the received OVC MTU size. Frame loss is acceptable up to $FLR_{SAC,}$ where FLR_{SAC} is the SAC for Frame Loss Ratio. • Simultaneously, ETE_2 offers double-tagged ENNI frames with CE-VLAN ID equal to 65 and S-VLAN ID equal to the S-VLAN ID defined in the Service Definition and frame size equal to the OVC_1 MTU size at ENNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_1 verifies that the ENNI Frames with S-VLAN ID equal to the S-VLAN ID defined in the Service Definition offered at ENNI configured in OVC_1 are received C-tagged with CE-VLAN ID equal to 65 at UNI and validates the received OVC MTU size. Frame loss is acceptable up to FLR_{SAC}. **Access EVPL Service:** • ETE_1 offers C-tagged Service Frames with CE-VLAN ID as per Service Definition and frame size equal to the OVC_1 MTU size at UNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_2 verifies that the Service Frames offered at the UNI are received double-tagged with S-VLAN ID equal to the S-VLAN ID as defined in the Service Definition at the ENNI configured in OVC_1. Frame loss is acceptable up to $FLR_{SAC,}$ where FLR_{SAC} is the SAC for Frame Loss Ratio. • Simultaneously, ETE_2 offers double-tagged ENNI frames with CE-VLAN ID as per Service Definition and S-VLAN ID equal to the S-VLAN ID defined in the Service Definition and frame size equal to the OVC_1 MTU size at ENNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_1 verifies that the ENNI Frames with S-VLAN ID equal to the S-VLAN ID as per Service Definition offered at ENNI configured in OVC_1 are received C-tagged with CE-VLAN ID equal to the value in the Service Definition at the UNI. Frame loss is acceptable up to FLR_{SAC}.
Units	Number of valid frames received at the external interfaces
Variables	OVC MTU size, IR_{SC}, test duration T_{SC} and FLR_{SAC}
Results	Pass or fail
Remarks	Note 1: OVC MTU size of the E-Access Service [20] under test is to be provided by the Access Provider. Note 2: The OVC MTU size has to be ≤ to the MTU size of each External Interface where an OVC EP exists that is associated by the OVC.

Table 13 – SAT Methodology – OVC MTU Size Test

10.3.2 CE-VLAN ID Preservation Test

CE-VLAN ID Preservation describes a relationship between the format and certain field values of the frame at one External Interface and the format and certain field values of the corresponding frame at another External Interface that allows the CE-VLAN ID value of the UNI Service

Frame to be derived from the ENNI Frame and vice versa. MEF 26.1 Section 7.2.11 [18] provides a detailed explanation of CE-VLAN ID Preservation.

[R38] The Access Provider **MUST** test the CE-VLAN ID Preservation as per the methodology defined in Table 14 for Access EPL or Table 15 for Access EVPL.

[R39] The Service Provider **MUST** test the CE-VLAN ID Preservation as per the methodology defined in Table 14 for Access EPL or Table 15 for Access EVPL.

Table 14 and Table 15 below define the test methodology to perform CE-VLAN ID Preservation test. This methodology explains how the CE-VLAN ID Preservation test is used to test Access EPL and Access EVPL services [20]. For Access EVPL services [20], there are two test procedures described, one for maximum number of CE-VLAN IDs per OVC equal to 1 (mandatory as part of Access EVPL service definition [20]) and one procedure for CE-VLAN IDs per OVC greater than 1 (optional as part of Access EVPL service definition [20]).

Service Activation Test Methodology	
Test Name	CE-VLAN ID Preservation test for Access EPL Services
Test Type	Service Activation
Service Type	Access EPL
Test Status	Mandatory for Access Provider and Service Provider
Test Object	Verify that for an Access EPL service, CE-VLAN IDs mapped to the OVC are preserved.
Test Procedure	• The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2. • ETE_1 offers C-tagged Service Frames with CE-VLAN IDs as per test definition at UNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. (See Note 1) • ETE_2 verifies that the C-tagged Service Frames offered at UNI are delivered double-tagged with CE-VLAN IDs as per test definition and S-VLAN ID as per Service Definition at the ENNI configured in OVC_1. Frame loss is acceptable up to $FLR_{SAC,}$ where FLR_{SAC} is the SAC for Frame Loss Ratio. • Simultaneously, ETE_2 offers double-tagged ENNI Frames with CE-VLAN IDs as per test definition and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_1 verifies that the ENNI Frames offered at ENNI double-tagged with CE-VLAN IDs as per test definition and S-VLAN ID as per Service Definition are received C-tagged at UNI configured in OVC_1 with CE-VLAN IDs as per Service Definition. Frame loss is acceptable up to FLR_{SAC}.
Units	CE-VLAN ID and S-VLAN ID values
Variables	Service and ENNI Frame sizes, IR_{SC}, test duration T_{SC} and FLR_{SAC}
Results	Pass or fail
Remarks	Note 1: For Access EPL testing, the test definition is for 4 VLAN IDs values to be tested: for example, one at the beginning of the VLAN range (value = 1), 2 in the middle of the range (Value = 1024 and 2048) and 1 at the top end (Value = 4094). The values of the VLAN IDs are to be determined by the Access and Service Providers. Note 2: CE-VLAN and S-VLAN formats are as specified for the C-TAG and S-TAG in IEEE Std 802.1Q™-2011 sections 9.5 and 9.6 [3].

Table 14 – SAT Methodology – CE-VLAN ID Preservation Test for Access EPL Services

Service Activation Test Methodology	
Test Name	CE-VLAN ID Preservation test for Access EVPL Services
Test Type	Service Activation
Service Type	Access EVPL
Test Status	Mandatory for Access Provider and Service Provider
Test Object	Verify that for an Access EVPL service, the CE-VLAN ID mapped to the OVC is preserved.
Test Procedure	For maximum number of CE-VLAN IDs per OVC = 1 • The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2. • ETE_1 offers C-tagged Service Frames with CE-VLAN ID as per service definition at UNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_2 verifies that the C-tagged Service Frames offered at UNI are delivered double-tagged with CE-VLAN ID as per service definition and S-VLAN ID as per Service Definition at the ENNI configured in OVC_1. Frame loss is acceptable up to $FLR_{SAC,}$ where FLR_{SAC} is the SAC for Frame Loss Ratio. • Simultaneously, ETE_2 offers double-tagged ENNI Frames with CE-VLAN IDs as per service definition and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_1 verifies that the ENNI Frames offered at ENNI double-tagged with CE-VLAN IDs as per service definition and S-VLAN ID as per Service Definition are received C-tagged at UNI configured in OVC_1 with CE-VLAN IDs as per Service Definition. Frame loss is acceptable up to FLR_{SAC}. For maximum number of CE-VLAN IDs per OVC > 1 • The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2. • ETE_1 offers C-tagged Service Frames with CE-VLAN IDs as per test definition at UNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. (See Note 1) • ETE_2 verifies that the C-tagged Service Frames offered at UNI are delivered double-tagged with CE-VLAN IDs as per test definition and S-VLAN ID as per Service Definition at the ENNI configured in OVC_1. Frame loss is acceptable up to $FLR_{SAC,}$ where FLR_{SAC} is the SAC for Frame Loss Ratio. • Simultaneously, ETE_2 offers double-tagged ENNI Frames with CE-VLAN IDs as per test definition and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_1 verifies that the ENNI Frames offered at ENNI double-tagged with CE-VLAN IDs as per test definition and S-VLAN ID as per Service Definition are received C-tagged at UNI configured in OVC_1 with CE-VLAN IDs as per Service Definition. Frame loss is acceptable up to FLR_{SAC}. • The test procedure is repeated for each CE-VLAN ID to be tested.
Units	CE-VLAN ID and S-VLAN ID values
Variables	Service and ENNI Frame sizes, IR_{SC}, test duration T_{SC} and FLR_{SAC}
Results	Pass or fail
Remarks	Note 1: For Access EVPL testing with maximum number of CE-VLAN IDs per OVC > 1, the values of the CE-VLAN IDs are to be determined by the Access and Service Providers. Note 2: CE-VLAN and S-VLAN formats are as specified for the C-TAG and S-TAG in IEEE Std 802.1Q™-2011 sections 9.5 and 9.6 [3].

Table 15 – SAT Methodology – CE-VLAN ID Preservation Test for Access EVPL Services

10.3.3 CE VLAN CoS ID Preservation Test

CE-VLAN CoS ID Preservation describes a relationship between the format and certain field values of the frame at one External Interface and the format and certain field values of the corresponding frame at another External Interface that allows the CE-VLAN CoS ID value of the UNI Service Frame to be derived from the ENNI Frame and vice versa. MEF 26.1 Section 7.2.12 [18] provides a detailed explanation of CE-VLAN CoS ID Preservation.

[R40] The Access Provider **MUST** test the CE-VLAN CoS ID Preservation as per the methodology defined in Table 16 for Access EPL or Table 17 for Access EVPL.

[R41] The Service Provider **MUST** test the CE-VLAN CoS ID Preservation as per the methodology defined in Table 16 for Access EPL or Table 17 for Access EVPL.

As part of the CE-VLAN CoS ID Preservation test, the Class of Service Identifier for Service Frames and the Class of Service Identifier for ENNI Frames are assessed. When a Service Frame is mapped to an OVC end point, it is according to its CE-VLAN ID. When testing CE-VLAN CoS ID Preservation, the mapping process of the Service Frame is tested. For this reason, Class of Service IDs are by default tested as part of this test methodology.

Table 16 and Table 17 below define the test methodology to perform CE-VLAN CoS ID Preservation test. This methodology explains how the CE-VLAN CoS ID Preservation test is used to test an Access EPL and Access EVPL services.

Service Activation Test Methodology	
Test Name	CE-VLAN CoS ID Preservation test for Access EPL Services
Test Type	Service Activation
Service Type	Access EPL
Test Status	Mandatory for Access Provider and Service Provider
Test Object	Verify that for an Access EPL service, all CE-VLAN CoS IDs mapped to the OVC are preserved.
Test Procedure	• The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2. • ETE_1 offers C-tagged Service Frames with CE-VLAN ID equal to 65 and CE-VLAN CoS ID equal to 0 at UNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_2 verifies that the C-tagged Service Frames offered at UNI are delivered double-tagged with CE-VLAN ID equal to 65 and CE-VLAN CoS ID equal to 0 and S-VLAN ID as per Service Definition at the ENNI configured in OVC_1. Frame loss is acceptable up to $FLR_{SAC,}$ where FLR_{SAC} is the SAC for Frame Loss Ratio. • Simultaneously, ETE_2 offers double-tagged ENNI Frames with CE-VLAN ID equal to 65 and CE-VLAN CoS ID equal to 0 and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_1 verifies that the ENNI Frames offered at ENNI double-tagged with CE-VLAN ID equal to 65 and CE-VLAN CoS ID equal to 0 and S-VLAN ID as per Service Definition are received C-tagged at UNI configured in OVC_1 with CE-VLAN ID equal to 65 and CE-VLAN CoS ID equal to 0. Frame loss is acceptable up to FLR_{SAC}. • The test procedure is repeated by incrementing the CE-VLAN CoS ID by one until all CoS IDs are tested.
Units	CE-VLAN ID, CE-VLAN CoS ID and S-VLAN ID values
Variables	Service and ENNI Frame sizes, IR_{SC}, test duration T_{SC} and FLR_{SAC}
Results	Pass or fail
Remark	CE-VLAN and S-VLAN formats are as specified for the C-TAG and S-TAG in IEEE Std 802.1Q™-2011 sections 9.5 and 9.6 [3].

Table 16 – SAT Methodology – CE-VLAN CoS ID Preservation Test for Access EPL Services

Service Activation Test Methodology	
Test Name	CE-VLAN CoS ID Preservation test for Access EVPL Services
Test Type	Service Activation
Service Type	Access EVPL
Test Status	Mandatory for Access Provider and Service Provider
Test Object	Verify that for an Access EVPL service, the CE-VLAN CoS IDs are preserved.
Test Procedure	• The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2. • ETE_1 offers C-tagged Service Frames with CE-VLAN ID as per Service Definition and CE-VLAN CoS ID equal to 0 at UNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_2 verifies that the C-tagged Service Frames offered at UNI are delivered double-tagged with CE-VLAN ID as per Service Definition and CE-VLAN CoS ID equal to 0 and S-VLAN ID as per Service Definition at the ENNI configured in OVC_1. Frame loss is acceptable up to $FLR_{SAC,}$ where FLR_{SAC} is the SAC for Frame Loss Ratio. • Simultaneously, ETE_2 offers double-tagged ENNI Frames with CE-VLAN ID as per Service Definition and CE-VLAN CoS ID equal to 0 and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_1 verifies that the ENNI Frames offered at ENNI double-tagged with CE-VLAN ID as per Service Definition and CE-VLAN CoS ID equal to 0 and S-VLAN ID as per Service Definition are received C-tagged at UNI configured in OVC_1 with CE-VLAN ID as per Service Definition and CE-VLAN CoS ID equal to 0. Frame loss is acceptable up to FLR_{SAC}. • The test procedure is repeated by incrementing the CE-VLAN CoS ID by one until all CoS IDs are tested (see note 1).
Units	CE-VLAN ID, CE-VLAN CoS ID and S-VLAN ID values
Variables	Service and ENNI Frame sizes, IR_{SC}, test duration T_{SC} and FLR_{SAC}
Results	Pass or fail
Remarks	Note 1: For Access EVPL testing with maximum number of CE-VLAN IDs per OVC > 1, the test procedure must be repeated for each value of the CE-VLAN IDs as determined by the Access and Service Providers. Note 2: CE-VLAN and S-VLAN formats are as specified for the C-TAG and S-TAG in IEEE Std 802.1Q™-2011 sections 9.5 and 9.6 [3].

Table 17 – SAT Methodology – CE-VLAN CoS ID Preservation Test for Access EVPL Services

10.3.4 Broadcast, Unicast, Multicast Frame Delivery Test

The goal of this test is to validate Broadcast, Unicast, and Multicast Service Frame Delivery from UNI to ENNI and ENNI to UNI with parameters of Deliver Unconditionally. An ETE offers Service Frames with IEEE 802.3 [2] frame formats at the UNI supporting the OVC to be tested and verified.

[R42] OVC Data Service Frame Delivery tests **MUST** be performed during the Service Configuration test.

The methodology to test the Broadcast, Unicast and Multicast Data Service Frame Delivery is detailed in the following sub-sections.

10.3.4.1 Broadcast Data Service Frame Delivery Test

The Broadcast Data Service Delivery attribute describes how ingress frames mapped to an OVC End Point at an External Interface with the Broadcast destination MAC address are delivered to the other End Points associated by the OVC. MEF 26.1 Section 7.2.19 [18] provides a detailed explanation of the Broadcast Data Service Delivery attribute.

[R43] The Access Provider **MUST** test the Broadcast Data Service Delivery as per the methodology defined in Table 18 for Access EPL or Table 19 for Access EVPL.

[O5] The Service Provider **MAY** test the Broadcast Data Service Delivery as per the methodology defined in Table 18 for Access EPL or Table 19 for Access EVPL.

Table 18 and Table 19 below define the test methodology to perform Broadcast Data Service Delivery test. This methodology explains how the Broadcast Data Service Delivery test is used to test Access EPL and Access EVPL services [20].

The methodology presented below is defined for the Unconditional Delivery of Broadcast Frames. If Delivered Conditionally, the Access Provider and Service Provider have to negotiate the conditions for the delivery and the methodology to test. Conditional Delivery is beyond the scope of this specification.

Service Activation Test Methodology	
Test Name	Broadcast Unconditional Frame Delivery Test for Access EPL Services
Test Type	Service Activation
Service Type	Access EPL
Test Status	Mandatory for Access Provider and Optional for Service Provider
Test Object	Verify that for an Access EPL service, the Broadcast frames are Delivered Unconditionally.
Test Procedure	• The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2. • ETE_1 offers C-tagged Service Frames with CE-VLAN ID equal to 65 with Broadcast destination address at UNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. Frame loss is acceptable up to $FLR_{SAC,}$ where FLR_{SAC} is the SAC for Frame Loss Ratio. • ETE_2 verifies that the Broadcast C-tagged Service Frames offered at UNI are delivered double-tagged with CE-VLAN ID equal to 65 and S-VLAN ID as per Service Definition at the ENNI configured in OVC_1. • Simultaneously, ETE_2 offers Broadcast double-tagged ENNI Frames with CE-VLAN ID equal to 65 and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_1 verifies that the Broadcast ENNI Frames offered at ENNI double-tagged with CE-VLAN ID equal to 65 and S-VLAN ID as per Service Definition are received C-tagged at UNI configured in OVC_1 with CE-VLAN ID equal to 65. Frame loss is acceptable up to FLR_{SAC}.
Units	Number of valid frames received at the external interfaces
Variables	Service and ENNI Frame sizes, IR_{SC}, test duration T_{SC} and FLR_{SAC}
Results	Pass or fail
Remark	None

Table 18 – SAT Methodology – Broadcast Delivery Test for Access EPL Services

Service Activation Test Methodology	
Test Name	Broadcast Unconditional Frame Delivery Test for Access EVPL Services
Test Type	Service Activation
Service Type	Access EVPL
Test Status	Mandatory for Access Provider and Optional for Service Provider
Test Object	Verify that for an Access EVPL service, the Broadcast frames are Delivered Unconditionally.
Test Procedure	• The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2. • ETE_1 offers C-tagged Service Frames with CE-VLAN ID as per Service Definition with Broadcast destination address at UNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_2 verifies that the Broadcast C-tagged Service Frames offered at UNI are delivered double-tagged with CE-VLAN ID as per Service Definition and S-VLAN ID as per Service Definition at the ENNI configured in OVC_1. Frame loss is acceptable up to $FLR_{SAC,}$ where FLR_{SAC} is the SAC for Frame Loss Ratio. • Simultaneously, ETE_2 offers Broadcast double-tagged ENNI Frames with CE-VLAN ID as per Service Definition and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_1 verifies that the Broadcast ENNI Frames offered at ENNI double-tagged with CE-VLAN ID as per Service Definition and S-VLAN ID as per Service Definition are received C-tagged at UNI configured in OVC_1 with CE-VLAN ID as per Service Definition. Frame loss is acceptable up to FLR_{SAC}.
Units	Number of valid frames received at the external interfaces
Variables	Service and ENNI Frame sizes, IR_{SC}, test duration T_{SC} and FLR_{SAC}
Results	Pass or fail
Remark	None

Table 19 – SAT Methodology – Broadcast Delivery Test for Access EVPL Services

10.3.4.2 Unicast Data Service Frame Delivery Test

The Unicast Data Service Delivery attribute describes how ingress frames mapped to an OVC End Point at an External Interface with a Unicast destination MAC address of the remote ETE are delivered to the other End Points associated by the OVC. MEF 26.1 Section 7.2.17 [18] provides a detailed explanation of the Unicast Data Service Delivery attribute.

[R44] The Access Provider **MUST** test the Unicast Data Service Delivery as per the methodology defined in Table 20 for Access EPL or Table 21 for Access EVPL.

[O6] The Service Provider **MAY** test the Unicast Data Service Delivery as per the methodology defined in Table 20 for Access EPL or Table 21 for Access EVPL.

Table 20 and Table 21 below define the test methodology to perform Unicast Data Service Delivery test. This methodology explains how the Unicast Data Service Delivery test is used to test an Access EPL and Access EVPL Services [20].

The methodology presented below is defined for the Unconditional Delivery of Unicast frames. If Delivered Conditionally, the Access Provider and Service Provider have to negotiate the conditions for the delivery and the methodology to test. Conditional Delivery is beyond the scope of this specification.

Service Activation Test Methodology	
Test Name	Unicast Unconditional Frame Delivery Test for Access EPL Services
Test Type	Service Activation
Service Type	Access EPL
Test Status	Mandatory for Access Provider and Optional for Service Provider
Test Object	Verify that for an Access EPL service, the Unicast frames are Delivered Unconditionally.
Test Procedure	• The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2. • ETE_1 offers C-tagged Service Frames with CE-VLAN ID equal to 65 with Unicast destination address at UNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_2 verifies that the Unicast C-tagged Service Frames offered at UNI are delivered double-tagged with CE-VLAN ID equal to 65 and S-VLAN ID as per Service Definition at the ENNI configured in OVC_1. Frame loss is acceptable up to $FLR_{SAC,}$ where FLR_{SAC} is the SAC for Frame Loss Ratio. • Simultaneously, ETE_2 offers Unicast double-tagged ENNI Frames with CE-VLAN ID equal to 65 and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_1 verifies that the Unicast ENNI Frames offered at ENNI double-tagged with CE-VLAN ID equal to 65 and S-VLAN ID as per Service Definition are received C-tagged at UNI configured in OVC_1 with CE-VLAN ID equal to 65. Frame loss is acceptable up to FLR_{SAC}.
Units	Number of valid frames received at the external interfaces
Variables	Service and ENNI Frame sizes, IR_{SC}, test duration T_{SC} and FLR_{SAC}
Results	Pass or fail
Remark	None

Table 20 – SAT Methodology – Unicast Delivery Test for Access EPL Services

Service Activation Test Methodology	
Test Name	Unicast Unconditional Frame Delivery Test for Access EVPL Services
Test Type	Service Activation
Service Type	Access EVPL
Test Status	Mandatory for Access Provider and Optional for Service Provider
Test Object	Verify that for an Access EVPL service, the Unicast frames are Delivered Unconditionally.
Test Procedure	• The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2. • ETE_1 offers C-tagged Service Frames with CE-VLAN ID as per Service Definition with Unicast destination address at UNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_2 verifies that the Unicast C-tagged Service Frames offered at UNI are delivered double-tagged with CE-VLAN ID as per Service Definition and S-VLAN ID as per Service Definition at the ENNI configured in OVC_1. Frame loss is acceptable up to $FLR_{SAC,}$ where FLR_{SAC} is the SAC for Frame Loss Ratio.

	• Simultaneously, ETE_2 offers Unicast double-tagged ENNI Frames with CE-VLAN ID as per Service Definition and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_1 verifies that the Unicast ENNI Frames offered at ENNI double-tagged with CE-VLAN ID as per Service Definition and S-VLAN ID as per Service Definition are received C-tagged at UNI configured in OVC_1 with CE-VLAN ID as per Service Definition. Frame loss is acceptable up to FLR_{SAC}.
Units	Number of valid frames received at the external interfaces
Variables	Service and ENNI Frame sizes, IR_{SC}, test duration T_{SC} and FLR_{SAC}
Results	Pass or fail
Remark	None

Table 21 – SAT Methodology – Unicast Delivery Test for Access EVPL Services

10.3.4.3 Multicast Data Service Frame Delivery Test

Multicast Data Service Delivery attribute describes how ingress frames mapped to an OVC End Point at an External Interface with a Multicast destination MAC address (provided by the SP or AP) are delivered to the other End Points associated by the OVC. MEF 26.1 Section 7.2.18 [18] provides a detailed explanation of the Multicast Data Service Delivery attribute.

[R45] The Access Provider **MUST** test the Multicast Data Service Delivery as per the methodology defined in Table 22 for Access EPL or Table 23 for Access EVPL.

[O7] The Service Provider **MAY** test the Multicast Data Service Delivery as per the methodology defined in Table 22 for Access EPL or Table 23 for Access EVPL.

Table 22 and Table 23 below define the test methodology to perform Multicast Data Service Delivery Test. This methodology explains how the Multicast Data Service Delivery Test is used to test an Access EPL and Access EVPL Services [20].

The methodology presented below is defined for the Unconditional delivery of Multicast Frames. If Delivered Conditionally, the Access Provider and Service Provider have to negotiate the conditions for the delivery and the methodology to test. Conditional Delivery is beyond the scope of this specification.

Service Activation Test Methodology	
Test Name	Multicast Unconditional Frame Delivery Test for Access EPL Services
Test Type	Service Activation
Service Type	Access EPL
Test Status	Mandatory for Access Provider and Optional for Service Provider
Test Object	Verify that for an Access EPL service, the Multicast frames are Delivered Unconditionally.
Test Procedure	• The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2. • ETE_1 offers C-tagged Service Frames with CE-VLAN ID equal to 65 with Multicast destination address at UNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_2 verifies that the Multicast C-tagged Service Frames offered at UNI are delivered double-

	tagged with CE-VLAN ID equal to 65 and S-VLAN ID as per Service Definition at the ENNI configured in OVC_1. Frame loss is acceptable up to $FLR_{SAC,}$ where FLR_{SAC} is the SAC for Frame Loss Ratio. • Simultaneously, ETE_2 offers Multicast double-tagged ENNI Frames with CE-VLAN ID equal to 65 and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_1 verifies that the Multicast ENNI Frames offered at ENNI double-tagged with CE-VLAN ID equal to 65 and S-VLAN ID as per Service Definition are received C-tagged at UNI configured in OVC_1 with CE-VLAN ID equal to 65. Frame loss is acceptable up to FLR_{SAC}.
Units	Number of valid frames received at the external interfaces
Variables	Service and ENNI Frame sizes, IR_{SC}, test duration T_{SC} and FLR_{SAC}
Results	Pass or fail
Remark	The Multicast frames are not to be Layer 2 Control Protocol (L2CP) Frames. See MEF L2CP [24] Table 2.

Table 22 – SAT Methodology – Multicast Delivery Test for Access EPL Services

Service Activation Test Methodology	
Test Name	Multicast Unconditional Frame Delivery Test for Access EVPL Services
Test Type	Service Activation
Service Type	Access EVPL
Test Status	Mandatory for Access Provider and Optional for Service Provider
Test Object	Verify that for an Access EVPL service, the Multicast frames are Delivered Unconditionally.
Test Procedure	• The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2. • ETE_1 offers C-tagged Service Frames with CE-VLAN ID as per Service Definition with Multicast destination address at UNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_2 verifies that the Multicast C-tagged Service Frames offered at UNI are delivered double-tagged with CE-VLAN ID as per Service Definition and S-VLAN ID as per Service Definition at the ENNI configured in OVC_1. Frame loss is acceptable up to $FLR_{SAC,}$ where FLR_{SAC} is the SAC for Frame Loss Ratio. • Simultaneously, ETE_2 offers Multicast double-tagged ENNI Frames with CE-VLAN ID as per Service Definition and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a rate IR_{SC} and for a time T_{SC} defined by the Access Provider and Service Provider. • ETE_1 verifies that the Multicast ENNI Frames offered at ENNI double-tagged with CE-VLAN ID as per Service Definition and S-VLAN ID as per Service Definition are received C-tagged at UNI configured in OVC_1 with CE-VLAN ID as per Service Definition. Frame loss is acceptable up to FLR_{SAC}.
Units	Number of valid frames received at the external interfaces
Variables	Service and ENNI Frame sizes, IR_{SC}, test duration T_{SC} and FLR_{SAC}
Results	Pass or fail
Remark	The Multicast frames are not to be Layer 2 Control Protocol Frames. See MEF L2CP [24] Table 2.

Table 23 – SAT Methodology – Multicast Delivery Test for Access EVPL Services

10.3.5 Ingress Bandwidth Profile per OVC End Point Tests

The ingress Bandwidth Profile per OVC End Point describes ingress policing by the Operator CEN on all ingress Service Frames or ENNI Frames mapped to a given OVC End Point. MEF 26.1 Section 7.5.4 (UNI) and MEF 26.1 Section 7.3.4 (ENNI) [18] provide a detailed explanation of the ingress Bandwidth Profile per OVC End Point.

The goal of the ingress Bandwidth Profile per OVC End Point tests are to validate that the service Bandwidth Profiles are configured as intended. The SAT methodology is derived from ITU-T Recommendation Y.1564 [11].

The first step is to validate the CIR configuration of the E-Access service [20]. By offering Service and ENNI Frames at the respective ingress Bandwidth Profiles at a rate of CIR and by observing the Frame Loss Ratio, it is possible to determine the Information Rate of the service. As Service and ENNI Frames are being transmitted across the service, it will also be possible to measure/calculate the performance service attributes as found in Table 8. Validating the performance service attributes during the Service Configuration tests ensure that the tested service can potentially pass the Service Performance tests as defined in Section 10.4.

The next step of the ingress Bandwidth Profile per OVC End Point tests is to validate the configuration of the EIR (if required by the Service Definition). During this step of the tests, Service and ENNI Frames are offered at the External Interface at a rate of CIR + EIR. The goal of this step is to validate that CIR + EIR can be carried by the service.

Finally, a Traffic Policing test will be performed to validate that the service is limited in bandwidth as per the Service Definition.

An example of these steps is demonstrated in Figure 13. For the CIR step, the Information Rate, FD/MFD, FDR/IFDV and FLR are measured/calculated.

After the EIR and traffic policing tests are performed, an optional burst size configuration test can be executed. An example of a CBS and EBS configuration test is illustrated in Y.1564 Appendix I [11]. A normative methodology for CBS and EBS is for further study.

The burst configuration is verified first for the CBS, and then for the CBS and EBS together.

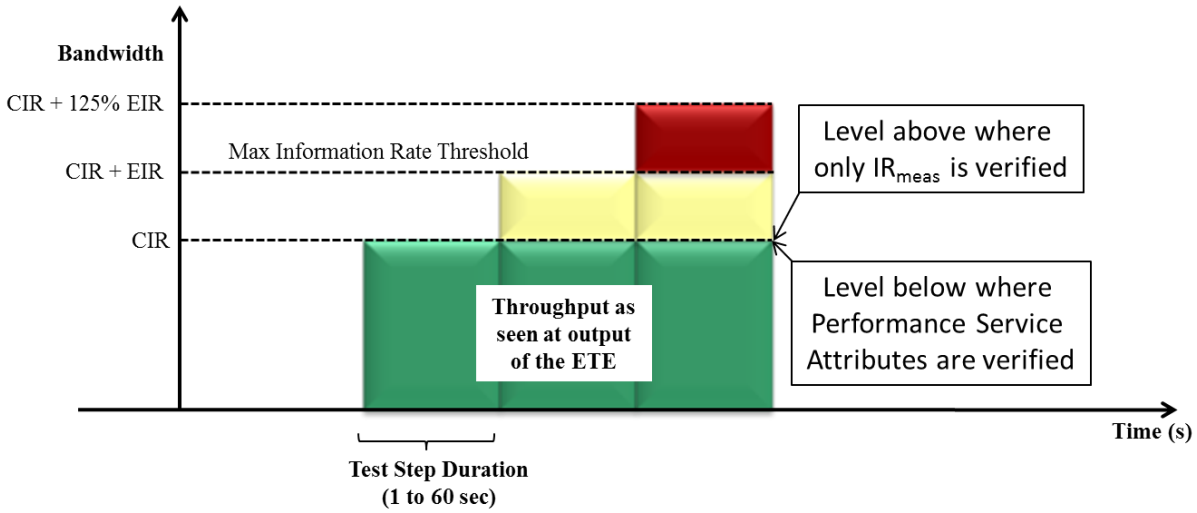


Figure 13 – Service Configuration Test – Ingress Bandwidth Profile per OVC End Point Test

Note 1 – The test steps demonstrated in Figure 13 represents the transmission rate as would be seen at the output of the Ethernet Test Equipment.

Note 2 – Caution should be exercised when configuring the test time for the bandwidth profile test to make sure the traffic policer has enough time to be exercised. Low Information Rate combined with high burst sizes require more time for the traffic policing to take effect. Guidance on test time is for further study.

Note 3 – When testing CIR (or EIR) configuration with a large token bucket size for CBS (or EBS) and a low Information Rate for the test traffic the token bucket might not go empty so as to verify the policing action. Additionally, when testing token bucket size for CBS (or EBS) configuration sufficient idle time might be needed between bursts to allow the token bucket to fill.

The Test Step Duration as presented in Figure 13 is defined as T_{BWD} (Time BWD).

[R46] The Ethernet Test Equipment **MUST** have the possibility of configuring T_{BWD} as illustrated in Figure 13.

[R47] T_{BWD} for each test step size **MUST** be configurable from at least 1 second up to 60 seconds as illustrated in Figure 13.

From MEF 10.3 [13], the Coupling Flag CF is set to either 0 or 1. The choice of the value for CF has the effect of controlling the volume of the Service Frames that are declared Yellow. When CF is set to 0, the long-term average bit rate of Service Frames that are declared Yellow is bounded by EIR. When CF is set to 1, the long-term average bit rate of Service Frames that are declared Yellow is bounded by CIR + EIR depending on volume of the offered Service Frames that are declared Green. In both cases the burst size of the Service Frames that are declared Yellow is bounded by EBS. As per the Table 9 in Section 9.3, CF has a value of 0 or 1. Procedures are available for 0 in this document. Procedures for 1 are left for further study.

The following steps provide the test procedure for verifying proper network configuration of the ingress Bandwidth Profile per OVC End Point before proceeding to the Service Performance tests.

[O8] Utilized Line Rate (ULR) and Information Rate **MAY** be used to define and report Bandwidth Profiles test parameters, results or information.

To simplify this procedure, only Information Rate will be used in the following sections.

The following sections list the test methodology to be used to test the Bandwidth Profile as per the Service Definition.

[R48] Each of the tests listed in section 10.3.5 **MUST** be run separately when applicable as per the Service Definition.

10.3.5.1 Ingress Bandwidth Profile per OVC End Point - CIR Configuration Test (Color-aware)

The CIR Configuration test as part of the ingress Bandwidth Profile per OVC End Point Test validates that the CIR Bandwidth Profile parameter is configured as per Service Definition. The CIR test is valid for a Service Definition that is color-aware.

Table 24 provides the methodology to test the CIR configuration of the ingress Bandwidth Profile per OVC End Point at the UNI and the ENNI.

Service Activation Test Methodology	
Test Name	Ingress Bandwidth Profile per OVC End Point – CIR Test Color-aware
Test Type	Service Activation
Service Type	Access EPL and Access EVPL
Test Status	Mandatory for Access Provider and Service Provider
Test Object	Verify that an ingress Bandwidth Profile per OVC EP with BWP parameters defined in the Service Definition is in force at the UNI and the ENNI. The Bandwidth Profile is applied to all ingress Service and ENNI Frames that are mapped to the given OVC EP and the amount of Green traffic delivered at the OVC EP is within SAC.
Test Procedure	• The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2. • ETE_1 offers Green C-tagged Service Frames at a constant rate equal to CIR for a time T_{BWD}. The CE-VLAN ID is equal to 65 for Access EPL. For Access EVPL services, the CE-VLAN ID is as per the Service Definition. • ETE_2 measures the received IR_{MEAS}-G, the Information Rate of Green-colored frames, FLR_{MEAS}-G, the Frame Loss Ratio for Green frames, and FD_{MEAS}/MFD_{MEAS}-G, the Frame Delay/Mean Delay for Green-colored frames. ETE_2 also calculate IFDV/FDR from FD_{MEAS}-G, the Inter-Frame Delay Variation/Frame Delay Range for Green-colored frames. • Simultaneously, ETE2 offers Green double-tagged ENNI Frames with CE-VLAN ID equal to 65 and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a constant rate equal to CIR for a time T_{BWD}. For Access EVPL services, the CE-VLAN ID is as per the Service Definition. • ETE_1 measures the received IR_{MEAS}-G, the Information Rate of Green-colored frames, FLR_{MEAS}-G, the Frame Loss Ratio for Green frames and FD_{MEAS}/MFD_{MEAS}-G, the Frame Delay/Mean Delay for Green-colored frames. ETE_1 also calculate IFDV/FDR from FD_{MEAS}-G, the Inter-Frame Delay Variation/Frame Delay Range for Green-colored frames. • IR_{SAC}, FD_{SAC}/MFD_{SAC}, $IFDV_{SAC}$/FDR_{SAC} and FLR_{SAC} are the limits as specified as the SAC. • If the IR_{MEAS}-G, FLR_{MEAS}-G, FD_{MEAS}/MFD_{MEAS}-G and $IFDV_{MEAS}$/ FDR_{MEAS}-G are all within the limits specified by the SAC for ETE_1 and ETE_2, then the result is PASS. Proceed to the EIR configuration test (10.3.5.3).

<table>
<tr><td>Units</td><td>Information Rate: Mbit/s, Delay: ms</td></tr>
<tr><td>Variables</td><td>Service and ENNI Frame sizes, test step duration T_{BWD}, IR_{SAC}, FD_{SAC}/MFD_{SAC}, $IFDV_{SAC}$/FDR_{SAC} and FLR_{SAC}</td></tr>
<tr><td>Results</td><td>ETE_1 Results:
<table>
<tr><th>Attribute Tested</th><th>Measured/Calculated</th><th>SAC value</th><th>Pass/Fail</th></tr>
<tr><td>IR-G</td><td></td><td></td><td></td></tr>
<tr><td>FD-G or MFD-G</td><td></td><td></td><td></td></tr>
<tr><td>IFDV-G or FDR-G</td><td></td><td></td><td></td></tr>
<tr><td>FLR-G</td><td></td><td></td><td></td></tr>
</table>
ETE_2 Results:
<table>
<tr><th>Attribute Tested</th><th>Measured/Calculated</th><th>SAC value</th><th>Pass/Fail</th></tr>
<tr><td>IR-G</td><td></td><td></td><td></td></tr>
<tr><td>FD-G or MFD-G</td><td></td><td></td><td></td></tr>
<tr><td>IFDV-G or FDR-G</td><td></td><td></td><td></td></tr>
<tr><td>FLR-G</td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Remarks</td><td>Note 1: Bandwidth Profile is measured in terms of Service or ENNI Frame traffic where the Service or ENNI Frame consists of the first bit of the destination MAC Address through the last bit of the Frame Check Sequence.
Note 2: Green Color Identifiers defined in MEF 23.1 Table 4 [17].
Note 3: The length of the time T_{BWD} must be such that the number of bytes in CBS is negligible compared to the total volume of traffic received over the duration of the test.
Note 4: Frames would be transmitted at constant intervals, e.g., without burstiness or interval variation. If interval variation is present, it would be proportional to the size variation in the EMIX.</td></tr>
</table>

Table 24 – SAT Methodology –CIR Configuration Test (Color-aware)

10.3.5.2 Ingress Bandwidth Profile per OVC End Point - CIR Configuration Test (Color-blind)

The CIR Configuration test as part of the ingress Bandwidth Profile per OVC End Point Test validates that the CIR Bandwidth Profile parameter is configured as per Service Definition. The CIR test is valid for a Service Definition that is color-blind.

Table 25 provides the methodology to test the CIR configuration of the ingress Bandwidth Profile per OVC End Point at the UNI and the ENNI.

Service Activation Test Methodology	
Test Name	Ingress Bandwidth Profile per OVC End Point – CIR Test Color-blind
Test Type	Service Activation
Service Type	Access EPL and Access EVPL
Test Status	Mandatory for Access Provider and Service Provider
Test Object	Verify that an ingress Bandwidth Profile per OVC EP with BWP parameters defined in the Service Definition is in force at the UNI and the ENNI. The Bandwidth Profile is applied to all ingress Service and ENNI Frames that are mapped to the given OVC EP and the amount of Green traffic delivered at the OVC EP is within SAC.

<table>
<tr><td>Test Procedure</td><td>

The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2.
ETE_1 offers C-tagged Service Frames at a constant rate equal to CIR for a time T_{BWD}. The CE-VLAN ID is equal to 65 for Access EPL. For Access EVPL services, the CE-VLAN ID is as per the Service Definition.
ETE_2 measures the received IR_{MEAS}-G, the Information Rate of Green-colored frames, FLR_{MEAS}-G, the Frame Loss Ratio for Green frames, and FD_{MEAS}/MFD_{MEAS}-G, the Frame Delay/Mean Delay for Green-colored frames. ETE_2 also calculate IFDV/FDR from FD_{MEAS}-G, the Inter-Frame Delay Variation/Frame Delay Range for Green-colored frames.
Simultaneously, ETE2 offers Green double-tagged ENNI Frames with CE-VLAN ID equal to 65 and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a constant rate equal to CIR for a time T_{BWD}. For Access EVPL services, the CE-VLAN ID is as per the Service Definition.
ETE_1 measures the received IR_{MEAS}, FLR_{MEAS} and FD_{MEAS}/MFD_{MEAS}. ETE_1 also calculate IFDV/FDR from FD_{MEAS}.
IR_{SAC}, FD_{SAC}/MFD_{SAC}, $IFDV_{SAC}$/FDR_{SAC} and FLR_{SAC} are the limits as specified as the SAC.
If the IR_{MEAS}, FLR_{MEAS}, FD_{MEAS}/MFD_{MEAS} and $IFDV_{MEAS}$/ FDR_{MEAS} for ETE_1 and IR_{MEAS}-G, FLR_{MEAS}-G, FD_{MEAS}/MFD_{MEAS}-G and $IFDV_{MEAS}$/ FDR_{MEAS}-G for ETE2 are all within the limits specified by the SAC, then the result is PASS. Proceed to the EIR configuration test (10.3.5.4).

</td></tr>
<tr><td>Units</td><td>Information Rate: Mbit/s, Delay: ms</td></tr>
<tr><td>Variables</td><td>Service and ENNI Frame sizes, test step duration T_{BWD}, IR_{SAC}, FD_{SAC}/MFD_{SAC}, $IFDV_{SAC}$/FDR_{SAC} and FLR_{SAC}</td></tr>
<tr><td>Results</td><td>
ETE_1 Results:
<table>
<tr><th>Attribute Tested</th><th>Measured/Calculated</th><th>SAC value</th><th>Pass/Fail</th></tr>
<tr><td>IR</td><td></td><td></td><td></td></tr>
<tr><td>FD or MFD</td><td></td><td></td><td></td></tr>
<tr><td>IFDV or FDR</td><td></td><td></td><td></td></tr>
<tr><td>FLR</td><td></td><td></td><td></td></tr>
</table>
ETE_2 Results:
<table>
<tr><th>Attribute Tested</th><th>Measured/Calculated</th><th>SAC value</th><th>Pass/Fail</th></tr>
<tr><td>IR-G</td><td></td><td></td><td></td></tr>
<tr><td>FD-G or MFD-G</td><td></td><td></td><td></td></tr>
<tr><td>IFDV-G or FDR-G</td><td></td><td></td><td></td></tr>
<tr><td>FLR-G</td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Remarks</td><td>Note 1: Bandwidth Profile is measured in terms of Service or ENNI Frame traffic where the Service or ENNI Frame consists of the first bit of the destination MAC Address through the last bit of the Frame Check Sequence.
Note 2: Green Color Identifiers defined in MEF 23.1 Table 4 [17].
Note 3: The length of the time T_{BWD} must be such that the number of bytes in CBS is negligible compared to the total volume of traffic received over the duration of the test.
Note 4: Frames would be transmitted at constant intervals, e.g., without burstiness or interval variation. If interval variation is present, it would be proportional to the size variation in the EMIX.</td></tr>
</table>

Table 25 – SAT Methodology –CIR Configuration Test (Color-blind)

10.3.5.3 Ingress Bandwidth Profile per OVC End Point - EIR Configuration Test (Color-aware)

The EIR Configuration test for a color-aware UNI as part of the ingress Bandwidth Profile per OVC End Point Test validates that the EIR Bandwidth Profile Parameter is configured as per Service Definition. The EIR test is valid for a Service Definition that is color-aware and the EIR > 0 and EBS > 0. If the EIR = 0 and EBS = 0, proceed to Traffic Policing test (Section 10.3.5.5). If the UNI is color-blind, proceed to Section 10.3.5.4.

Table 26 provides the methodology to test the EIR configuration of the ingress Bandwidth Profile per OVC End Point at the UNI (color-aware) and the ENNI.

Service Activation Test Methodology	
Test Name	Ingress Bandwidth Profile per OVC End Point – EIR Configuration Test – Color-aware
Test Type	Service Activation
Service Type	Access EPL and Access EVPL
Test Status	Mandatory for Access Provider and Service Provider
Test Object	Verify that an Ingress Bandwidth Profile per OVC EP with BWP parameters defined in the Service Definition is in force at the UNI (color-aware) and the ENNI. The Bandwidth Profile is applied to all ingress Service and ENNI Frames that are mapped to the given OVC EP and the amount of Green/Yellow traffic delivered at the OVC EP is within SAC.
Test Procedure	• The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2 • ETE_1 offers Green and Yellow C-tagged Service Frames at a constant rate equal to CIR for Green frames and EIR for Yellow frames for a time T_{BWD}. The CE-VLAN ID is equal to 65 for Access EPL. For Access EVPL services, the CE-VLAN ID is as per the Service Definition. • ETE_2 measures the received IR_{MEAS}-G, the Information Rate of Green-colored frames, IR_{MEAS}-Y, the Information Rate of Yellow-colored frames, IR_{MEAS}-T, the total combined Information Rate, FLR_{MEAS}-G, the Frame Loss Ratio for Green frames, FD_{MEAS}/MFD_{MEAS} -G, the Frame Delay/Mean Delay for Green-colored frames, FLR_{MEAS}-Y, the frame loss ratio for Yellow-colored frames, FD_{MEAS}/MFD_{MEAS} -Y, the frame delay for Yellow-colored frames. • ETE_2 also calculate $IFDV/FDR_{MEAS}$-G, the Inter-Frame Delay Variation/Frame Delay Range for Green-colored frames, and $IFDV_{MEAS}$-Y, the frame delay variation for Yellow-colored frames. • Simultaneously, ETE_2 offers Green and Yellow double-tagged ENNI Frames with CE-VLAN ID equal to 65 and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a constant rate equal to CIR for Green frames and EIR for Yellow frames for a time T_{BWD}. For Access EVPL services, the CE-VLAN ID is as per the Service Definition. • ETE_1 measures the received IR_{MEAS}-G, the Information Rate of Green-colored frames, IR_{MEAS}-Y, the Information Rate of Yellow-colored frames, IR_{MEAS}-T, the total combined Information Rate, FLR_{MEAS}-G, the Frame Loss Ratio for Green frames, FD_{MEAS}/MFD_{MEAS} -G, the Frame Delay/Mean Delay for Green-colored frames, FLR_{MEAS}-Y, the frame loss ratio for Yellow-colored frames, FD_{MEAS}/MFD_{MEAS} -Y, the frame delay for Yellow-colored frames. • ETE_1 also calculate $IFDV/FDR_{MEAS}$-G, the Inter-Frame Delay Variation/Frame Delay Range for Green-colored frames, and $IFDV_{MEAS}$-Y, the frame delay variation for Yellow-colored frames. • IR_{SAC}, FD_{SAC}/MFD_{SAC}, $IFDV_{SAC}/FDR_{SAC}$ and FLR_{SAC} are the limits as specified as the SAC. • If IR_{MEAS}-G, FD/MFD_{MEAS}-G, $IFDV/FDR_{MEAS}$-G and FLR_{MEAS}-G are all within the limits specified by SAC for ETE_1 and ETE_2, then the result is PASS; proceed to the traffic policing test (10.3.5.5).
Units	Information Rate: Mbit/s, Delay: ms
Variables	Service and ENNI Frame sizes, test step duration T_{BWD}, IR_{SAC}, FD_{SAC}/MFD_{SAC}, $IFDV_{SAC}/FDR_{SAC}$ and FLR_{SAC}

Results

ETE_1 Results:

Attribute Tested	Measured/Calculated	SAC value	Pass/Fail
IR-G			
FD-G or MFD-G			
IFDV-G or FDR-G			
FLR-G			
IR-Y		N/A	N/A
FD-Y or MFD-Y		N/A	N/A
IFDV-Y or FDR-Y		N/A	N/A
FLR-Y		N/A	N/A
IR-T		N/A	N/A

ETE_2 Results:

Attribute Tested	Measured/Calculated	SAC value	Pass/Fail
IR-G			
FD-G or MFD-G			
IFDV-G or FDR-G			
FLR-G			
IR-Y		N/A	N/A
FD-Y or MFD-Y		N/A	N/A
IFDV-Y or FDR-Y		N/A	N/A
FLR-Y		N/A	N/A
IR-T		N/A	N/A

Remarks

Note 1: Bandwidth Profile is measured in terms of Service or ENNI Frame traffic where the Service or ENNI Frame consists of the first bit of the destination MAC Address through the last bit of the Frame Check Sequence.
Note 2: Green/Yellow Color Identifiers defined in MEF 23.1 Table 4 [17].
Note 3: The length of the time T_{BWD} must be such that the number of bytes in CBS is negligible compared to the total volume of traffic received over the duration of the test.
Note 4: Frames would be transmitted at constant intervals, e.g., without burstiness or interval variation. If interval variation is present, it would be proportional to the size variation in the EMIX.
Note 5: All the parameters associated with the Yellow-colored frames can be reported for reference purposes only, because the SAC does not apply to Yellow-colored frames.

Table 26 – SAT Methodology – EIR Configuration Test (Color-aware)

10.3.5.4 Ingress Bandwidth Profile per OVC End Point - EIR Configuration Test (Color-blind)

The EIR test for a color-blind UNI as part of the ingress Bandwidth Profile per OVC End Point Test validates that the EIR Bandwidth Profile parameter is configured as per Service Definition. The EIR test is valid for a Service Definition that is color-blind and the EIR > 0 and EBS > 0. If the EIR = 0 and EBS = 0, proceed to Traffic Policing test (Section 10.3.5.5).

Table 27 provides the methodology to test the EIR configuration of the ingress Bandwidth Profile per OVC End Point at the UNI (color-blind) and the ENNI.

<table>
<tr><th colspan="2">Service Activation Test Methodology</th></tr>
<tr><td>Test Name</td><td>Ingress Bandwidth Profile per OVC End Point – EIR Configuration Test – Color-blind</td></tr>
<tr><td>Test Type</td><td>Service Activation</td></tr>
<tr><td>Service Type</td><td>Access EPL and Access EVPL</td></tr>
<tr><td>Test Status</td><td>Mandatory for Access Provider and Service Provider</td></tr>
<tr><td>Test Object</td><td>Verify that an Ingress Bandwidth Profile per OVC EP with BWP parameters defined in the Service Definition is in force at the UNI (color-blind) and the ENNI. The Bandwidth Profile is applied to all ingress Service and ENNI Frames that are mapped to the given OVC EP and the amount of Green/Yellow traffic delivered at the OVC EP is within SAC.</td></tr>
<tr><td>Test Procedure</td><td>

The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2.
ETE_1 offers C-tagged Service Frames at a constant rate equal to CIR+EIR for a time T_{BWD}. The CE-VLAN ID is equal to 65 for Access EPL. For Access EVPL services, the CE-VLAN ID is as per the Service Definition.
ETE_2 measures the received IR_{MEAS}-G, the Information Rate of Green-colored frames, IR_{MEAS}-Y, the Information Rate of Yellow-colored frames, IR_{MEAS}-T, the total combined Information Rate, FLR_{MEAS}-G, the Frame Loss Ratio for Green frames, FD_{MEAS}/MFD_{MEAS} -G, the Frame Delay/Mean Delay for Green-colored frames, FLR_{MEAS}-Y, the frame loss ratio for Yellow-colored frames, FD_{MEAS}/MFD_{MEAS} -Y, the frame delay for Yellow-colored frames.
ETE_2 also calculate $IFDV/FDR_{MEAS}$-G, the Inter-Frame Delay Variation/Frame Delay Range for Green-colored frames, and $IFDV/FDR_{MEAS}$-Y, the Inter-Frame Delay Variation/Frame Delay Range for Yellow-colored frames.
Simultaneously, ETE_2 offers Green and Yellow double-tagged ENNI Frames with CE-VLAN ID equal to 65 and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a constant rate equal to CIR for Green frames and EIR for Yellow frames for a time T_{BWD}. For Access EVPL services, the CE-VLAN ID is as per the Service Definition.
ETE_1 measures the received IR_{MEAS} and FLR_{MEAS}.
IR_{SAC}, FD_{SAC}/MFD_{SAC}, $IFDV_{SAC}/FDR_{SAC}$ and FLR_{SAC} are the limits as specified as the SAC.
For ETE_1: If $CIR*(1 - FLR_{SAC}) \leq IR_{MEAS} \leq CIR+EIR$, then the result is PASS; proceed to the traffic policing test (10.3.5.5).
For ETE_2: If $CIR*(1 - FLR_{SAC}) \leq IR_{MEAS}\text{-}T \leq CIR+EIR$, then the result is PASS; proceed to the traffic policing test (10.3.5.5).

</td></tr>
<tr><td>Units</td><td>Information Rate: Mbit/s, Delay: ms</td></tr>
<tr><td>Variables</td><td>Service and ENNI Frame sizes, test step duration T_{BWD}, IR_{SAC}, FD_{SAC}/MFD_{SAC}, $IFDV_{SAC}/FDR_{SAC}$ and FLR_{SAC}</td></tr>
<tr><td>Results</td><td>
ETE_1 Results:
<table>
<tr><th>Attribute Tested</th><th>Measured/Calculated</th><th>SAC value</th><th>Pass/Fail</th></tr>
<tr><td>IR</td><td></td><td></td><td></td></tr>
<tr><td>FLR</td><td></td><td></td><td></td></tr>
</table>
ETE_2 Results:
<table>
<tr><th>Attribute Tested</th><th>Measured/Calculated</th><th>SAC value</th><th>Pass/Fail</th></tr>
<tr><td>IR-G</td><td></td><td></td><td></td></tr>
<tr><td>FD-G or MFD-G</td><td></td><td></td><td></td></tr>
<tr><td>IFDV-G or FDR-G</td><td></td><td></td><td></td></tr>
<tr><td>FLR-G</td><td></td><td></td><td></td></tr>
<tr><td>IR-Y</td><td></td><td>N/A</td><td>N/A</td></tr>
<tr><td>FD-Y or MFD-Y</td><td></td><td>N/A</td><td>N/A</td></tr>
<tr><td>IFDV-Y or FDR-Y</td><td></td><td>N/A</td><td>N/A</td></tr>
<tr><td>FLR-Y</td><td></td><td>N/A</td><td>N/A</td></tr>
<tr><td>IR-T</td><td></td><td>N/A</td><td></td></tr>
</table>
</td></tr>
</table>

Remarks	Note 1: Bandwidth Profile is measured in terms of Service or ENNI Frame traffic where the Service or ENNI Frame consists of the first bit of the destination MAC Address through the last bit of the Frame Check Sequence. Note 2: Green/Yellow Color Identifiers defined in MEF 23.1 Table 4[17]. Note 3: The length of the time T_{BWD} must be such that the number of bytes in CBS is negligible compared to the total volume of traffic received over the duration of the test. Note 4: Frames would be transmitted at constant intervals, e.g., without burstiness or interval variation. If interval variation is present, it would be proportional to the size variation in the EMIX. Note 5: All the parameters associated with the Yellow-colored frames can be reported for reference purposes only, because the SAC does not apply to Yellow-colored frames. Note 6: FD/MFD_{SAC} and $IFDV/FDR_{SAC}$ are Not Applicable in a color-blind scenario as there is no method to determine the color of the measured frame for ETE_1.

Table 27 – SAT Methodology – EIR Configuration Test (Color-blind)

10.3.5.5 Ingress Bandwidth Profile per OVC End Point – Traffic Policing Test (Color-aware)

The Traffic Policing test for a color-aware UNI as part of the ingress Bandwidth Profile per OVC End Point Test validates that the CIR and EIR Bandwidth Profile parameter are configured as per Service Definition. The Traffic Policing test is valid for a Service Definition that is color-aware and the CIR > 0 and EIR > 0 and CBS > 0 and EBS > 0.

[O9] The Traffic Policing test **MAY** be performed by the SP and the AP.

The Traffic Policing test is deemed optional so that there will be no overloading of the network that would impact active services.

Table 28 provides the methodology to test the Traffic Policing configuration of the ingress Bandwidth Profile per OVC End Point at the UNI (color-aware) and the ENNI.

Service Activation Test Methodology	
Test Name	Ingress Bandwidth Profile per OVC End Point – Traffic Policing – Color-aware
Test Type	Service Activation
Service Type	Access EPL and Access EVPL
Test Status	Mandatory for Access Provider and Service Provider
Test Object	Verify that an Ingress Bandwidth Profile per OVC EP with BWP parameters defined in the Service Definition is in force at the UNI (color-aware) and the ENNI. The Bandwidth Profile is applied to all ingress Service and ENNI Frames that are mapped to the given OVC EP and the amount of Green/Yellow traffic delivered at the OVC EP is within SAC.
Test Procedure	• The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2. • ETE_1 offers Green and Yellow C-tagged Service Frames at a constant rate equal to CIR for Green frames and 125% EIR for Yellow frames for a time T_{BWD}. The CE-VLAN ID is equal to 65 for Access EPL. For Access EVPL services, the CE-VLAN ID is as per the Service Definition. (See Note 7) • ETE_2 measures the received IR_{MEAS}-G, the Information Rate of Green-colored frames, IR_{MEAS}-Y, the Information Rate of Yellow-colored frames, IR_{MEAS}-T, the total combined Information Rate, FLR_{MEAS}-G, the Frame Loss Ratio for Green frames, FD_{MEAS}/MFD_{MEAS} -G, the Frame Delay/Mean Frame Delay for Green-colored frames, FLR_{MEAS}-Y, the frame loss ratio for Yellow-colored frames, FD_{MEAS}/MFD_{MEAS} -Y, the frame delay for Yellow-colored frames. • ETE_2 also calculate $IFDV/FDR_{MEAS}$-G, the Inter-Frame Delay Variation/Frame Delay Range for Green-colored frames, and $IFDV/FDR_{MEAS}$-Y, the frame delay variation for Yellow-colored

frames.

- Simultaneously, ETE_2 offers Green and Yellow double-tagged ENNI Frames with CE-VLAN ID equal to 65 and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a constant rate equal to CIR for Green frames and 125% EIR for Yellow frames for a time T_{BWD}. For Access EVPL services, the CE-VLAN ID is as per the Service Definition. (See Note 7)
- ETE_1 measures the received IR_{MEAS}-G, the Information Rate of Green-colored frames, IR_{MEAS}-Y, the Information Rate of Yellow-colored frames, IR_{MEAS}-T, the total combined Information Rate, FLR_{MEAS}-G, the Frame Loss Ratio for Green frames, FD_{MEAS}/MFD_{MEAS} -G, the Frame Delay/Mean Delay for Green-colored frames, FLR_{MEAS}-Y, the frame loss ratio for Yellow-colored frames, FD_{MEAS}/MFD_{MEAS} -Y, the frame delay for Yellow-colored frames.
- ETE_1 also calculate IFDV/FDR_{MEAS}-G, the Inter-Frame Delay Variation/Frame Delay Range for Green-colored frames, and IFDV/FDR_{MEAS}-Y, the frame delay variation for Yellow-colored frames.
- IR_{SAC}, FD_{SAC}/MFD_{SAC}, $IFDV_{SAC}/FDR_{SAC}$ and FLR_{SAC} are the limits as specified as the SAC.
- If FLR_{MEAS}-G, FD_{MEAS}/MFD_{MEAS} -G, IFDV/FDR_{MEAS} -G, are all within the SAC limits, and if IR-T ≤ CIR+EIR+M (see Note 6), then the result is PASS.

Units	Information Rate: Mbit/s, Delay: ms
Variables	Service and ENNI Frame sizes, test step duration T_{BWD}, IR_{SAC}, FD_{SAC}/MFD_{SAC}, $IFDV_{SAC}/FDR_{SAC}$ and FLR_{SAC}

Results

ETE_1 Results:

Attribute Tested	Measured/Calculated	SAC value	Pass/Fail
IR-G			
FD-G or MFD-G			
IFDV-G or FDR-G			
FLR-G			
IR-Y		N/A	N/A
FD-Y or MFD-Y		N/A	N/A
IFDV-Y or FDR-Y		N/A	N/A
FLR-Y		N/A	N/A
IR-T		N/A	

ETE_2 Results:

Attribute Tested	Measured/Calculated	SAC value	Pass/Fail
IR-G			
FD-G or MFD-G			
IFDV-G or FDR-G			
FLR-G			
IR-Y		N/A	N/A
FD-Y or MFD-Y		N/A	N/A
IFDV-Y or FDR-Y		N/A	N/A
FLR-Y		N/A	N/A
IR-T		N/A	

Remarks	Note 1: Bandwidth Profile is measured in terms of Service or ENNI Frame traffic where the Service or ENNI Frame consists of the first bit of the destination MAC Address through the last bit of the Frame Check Sequence. Note 2: Green/Yellow Color Identifiers defined in MEF 23.1 Table 4 [17]. Note 3: The length of the time T_{BWD} must be such that the number of bytes in CBS is negligible compared to the total volume of traffic received over the duration of the test. Note 4: Frames would be transmitted at constant intervals, e.g., without burstiness or interval variation. If interval variation is present, it would be proportional to the size variation in the EMIX. Note 5: Note that all the Yellow-colored parameters can be reported for reference purposes only, because the SAC does not apply to Yellow-colored frames. Note 6: The M factor is added to allow for the effect of the traffic policer's CBS and EBS settings, and test time. Experience will determine the values for M. Additional guidance on M is for further study. Note 7: Note that if EIR < 20%*CIR, then the transmitted frames would be 100%*CIR Green-marked frames plus 25%*CIR Yellow-marked frames plus 100%*EIR Yellow-marked frames. This step was created to send an adequate number of test frames to test the traffic policer. This test is only valid if the CIR + EIR ULR is smaller than the interface ULR.

Table 28 – SAT Methodology – Traffic Policing Configuration Test (Color-aware)

10.3.5.6 Ingress Bandwidth Profile per OVC End Point – Traffic Policing Test (Color-blind)

The Traffic Policing Test for a color-blind UNI as part of the ingress Bandwidth Profile per OVC End Point Test validates that the CIR and EIR Bandwidth Profile parameter are configured as per Service Definition. The Traffic Policing test is valid for a Service Definition where the CIR > 0 and EIR > 0 and CBS > 0 and EBS>0.

[O10] The Traffic Policing test **MAY** be performed by the SP and the AP.

The Traffic Policing test is deemed optional so that there will be no overloading of the network that would impact active services.

Table 29 provides the methodology to test the Traffic Policing configuration of the ingress Bandwidth Profile per OVC End Point at the UNI (color-blind) and the ENNI.

Service Activation Test Methodology	
Test Name	Ingress Bandwidth Profile per OVC End Point – Traffic Policing – Color-blind
Test Type	Service Activation
Service Type	Access EPL and Access EVPL
Test Status	Mandatory for Access Provider and Service Provider
Test Object	Verify that an Ingress Bandwidth Profile per OVC EP with BWP parameters defined in the Service Definition is in force at the UNI (color-blind) and the ENNI. The Bandwidth Profile is applied to all ingress Service and ENNI Frames that are mapped to the given OVC EP and the amount of Green/Yellow traffic delivered at the OVC EP is within SAC.
Test Procedure	• The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2. • ETE_1 offers C-tagged Service Frames at a constant rate equal to CIR + 125% EIR for a time T_{BWD}. The CE-VLAN ID is equal to 65 for Access EPL. For Access EVPL services, the CE-VLAN ID is as per the Service Definition. (See Note 4) • ETE_2 measures the received IR_{MEAS}-G, the Information Rate of Green-colored frames, IR_{MEAS}-Y, the Information Rate of Yellow-colored frames, IR_{MEAS}-T, the total combined Information Rate, FLR_{MEAS}-G, the Frame Loss Ratio for Green frames, FD_{MEAS}/MFD_{MEAS} -G, the Frame Delay/Mean Delay for Green-colored frames, FLR_{MEAS}-Y, the frame loss ratio for Yellow-colored frames, FD_{MEAS}/MFD_{MEAS} -Y, the frame delay for Yellow-colored frames.

<table>
<tr><td></td><td>

ETE_2 also calculate $IFDV/FDR_{MEAS}$-G, the Inter-Frame Delay Variation/Frame Delay Range for Green-colored frames, and $IFDV/FDR_{MEAS}$-Y, the frame delay variation for Yellow-colored frames.
Simultaneously, ETE_2 offers Green and Yellow double-tagged ENNI Frames with CE-VLAN ID equal to 65 and S-VLAN ID as per Service Definition at ENNI configured in OVC_1 at a constant rate equal to CIR for Green frames and 125% EIR for Yellow frames for a time T_{BWD}. For Access EVPL services, the CE-VLAN ID is as per the Service Definition. (See Note 8)
ETE1 measures the received IR_{MEAS} and $FLR_{MEAS.}$
IR_{SAC}, FD_{SAC}/MFD_{SAC}, $IFDV_{SAC}/FDR_{SAC}$ and FLR_{SAC} are the limits as specified as the SAC.
For ETE_1: If $CIR*(1 - FLR_{SAC}) \leq IR_{MEAS} \leq CIR+EIR+M$ (see Note 7), then the result is PASS.
For ETE_2: If $CIR*(1 - FLR_{SAC}) \leq IR_{MEAS}\text{-}T \leq CIR+EIR+M$ (see Note 7), then the result is PASS.

</td></tr>
<tr><td>Units</td><td>Information Rate: Mbit/s, Delay: ms</td></tr>
<tr><td>Variables</td><td>Service and ENNI Frame sizes, test step duration T_{BWD}, IR_{SAC}, FD_{SAC}/MFD_{SAC}, $IFDV_{SAC}/FDR_{SAC}$ and $FLR\text{-}_{SAC}$</td></tr>
<tr><td>Results</td><td>
ETE_1 Results:
<table>
<tr><th>Attribute Tested</th><th>Measured/Calculated</th><th>SAC value</th><th>Pass/Fail</th></tr>
<tr><td>IR</td><td></td><td></td><td></td></tr>
<tr><td>FLR</td><td></td><td></td><td></td></tr>
</table>
ETE_2 Results:
<table>
<tr><th>Attribute Tested</th><th>Measured/Calculated</th><th>SAC value</th><th>Pass/Fail</th></tr>
<tr><td>IR-G</td><td></td><td></td><td></td></tr>
<tr><td>FD-G or MFD-G</td><td></td><td></td><td></td></tr>
<tr><td>IFDV-G or FDR-G</td><td></td><td></td><td></td></tr>
<tr><td>FLR-G</td><td></td><td></td><td></td></tr>
<tr><td>IR-Y</td><td></td><td>N/A</td><td>N/A</td></tr>
<tr><td>FD-Y or MFD-Y</td><td></td><td>N/A</td><td>N/A</td></tr>
<tr><td>IFDV-Y or FDR-Y</td><td></td><td>N/A</td><td>N/A</td></tr>
<tr><td>FLR-Y</td><td></td><td>N/A</td><td>N/A</td></tr>
<tr><td>IR-T</td><td></td><td>N/A</td><td></td></tr>
</table>
</td></tr>
</table>

Remarks	Note 1: Bandwidth Profile is measured in terms of Service or ENNI Frame traffic where the Service or ENNI Frame consists of the first bit of the destination MAC Address through the last bit of the Frame Check Sequence. Note 2: Green/Yellow Color Identifiers defined in MEF 23.1 Table 4 [17]. Note 3: The length of the time T_{BWD} is such that the number of bytes in CBS is negligible compared to the total volume of traffic received over the duration of the test. Note 4: If EIR < 20%*CIR, then the transmitted IR or ULR would be 125%*CIR + EIR. This step was created to send an adequate number of test frames to test the traffic policer. This test is only valid if the CIR + EIR ULR is smaller than the interface ULR. Note 5: Note that all the Yellow-colored parameters can be reported for reference purposes only, because the SAC does not apply to Yellow-colored frames. Note 6: FD/MFD_{SAC} and $IFDV/FDR_{SAC}$ are Not Applicable in a color-blind scenario as there is no method to determine the color of the measured frame for ETE_1. Note 7: The M factor is added to allow for the effect of the traffic policer's CBS and EBS settings, and test time. Experience will determine the values for M. Additional guidance on M is for further study. Note 8: Note that if EIR < 20%*CIR, then the transmitted frames would be 100%*CIR Green-marked frames plus 25%*CIR Yellow marked frames plus 100%*EIR Yellow-marked frames. This step was created to send an adequate number of test frames to test the traffic policer. This test is only valid if the CIR + EIR ULR is smaller than the interface ULR.

Table 29 – SAT Methodology – Traffic Policing Configuration Test (Color-blind)

10.3.5.7 Ingress Bandwidth Profile per OVC End Point –CBS/EBS Test

The goal of the CBS/EBS test is to validate the configuration of the CBS and EBS service attributes. The CBS/EBS test is optional and this testing is still considered experimental. The test methodology for CBS and EBS testing is still for further study.

[O11] The SP and the AP **MAY** perform CBS and EBS testing based on an agreed upon methodology.

10.4 Service Performance Tests

As the Service Configuration tests were completed prior to this sub-process, the network is configured correctly to deliver Ethernet-based services. The objective of the Service Performance tests is to validate the quality of the service over time. In this phase of the test methodology, the service attributes and all Ethernet performance parameters are measured simultaneously. This means that the IR, FD/MFD, IFDV/FDR, and FLR are monitored for the service simultaneously. In the case of multiple new Access EVPL services delivered between a single UNI and single ENNI (as per Figure 5 of MEF 33 [20], all new services and their performance attributes would be measured simultaneously. Figure 14 provides a graphical view of the Service Performance tests for an Access EPL service [20]. Figure 15 provides a graphical view of the Service Performance tests to test multiple Access EVPL services [20] simultaneously. Should there be a single Access EVPL service [20] to test, the Service Performance tests process would be the same as an Access EPL service [20], demonstrated in Figure 14.

This phase of the test methodology has a medium to long time duration. As the test duration has implications on the performance parameters measured, certain durations are to be respected. The test duration is detailed in section 10.4.1.

As part of the Service Performance tests, Service Providers can test the performance of the transmission of Broadcast, Unicast and Multicast Service Frames if there are different service configurations for these frame types.

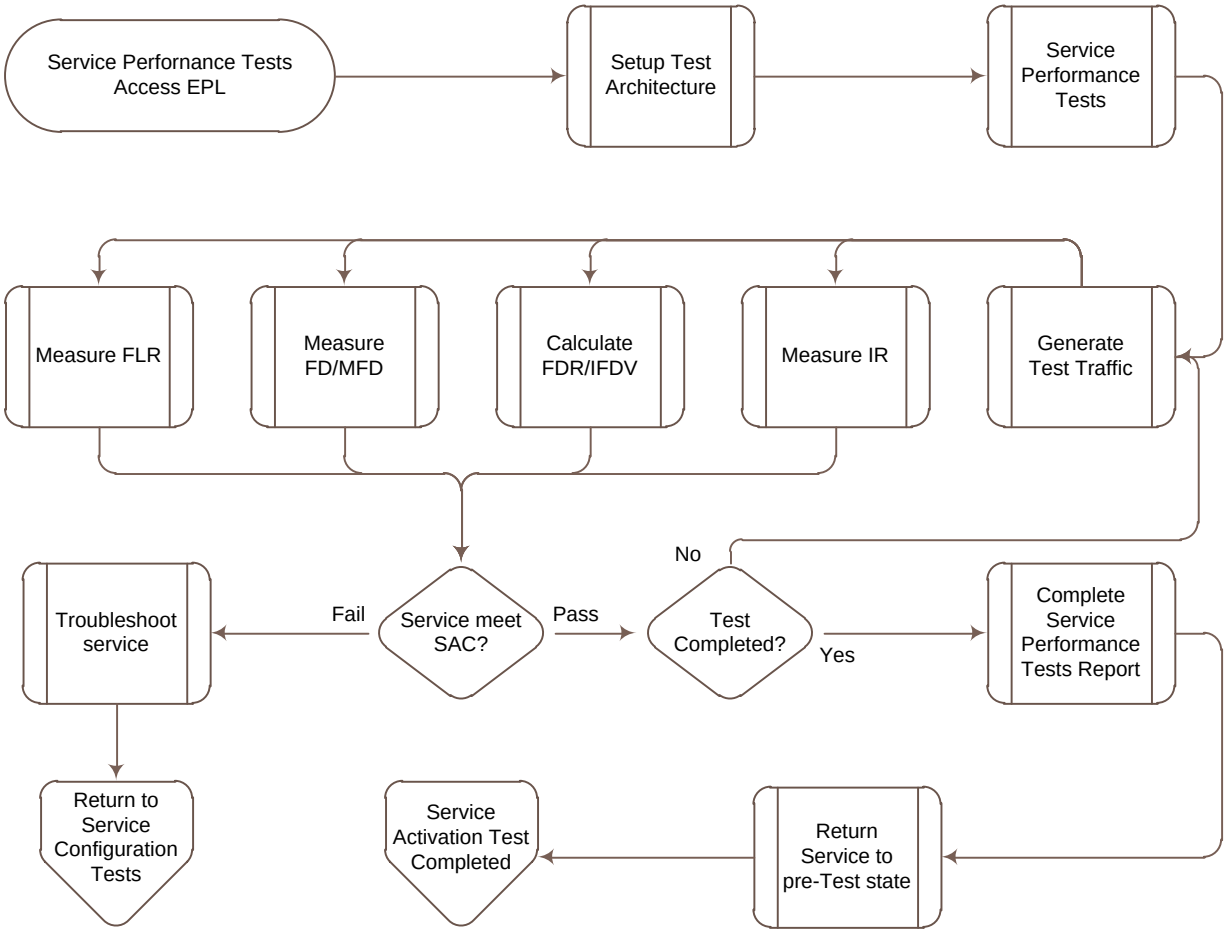


Figure 14 – Service Performance Tests Process – Access EPL

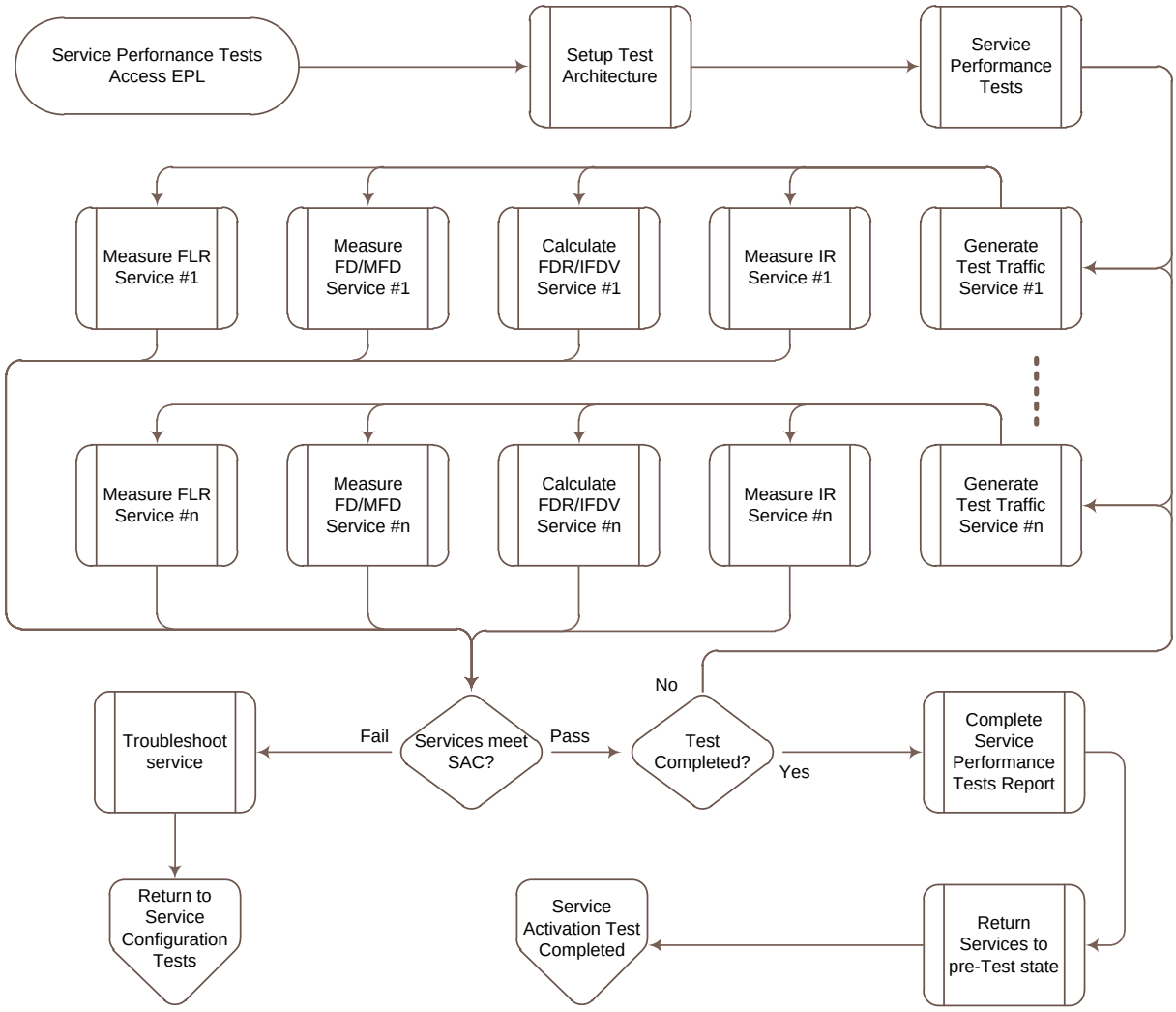


Figure 15 – Service Performance Tests Process – Access EVPL

[R49] The Service Performance tests **MUST** be performed by the Access Provider.

[R50] The Service Performance tests **MUST** be performed by the Service Provider.

[D3] The Service Performance tests **SHOULD** incorporate one-way measurement of the OVC performance service attributes as defined in MEF 26.1 [18].

Table 30 below provides a detailed methodology to test the performance attributes for single E-Access service [20].

<table>
<tr><th colspan="2">Service Activation Test Methodology</th></tr>
<tr><td>Test Name</td><td>Service Performance Tests – Single Service</td></tr>
<tr><td>Test Type</td><td>Service Activation</td></tr>
<tr><td>Service Type</td><td>Access EPL and Access EVPL</td></tr>
<tr><td>Test Status</td><td>Mandatory for Access Provider and Service Provider</td></tr>
<tr><td>Test Object</td><td>Verify that the Access EPL or Access EVPL service performs as per the Service Definition and meets SAC.</td></tr>
<tr><td>Test Procedure</td><td>

The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2.
ETE_1 offers C-tagged Service Frames at a constant rate equal to CIR for a time T_{SP}. The CE-VLAN ID is equal to 65 for Access EPL. For Access EVPL services, the CE-VLAN ID is as per the Service Definition.
ETE_2 measures the received IR_{MEAS}, FLR_{MEAS} and FD_{MEAS}/MFD_{MEAS}. ETE_2 also calculate IFDV/FDR from FD_{MEAS}.
Simultaneously, ETE_2 offers double-tagged ENNI Frames with CE-VLAN ID equal to 65 and S-VLAN ID as per Service Definition at the ENNI configured in OVC_1 at a constant rate equal to CIR for a time T_{SP}. For Access EVPL services, the CE-VLAN ID is as per the Service Definition.
ETE_1 measures the received IR_{MEAS}, FLR_{MEAS} and FD_{MEAS}/MFD_{MEAS}. ETE_1 also calculate IFDV/FDR from FD_{MEAS}.
IR_{SAC}, FD_{SAC}/MFD_{SAC}, $IFDV_{SAC}/FDR_{SAC}$ and FLR_{SAC} are the limits as specified as the SAC.
If the IR_{MEAS}, FLR_{MEAS}, FD_{MEAS}/MFD_{MEAS} and $IFDV_{MEAS}$/ FDR_{MEAS} are all within the limits specified by the SAC for ETE_1 and ETE_2, then the result is PASS.

</td></tr>
<tr><td>Units</td><td>Information Rate: Mbit/s, Delay: ms</td></tr>
<tr><td>Variables</td><td>Service and ENNI Frame sizes, test duration T_{SP}, IR_{SAC}, FD_{SAC}/MFD_{SAC}, $IFDV_{SAC}/FDR_{SAC}$ and FLR_{SAC}</td></tr>
<tr><td>Results</td><td>
ETE_1 Results:
<table>
<tr><th>Attribute Tested</th><th>Measured/Calculated</th><th>SAC value (See note 6)</th><th>Pass/Fail</th></tr>
<tr><td>IR</td><td></td><td></td><td></td></tr>
<tr><td>FD or MFD</td><td></td><td></td><td></td></tr>
<tr><td>IFDV or FDR</td><td></td><td></td><td></td></tr>
<tr><td>FLR</td><td></td><td></td><td></td></tr>
</table>
ETE_2 Results:
<table>
<tr><th>Attribute Tested</th><th>Measured/Calculated</th><th>SAC value (See note 6)</th><th>Pass/Fail</th></tr>
<tr><td>IR</td><td></td><td></td><td></td></tr>
<tr><td>FD or MFD</td><td></td><td></td><td></td></tr>
<tr><td>IFDV or FDR</td><td></td><td></td><td></td></tr>
<tr><td>FLR</td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Remarks</td><td>
Note 1: Bandwidth Profile is measured in terms of Service or ENNI Frame traffic where the Service or ENNI Frame consists of the first bit of the destination MAC Address through the last bit of the Frame Check Sequence.
Note 2: Green Color Identifiers defined in MEF 23.1 Table 4 [17].
Note 3: The length of the time T_{SP} has to be such that the number of bytes in CBS is negligible compared to the total volume of traffic received over the duration of the test.
Note 4: Frames would be transmitted at constant intervals, e.g., without burstiness or interval variation. If interval variation is present, it would be proportional to the size variation in the EMIX.
Note 5: Frames can be transmitted in units of IR bits per second, although transmission rate measured in Utilized Line Rate (ULR) bits per second is also acceptable.
Note 6: Refer to Section 10.2 for guidance on SAC values.
</td></tr>
</table>

Table 30 – SAT Methodology – Service Performance Tests – Single Service

Table 31 below provides a detailed methodology to test the performance attributes for multiple Access EVPL services [20] as described in Figure 5 of MEF 33 [20].

<table>
<tr><th colspan="2">Service Activation Test Methodology</th></tr>
<tr><td>Test Name</td><td>Service Performance Tests – Multiple Services</td></tr>
<tr><td>Test Type</td><td>Service Activation</td></tr>
<tr><td>Service Type</td><td>Access EVPL</td></tr>
<tr><td>Test Status</td><td>Mandatory for Access Provider and Service Provider</td></tr>
<tr><td>Test Object</td><td>Verify that the Access EVPL services perform as per the Service Definition and meets SAC.</td></tr>
<tr><td>Test Procedure</td><td>

The frame size to be used for testing can be a single frame size or an EMIX as per Section 10.1.2.
ETE_1 offers C-tagged Service Frames at a constant rate equal to CIR for a time T_{SP} with the CE-VLAN ID as per the Service Definition and this for each service concurrently.
ETE_2 measures the received IR_{MEAS}, FLR_{MEAS} and FD_{MEAS}/MFD_{MEAS}. ETE_2 also calculate IFDV/FDR from FD_{MEAS} for each service (i=service identifier, value of i = 1..n, where n is the number of service to test).
Simultaneously, ETE_2 offers double-tagged ENNI Frames with CE-VLAN ID and S-VLAN ID as per Service Definition at the ENNI configured in OVC_1 at a constant rate equal to CIR for a time interval T, and this for each service concurrently.
ETE_1 measures the received IR_{MEAS}, FLR_{MEAS} and FD_{MEAS}/MFD_{MEAS}. ETE_1 also calculate IFDV/FDR from FD_{MEAS} for each service.
IR_{SAC}, FD_{SAC}/MFD_{SAC}, $IFDV_{SAC}$/FDR_{SAC} and FLR_{SAC} are the limits as specified as the SAC. SAC are to be defined for each service.
If the IR_{MEAS}, FLR_{MEAS}, FD_{MEAS}/MFD_{MEAS} and $IFDV_{MEAS}$/ FDR_{MEAS} are all within the limits specified by the SAC for ETE_1 and ETE_2 and for each service, then the result is PASS.

</td></tr>
<tr><td>Units</td><td>Information Rate: Mbit/s, Delay: ms</td></tr>
<tr><td>Variables</td><td>Service and ENNI Frame sizes, test duration T_{SP} IR_{SAC}, FD_{SAC}/MFD_{SAC}, $IFDV_{SAC}$/FDR_{SAC} and FLR_{SAC}</td></tr>
<tr><td>Results</td><td>
ETE_1 Results:
Service #i
<table>
<tr><th>Attribute Tested</th><th>Measured/Calculated</th><th>SAC value
(See note 6)</th><th>Pass/Fail</th></tr>
<tr><td>IR</td><td></td><td></td><td></td></tr>
<tr><td>FD or MFD</td><td></td><td></td><td></td></tr>
<tr><td>IFDV or FDR</td><td></td><td></td><td></td></tr>
<tr><td>FLR</td><td></td><td></td><td></td></tr>
</table>
ETE_2 Results:
Service #i
<table>
<tr><th>Attribute Tested</th><th>Measured/Calculated</th><th>SAC value
(See note 6)</th><th>Pass/Fail</th></tr>
<tr><td>IR</td><td></td><td></td><td></td></tr>
<tr><td>FD or MFD</td><td></td><td></td><td></td></tr>
<tr><td>IFDV or FDR</td><td></td><td></td><td></td></tr>
<tr><td>FLR</td><td></td><td></td><td></td></tr>
</table>
</td></tr>
</table>

Remarks	Note 1: Bandwidth Profile is measured in terms of Service or ENNI Frame traffic where the Service or ENNI Frame consists of the first bit of the destination MAC Address through the last bit of the Frame Check Sequence. Note 2: Green Color Identifiers defined in MEF 23.1 Table 4 [17]. Note 3: The length of the time T_{SP} has to be such that the number of bytes in CBS is negligible compared to the total volume of traffic received over the duration of the test. Note 4: Frames would be transmitted at constant intervals, e.g., without burstiness or interval variation. If interval variation is present, it would be proportional to the size variation in the EMIX. Note 5: Frames can be transmitted in units of IR bits per second, although transmission rate measured in Utilized Line Rate (ULR) bits per second is also acceptable. Note 6: Refer to Section 10.2 for guidance on SAC values.

Table 31 – SAT Methodology – Service Performance Tests – Multiple Services

10.4.1 Service Performance Tests Duration

The Service Performance tests duration is defined as T_{SP} (Time Service Performance).

[R51] T_{SP} **MUST** be negotiated between the Service Provider and Access Provider before SAT.

[R52] T_{SP} **MUST** be reported.

[R53] The ETE **MUST** support T_{SP} of Test15m (15 minutes), Test2h (2 hours) and Test24h (24 hours).

There are four test durations defined in ITU-T M.2110 [9]. The continuity test is beyond the scope of this document as the service under test has already been tested with the service configuration tests. The applicable test durations are therefore Test15m, Test2h and Test24h. For example, a Service Provider can test services for 15 minutes if the services are provided over a network already carrying working traffic in a metro application. 2-hour test durations can be used for services running over a multi Service Provider long-haul network. Finally, a 24-hour test duration can be used for services which are being carried internationally over multiple Operator networks.

11 Results

This section provides the requirements to create the SAT Record. SAT Records can be used for SLA verification and validation prior to deploying the service under test to the customer.

Figure 16 provides a high level use case for the Service Activation Testing results process using an automated Ethernet Test Support System (ETSS). SAT can also be performed without an automated ETSS; in this case, the user of the ETE used to test the service can enter the information required to generate a SAT Record.

It is assumed that for the example use case SAT is actively running. Figure 16 represents a use case where the ETE-TH 'pushes' the status up to the ETSS autonomously. When a test completes, the ETE-TH automatically notifies the ETSS that the specified test has finished. At this point the ETSS can trigger querying the ETE-TH for the test results for the specified test. Once

the test results are obtained, they can be stored within a back office database and the SAT Record can be generated.

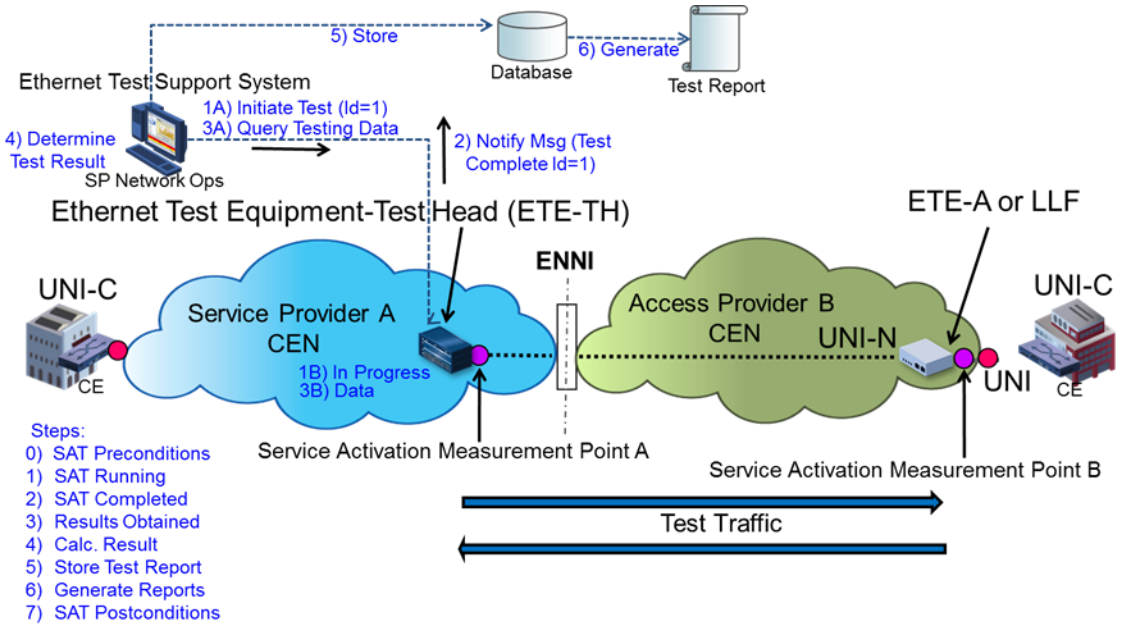


Figure 16 – Test Results Use Case (Push Model)

11.1 Monitoring Test

This use case encompasses several scenarios that are applicable when SAT is actively running or scheduled to run at a future point in time. A test result status is linked to a requested test.

A Service Provider can query, via an ETSS as shown in Figure 16, an ETE-TH and/or ETE-A to determine the current test status. The management interface used to perform this query might be SNMP or NETCONF, for example.

Autonomous events could be used to convey certain test status state changes as illustrated in Figure 16. For example, a device might send an SNMP or NETCONF Notification to indicate a test (with a given Test ID) has been completed. Similarly, an ETSS might show a visual indicator that a test has completed execution.

An ETE-I might convey certain test status information via visual indicators such as LEDs or local on-screen display information.

11.1.1 Determine Test Status

ETE-THs and ETE-As can support the following test statuses:

None	This state correlates to the testing state where a test has never been run since the device or service was brought online from an initialization state.

Completed	The requested test execution succeeded.
In Progress	The requested test execution is still in progress.
Not Supported	The requested test is not supported by the system and/or device.
Unable To Run	The requested test cannot be executed. For example, a device has not met the pre-conditions to execute the test (e.g., taken out-of-service).
Aborted	A test was aborted, either manually by an Operator or automatically by a device due to problems or error conditions. Results are not deemed acceptable. Within this state, an Operator might be interested to determine if the test was aborted due to manual intervention or due to device intervention. This might include the scenario where a test timed out due to a control path communication error.
Failed	The requested test execution has failed since the expected criteria, outcome and behavior was not met. For example, a measurement did not meet the expected criteria.
Unknown	This state indicates the test result state is currently unknown.

Test status is key information included in the test reports, along with other correlational data.

ETE-THs and ETE-As might support autonomous events (e.g., SNMP Traps, NETCONF asynchronous messages, etc.) to convey test status state changes.

11.1.2 Determine Test Result

The final test results can be reported for each test or suite of tests as defined in Section 10. Testing results need to follow POSIX [1] test result ratings (such as PASS, FAIL, UNRESOLVED) and multiple results can be rolled into a final test disposition. For example, a test that timed out with a test execution failure would report a result of UNRESOLVED.

Test results are key information included in the test reports, along with other correlational data.

[R54] An Ethernet Test Support System **MUST** support reporting test results in the following POSIX [1] test result assertion codes:

- PASS
- FAIL
- UNTESTED
- UNSUPPORTED
- NOT_APPLICABLE
- NOT_TESTABLE
- UNRESOLVED
- NOT_INITIATED

[D4] An Ethernet Test Equipment **SHOULD** support reporting test results in the POSIX [1] test result assertion codes.

11.1.3 Test Report

This section provides the requirements that are to be used for the creation of the SAT Records. Section 9 identifies the MEF service attributes which are to be included as part of the SAT Record. Other information will also be necessary in the SAT Record such as a record name, start time, end time, etc.

Test automation being a goal for Service Providers, an XML Service Activation Test Report is to be generated for back office applications to be able to parse and understand the reports and be able to generate reports in other formats such as PDF, Word, Excel, etc. By providing a standardized SAT Record format in XML, many different applications and processes can parse and utilize the information contained with-in the report.

As the example use case in this section highlights, the ETE might provide test result and status data to an Ethernet Test Support System (ETSS) or Element Management System (EMS) using other management protocols, including SNMP, NETCONF, XML or vendor proprietary methods. These ETSS and EMS applications, in turn, will aggregate the test result and status information and generate the SAT Record in XML. If an automated ETSS is not used, the user of the ETE will need to input manually the parameters to be able to create the Service Activation Test Records.

[R55] The SAT Record **MUST** support test report generation based on XML.

[O12] SAT Record **MAY** support test report generation based on other reporting formats as agreed to by the two involved parties.

A detailed definition of the SAT Record in XML is for further study. An example of a Service Activation Test Record is presented in a table format in Appendix B.

12 Terminology Alignment

12.1 ITU-T Y.1563

ITU-T Recommendation Y.1563 [10] defines the parameters that may be used in specifying and assessing the performance of speed, accuracy, dependability and availability of Ethernet frame transfer of an Ethernet communication service.

ITU-T Y.1563 [10] defines a Measurement Point (MP) as a boundary between a bridge and an adjacent link at which performance reference events can be observed and measured. A section or a combination of sections is measurable if it is bounded by a set of MPs.

This definition differs from this specification as the SAMP definition is more precise as it locates the measurement point with regards to the ESCF/EPCF. The SAMP location is presented in Section 8.1.1 of this specification.

13 References

[1] IEEE Std 1003.3-1991, IEEE Standard for Information Technology-Test Methods for Measuring Conformance to POSIX, 1991.

[2] IEEE Std 802.3™ – 2012, IEEE Standard for Ethernet, December 2012.

[3] IEEE Std 802.1Q™ – 2011, Media Access Control (MAC) Bridges and Virtual Bridge Local Area Networks

[4] IETF RFC 1242, Benchmarking Terminology for Network Interconnection Devices, July 1991.

[5] IETF RFC 2119, Key words for use in RFCs to Indicate Requirement Levels, March 1997.

[6] IETF RFC 2544, Benchmarking Methodology for Network Interconnect Devices, March 1999.

[7] IETF RFC 6815, Applicability Statement for RFC 2544: Use on Production Networks Considered Harmful, November 2012.

[8] IETF RFC 6985, IMIX Genome: Specification of Variable Packet Sizes for Additional Testing, July 2013.

[9] ITU-T Recommendation M.2110, Bringing into service international multi-operator paths, sections and transmission systems, July 2002.

[10] ITU-T Recommendation Y.1563 (2009), Ethernet frame transfer and availability performance, plus Amendment 1 (2009).

[11] ITU-T Recommendation Y.1564, Ethernet service activation test methodology, March 2011.

[12] MEF 4, Metro Ethernet Network Architecture Framework - Part 1: Generic Framework, May 2004.

[13] MEF 10.3, Ethernet Services Attributes Phase 3, October 2013.

[14] MEF 12.2, Carrier Ethernet Network Architecture Framework Part 2: Ethernet Services Layer, April 2014.

[15] MEF 15, Requirements for Management of Metro Ethernet Phase 1 Network Elements, November 2005.

[16] MEF 17, Service OAM Requirements & Framework – Phase 1, April 2007.

[17] MEF 23.1, Carrier Ethernet Class of Service – Phase 2, January 2012.

[18] MEF 26.1, External Network Network Interface (ENNI) -- Phase 2, January 2012.

[19] MEF 30.1, Service OAM Fault Management Implementation Agreement: Phase 2, April 2013.

[20] MEF 33, Ethernet Access Services Definition, January 2012.

[21] MEF 35, Service OAM Performance Monitoring Implementation Agreement, April 2012.

[22] MEF 37, Abstract Test Suite for ENNI, January 2012

[23] MEF 46, Latching Loopback Protocol and Functionality, July 2014

[24] MEF L2CP, Multi-CEN L2CP, July 2014

[25] OMG Unified Modeling Language™ (OMG UML), Superstructure, Version 2.3, May 2010, http://www.omg.org/spec/UML/2.3/Superstructure.

[26] OMG Unified Modeling Language™ (OMG UML), Infrastructure, Version 2.3, May 2010, http://www.omg.org/spec/UML/2.3/Infrastructure.

[27] Business Process Framework (eTOM), Addendum DX: Extended Process Decompositions and Descriptions, GB921 Addendum DX, Version 12.3, TM Forum, April 2012.

Appendix A Special Use Cases when performing SAT on MEF Services (Informative)

A.1 E-Access Use Cases

This section identifies E-Access [20] use cases. They are specific to testing a new Access EPL or Access EVPL service [20] being activated on an existing ENNI that a Service Provider has with an Access Provider.

These use cases also assume that there is only an Access Provider NID at the customer premise, although the addition of a Service Provider NID would not substantially change the use cases.

A.1.1 Cooperative Service Activation Testing by Service and Access Providers

The use case shown in Figure 17 assumes that the final joint OVC testing session is coordinated between the Service Provider and Access Provider, requiring joint planning of resources needed for the test at both locations. In addition to personnel and schedule coordination, the SP and AP need to have compatible (interoperable) ETEs if they are to source and sink traffic in each direction. In addition to compatible ETEs, if one-way delay measurements are to be made the ETEs will need to have access to Time-of-Day (ToD) clock sources to synchronize time stamping at the source and sink ETEs. The Service Provider needs to be able to source and sink test traffic on a single OVC on an ENNI without disturbing any of the in-service traffic on that interface. The Access Provider ETE is beyond their NID so that test traffic flows past the Traffic Conditioning Point (TrCP) and properly measures behavior of the customer circuit. In this use case, the

Service Provider initiates and controls the testing from the ETE-TH. The ETE-I at the Access Provider's UNI could also be replaced with an ETE-A at the UNI-N to support the one-way co-ordinated testing.

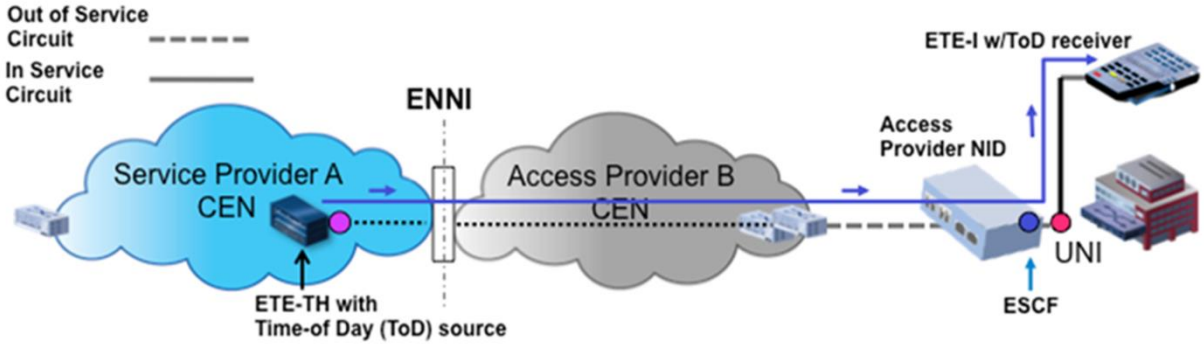


Figure 17 – SAT performed "cooperatively" by Service & Access Providers

A.1.2 Service Activation Testing with an existing EVC at the UNI

SAT for an OVC might need to be performed differently when there is an existing EVC at a UNI (Access EVPL service [20]). This is due to the desire to not adversely impact the existing in-service EVC. If an ETE-I is used to perform the testing at the UNI that has existing customer traffic, the ETE-I is connected to the UNI-N, which likely breaks the connection between the UNI-N and the UNI-C. This, of course, affects any EVC that already exist on a UNI. To avoid the impact of using an ETE-I at a UNI-N that already has in-service EVCs, a different method is recommended such as a Latching Loopback (LL) or an ETE-A.

Even when an ETE-I is not used, the existing EVC can be impacted by testing of a new OVC being activated. This is due to the customer sending frames from the UNI-C at the same time that frames are either being generated by the ETE-A or looped back at the UNI-N. Since the customer's equipment is not aware of the test frames, they may continue to send frames up to the CBS of their existing services while SAT is underway. If SAT is concurrently sending bursts of frames, the customer may experience additional delay or frame loss on the existing EVC and the SAT may experience additional delay that could cause SAT to fail. Figure 18 provides an example of this use case where one EVC is in-service and one OVC is being activated. Each EVC and OVC have a CIR of 40 Mb/s and a CBS of 40 KB. All physical interfaces in this example are 100 Mb/s.

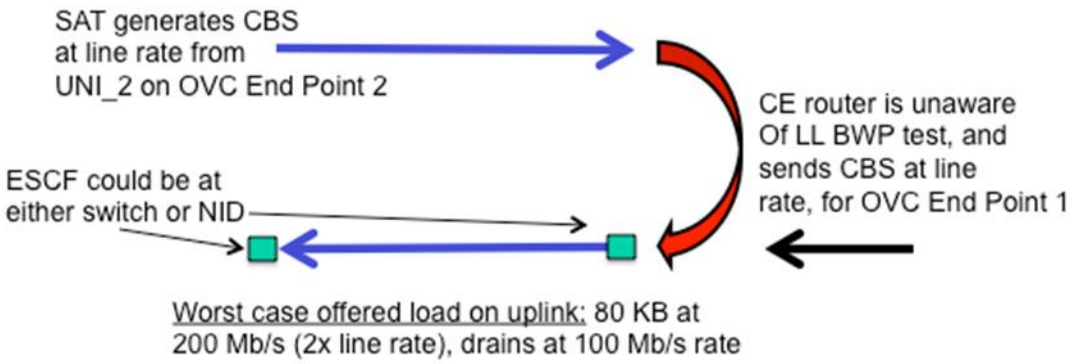


Figure 18 – Congestion Due to SAT using Latching Loopback (LL)

As can be seen in the use case above, a full BWP test run while a customer is sending Service Frames at line rate causes congestion since the egress port can support only 100 Mb/s. A similar issue exists if an ETE-A is used versus a LL. Service Frames and test traffic will contend for the same upstream bandwidth and additional Frame Delay or Inter-Frame Delay Variation may be experienced. An example of this is shown in Figure 19.

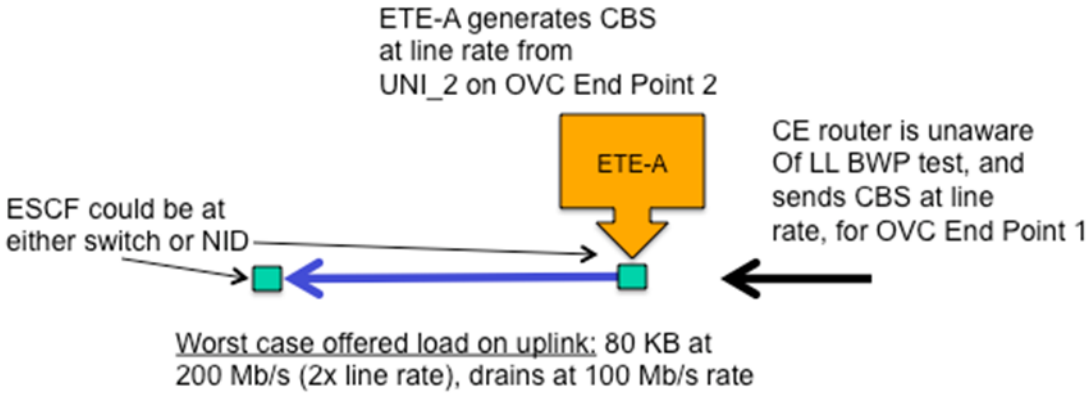


Figure 19 – Congestion Due to SAT using Ethernet Test Equipment-Application

Appendix B SAT Record example (Informative)

This appendix presents a table view of a SAT Record. The test record includes the test information (date, time, etc…), reportable service attributes that are not tested and results from testing the service attributes. These records are to be included for Service Configuration and Service Performance Tests.

B.1 Access Provider SAT Record

This part of the appendix covers SAT Record from an Access Provider's perspective. Each part of the AP's SAT Record is covered in a sub-section. The complete AP SAT Record would merge all the different tables into a single record. Each sub-section provides an example of a record for each reportable service attribute or test configuration and results. Differences between different E-Access services [20] tested will be explained in each sub-section, when necessary, without having a table for each possible use case.

B.1.1 UNI Service Attributes Record

Table 32 below provides an example of the UNI service attributes record for an AP.

UNI Service Attribute	Value
UNI Identifier	MTRL333-Node3-Slot2-Port1
Physical Medium	1000BASE-SX
Speed	1 Gb/s
Auto-Negotiation	Auto
Mode	Full Duplex
UNI MTU Size (byte)	1522

Table 32 – UNI Service Attributes Record Example

B.1.2 OVC per UNI Service Attributes Record

Table 33 below provides an example of the OVC per UNI service attributes record for an AP.

OVC per UNI Service Attribute	Value	
UNI OVC Identifier	MTRL333-Node3-Slot2-Port1-OVC-0001965-ACME-MEGAMART	
OVC End Point Map	CE VLAN ID	OVC EP
	All	1

Table 33 – OVC per UNI Service Attributes Record Example

B.1.3 OVC Service Attributes Record

Table 34 below provides an example of the OVC service attributes record for an AP.

OVC Service Attributes	Value
OVC Identifier	OVC-0001965-ACME-MEGAMART
Color Forwarding	Yes

Table 34 – OVC Service Attributes Record Example

B.1.4 OVC End Point per ENNI Service Attributes Record

Table 35 below provides an example of the OVC per ENNI service attributes record for an AP.

OVC End Point per ENNI Service Attribute	Value
OVC End Point Identifier	MMART1965

Table 35 – OVC End Point per ENNI Service Attribute Record Example

B.1.5 ENNI Service Attributes Record

Table 36 below provides an example of the ENNI service attributes record for an AP.

OVC End Point per ENNI Service Attribute	Value
Operator ENNI Identifier	ENNI-MTRL Central Exchange_14-0624

Table 36 –ENNI Service Attribute Record Example

B.1.6 Access EPL Service Definition Record

Table 37 below provides an example of an Access EPL Service Definition record for an AP.

Access EPL Service Definition	Value	
End Points Map	OVC End Point Map at UNI	
	CE-VLAN ID	OVC End Point
	All	1
	OVC End Point Map at ENNI	
	S-VLAN ID	OVC End Point
	65	50
Ingress Bandwidth Profile per OVC	CIR	100 Mb/s

EP at UNI	CBS	12 KB
	EIR	50 Mb/s
	EBS	6 KB
	CF	Yes
	CM	Blind
Ingress Bandwidth Profile per OVC EP at ENNI	CIR	100 Mb/s
	CBS	12 KB
	EIR	50 Mb/s
	EBS	6 KB
	CF	Yes
	CM	Aware

Table 37 – Access EPL Service Definition Record Example

B.1.7 Service Acceptance Criteria Record

Table 38 below provides an example of the Service Acceptance Criteria for an AP.

Service Acceptance Criteria	Value
Information Rate (IR_{SAC})	100 Mb/s
Mean Frame Delay (MFD_{SAC})	25 ms
Inter-Frame Delay Variation ($IFDV_{SAC}$)	10 ms
Frame Loss Ratio (FLR_{SAC})	10^{-4}

Table 38 – Service Acceptance Criteria Record Example

B.1.8 EMIX Frame Size Configuration Test Record

Table 39 below provides an example of the EMIX Frame Size configuration test record for an AP.

EMIX Frame Size Configuration	Value								
EMIX Definition	a	b	c	d	e	f	g	h	u
EMIX size (byte)	64	128	256	512	1024	1280	1518	1526	576

Table 39 – EMIX Frame Size Configuration Record Example

B.1.9 OVC MTU Size Test Record

Table 40 below provides an example of the OVC MTU Size test record for an AP.

OVC MTU Size Test Configuration Parameters	Value	
Test Frame Size (byte)	1526	
Test Frame Type	Unicast	
Test Information Rate (IR_{SC})	50 Mb/s	
Test Duration (T_{SC})	1 sec	
Frame Loss Ratio (FLR_{SAC})	10^{-4}	
OVC MTU Size Test Results	**Results**	
		Verdict
ETE_1 TX Service Frames	**4095**	**-**
ETE_1 RX Service Frames	**4095**	**-**
ETE_1 – ETE_2 One-way FLR	**0**	**PASS**
ETE_2 TX Service Frames	**4095**	**-**
ETE_2 RX Service Frames	**4095**	**-**
ETE_2 – ETE_1 One-way FLR	**0**	**PASS**
OVC MTU Size Test Verdict		**PASS**

Table 40 – OVC MTU Size Test Record Example

B.1.10 CE-VLAN ID Preservation Test Record – Access EPL

Table 41 below provides an example of the CE-VLAN ID Preservation test record for an Access EPL service for an AP.

In the case of an Access EVPL service [20], Table 41 would only list the CE-VLAN ID tested (CE-VLAN IDs per OVC = 1 or CE-VLAN IDs per OVC > 1).

CE-VLAN ID Preservation Test Configuration Parameters	Value	
Test Frame Size (byte)	EMIX	
Test Frame Type	Unicast	
EMIX	abcdefgh	
Test Information Rate (IR_{SC})	50 Mb/s	
Test Duration (T_{SC})	1 sec	
Frame Loss Ratio (FLR_{SAC})	10^{-4}	
CE-VLAN ID Preservation Results	**Results**	
CE VLAN ID	**1**	
		Verdict
ETE_1 TX Service Frames	**7926**	**-**
ETE_1 RX Service Frames	**7926**	**-**
ETE_1 – ETE_2 One-way FLR	**0**	**PASS**
ETE_2 TX Service Frames	**7926**	**-**

ETE_2 RX Service Frames	**7926**	**-**
ETE_2 – ETE_1 One-way FLR	**0**	**PASS**
CE VLAN ID	**1024**	
		Verdict
ETE_1 TX Service Frames	**7926**	**-**
ETE_1 RX Service Frames	**7926**	**-**
ETE_1 – ETE_2 One-way FLR	**0**	**PASS**
ETE_2 TX Service Frames	**7926**	**-**
ETE_2 RX Service Frames	**7926**	**-**
ETE_2 – ETE_1 One-way FLR	**0**	**PASS**
CE VLAN ID	**2048**	
		Verdict
ETE_1 TX Service Frames	**7926**	**-**
ETE_1 RX Service Frames	**7926**	**-**
ETE_1 – ETE_2 One-way FLR	**0**	**PASS**
ETE_2 TX Service Frames	**7926**	**-**
ETE_2 RX Service Frames	**7926**	**-**
ETE_2 – ETE_1 One-way FLR	**0**	**PASS**
CE VLAN ID	**4094**	
		Verdict
ETE_1 TX Service Frames	**7926**	**-**
ETE_1 RX Service Frames	**7926**	**-**
ETE_1 – ETE_2 One-way FLR	**0**	**PASS**
ETE_2 TX Service Frames	**7926**	**-**
ETE_2 RX Service Frames	**7926**	**-**
ETE_2 – ETE_1 One-way FLR	**0**	**PASS**
CE-VLAN ID Preservation Test Verdict		**PASS**

Table 41 – CE-VLAN ID Preservation Test Record – Access EPL

B.1.11 CE-VLAN CoS ID Preservation Test Record

Table 42 below provides an example of the CE-VLAN CoS ID Preservation test record for an AP.

CE-VLAN CoS ID Preservation Test Configuration Parameters	Value
Test Frame Size (byte)	EMIX
Test Frame Type	Unicast
EMIX	abcdefgh
Test Information Rate (IR_{SC})	50 Mb/s

Test Duration (T_{SC})	1 sec	
Frame Loss Ratio (FLR_{SAC})	10^{-4}	
CE-VLAN CoS ID Preservation Results	**Results**	
CE VLAN CoS ID	**0**	
		Verdict
ETE_1 TX Service Frames	**7926**	**-**
ETE_1 RX Service Frames	**7926**	**-**
ETE_1 – ETE_2 One-way FLR	**0**	**PASS**
ETE_2 TX Service Frames	**7926**	**-**
ETE_2 RX Service Frames	**7926**	**-**
ETE_2 – ETE_1 One-way FLR	**0**	**PASS**
CE VLAN CoS ID	**1**	
		Verdict
ETE_1 TX Service Frames	**7926**	**-**
ETE_1 RX Service Frames	**7926**	**-**
ETE_1 – ETE_2 One-way FLR	**0**	**PASS**
ETE_2 TX Service Frames	**7926**	**-**
ETE_2 RX Service Frames	**7926**	**-**
ETE_2 – ETE_1 One-way FLR	**0**	**PASS**
CE VLAN CoS ID	**2**	
		Verdict
ETE_1 TX Service Frames	**7926**	**-**
ETE_1 RX Service Frames	**7926**	**-**
ETE_1 – ETE_2 One-way FLR	**0**	**PASS**
ETE_2 TX Service Frames	**7926**	**-**
ETE_2 RX Service Frames	**7926**	**-**
ETE_2 – ETE_1 One-way FLR	**0**	**PASS**
CE VLAN CoS ID	**3**	
		Verdict
ETE_1 TX Service Frames	**7926**	**-**
ETE_1 RX Service Frames	**7926**	**-**
ETE_1 – ETE_2 One-way FLR	**0**	**PASS**
ETE_2 TX Service Frames	**7926**	**-**
ETE_2 RX Service Frames	**7926**	**-**
ETE_2 – ETE_1 One-way FLR	**0**	**PASS**
CE VLAN CoS ID	**4**	
		Verdict
ETE_1 TX Service Frames	**7926**	**-**
ETE_1 RX Service Frames	**7926**	**-**
ETE_1 – ETE_2 One-way FLR	**0**	**PASS**

ETE_2 TX Service Frames	**7926**	**-**
ETE_2 RX Service Frames	**7926**	**-**
ETE_2 – ETE_1 One-way FLR	**0**	**PASS**
CE VLAN CoS ID	**5**	
		Verdict
ETE_1 TX Service Frames	**7926**	**-**
ETE_1 RX Service Frames	**7926**	**-**
ETE_1 – ETE_2 One-way FLR	**0**	**PASS**
ETE_2 TX Service Frames	**7926**	**-**
ETE_2 RX Service Frames	**7926**	**-**
ETE_2 – ETE_1 One-way FLR	**0**	**PASS**
CE VLAN CoS ID	**6**	
		Verdict
ETE_1 TX Service Frames	**7926**	**-**
ETE_1 RX Service Frames	**7926**	**-**
ETE_1 – ETE_2 One-way FLR	**0**	**PASS**
ETE_2 TX Service Frames	**7926**	**-**
ETE_2 RX Service Frames	**7926**	**-**
ETE_2 – ETE_1 One-way FLR	**0**	**PASS**
CE VLAN CoS ID	**7**	
		Verdict
ETE_1 TX Service Frames	**7926**	**-**
ETE_1 RX Service Frames	**7926**	**-**
ETE_1 – ETE_2 One-way FLR	**0**	**PASS**
ETE_2 TX Service Frames	**7926**	**-**
ETE_2 RX Service Frames	**7926**	**-**
ETE_2 – ETE_1 One-way FLR	**0**	**PASS**
CE-VLAN CoS ID Preservation Test Verdict		**PASS**

Table 42 – CE-VLAN CoS ID Preservation Test Record

B.1.12 Broadcast Delivery Test Record

Table 43 below provides an example of the Broadcast Delivery test record for an AP.

Broadcast Unconditional Delivery Test Configuration Parameters	**Value**
Test Frame Size (byte)	EMIX
Test Frame Type	Broadcast
EMIX	abcdefgh
Test Information Rate (IR_{SC})	31.5 Kb/s

Test Duration (T_{SC})	1 sec	
Frame Loss Ratio (FLR_{SAC})	10^{-4}	
Broadcast Unconditional Delivery Test Configuration Results	**Results**	
		Verdict
ETE_1 TX Service Frames	**5**	**-**
ETE_1 RX Service Frames	**5**	**-**
ETE_1 – ETE_2 One-way FLR	**0**	**PASS**
ETE_2 TX Service Frames	**5**	**-**
ETE_2 RX Service Frames	**5**	**-**
ETE_2 – ETE_1 One-way FLR	**0**	**PASS**
Broadcast Unconditional Delivery Test Verdict		**PASS**

Table 43 – Broadcast Delivery Test Record Example

B.1.13 Unicast Delivery Test Record

Table 44 below provides an example of the Unicast Delivery test record for an AP.

Unicast Unconditional Delivery Test Configuration Parameters	**Value**	
Test Frame Size (byte)	EMIX	
Test Frame Type	Unicast	
EMIX	abcdefgh	
Test Information Rate (IR_{SC})	50 Mb/s	
Test Duration (T_{SC})	1 sec	
Frame Loss Ratio (FLR_{SAC})	10^{-4}	
Unicast Unconditional Delivery Test Configuration Results	**Results**	
		Verdict
ETE_1 TX Service Frames	**7926**	**-**
ETE_1 RX Service Frames	**7926**	**-**
ETE_1 – ETE_2 One-way FLR	**0**	**PASS**
ETE_2 TX Service Frames	**7926**	**-**
ETE_2 RX Service Frames	**7926**	**-**
ETE_2 – ETE_1 One-way FLR	**0**	**PASS**
Unicast Unconditional Delivery Test Verdict		**PASS**

Table 44 – Unicast Delivery Test Record Example

B.1.14 Multicast Delivery Test Record

Table 45 below provides an example of the Multicast Delivery test record for an AP.

Multicast Unconditional Delivery Test Configuration Parameters	**Value**	
Test Frame Size (byte)	EMIX	
Test Frame Type	Multicast	
EMIX	abcdefgh	
Test Information Rate (IR_{SC})	50 Mb/s	
Test Duration (T_{SC})	1 sec	
Frame Loss Ratio (FLR_{SAC})	10^{-4}	
Multicast Unconditional Delivery Test Configuration Results	**Results**	
		Verdict
ETE_1 TX Service Frames	**7926**	**-**
ETE_1 RX Service Frames	**7926**	**-**
ETE_1 – ETE_2 One-way FLR	**0**	**PASS**
ETE_2 TX Service Frames	**7926**	**-**
ETE_2 RX Service Frames	**7926**	**-**
ETE_2 – ETE_1 One-way FLR	**0**	**PASS**
Multicast Unconditional Delivery Test Verdict		**PASS**

Table 45 – Multicast Delivery Test Record Example

B.1.15 Ingress Bandwidth Profile per OVC End Point – CIR Configuration Test Record

Table 46 below provides an example of the ingress Bandwidth Profile per OVC End Point – CIR Configuration Test (Color-blind) record for an AP.

Ingress Bandwidth Profile per OVC End Point – CIR Configuration Test Parameters	**Value**	
Test Frame Size (byte)	EMIX	
Test Frame Type	Unicast	
EMIX	abcdefgh	
Test Step Duration (T_{BWD})	10 sec	
Ingress Bandwidth Profile per OVC End Point – CIR Configuration Test Result	**Results**	
		Verdict
ETE_1 One-way IR_{MEAS}	**100 Mb/s**	**PASS**
ETE_1 One-way MFD_{MEAS}	**18**	**PASS**

ETE_1 One-Way $IFDV_{MEAS}$	**6**	**PASS**
ETE_1 One-way FLR_{MEAS}	**0**	**PASS**
ETE_2 One-way IR_{MEAS}-G	**100 Mb/s**	**PASS**
ETE_2 One-way MFD_{MEAS}-G	**19**	**PASS**
ETE_2 One-way $IFDV_{MEAS}$-G	**7**	**PASS**
ETE_2 One-Way FLR_{MEAS}-G	**0**	**PASS**
Ingress Bandwidth Profile per OVC End Point – CIR Configuration Test Verdict	-	**PASS**

Table 46 – Ingress Bandwidth Profile per OVC End Point – CIR Configuration Test (Color-blind) Record Example

B.1.16 Ingress Bandwidth Profile per OVC End Point – EIR Configuration Test Record

Table 47 below provides an example of the ingress Bandwidth Profile per OVC End Point – EIR Configuration Test (Color-aware) record for an AP.

In the case of the color-blind EIR Configuration Test presented in Table 27, the ETE_1 would only list the different results without color (IR_{MEAS} and FLR_{MEAS}).

Ingress Bandwidth Profile per OVC End Point – EIR Configuration Test (Color-aware) Parameters	**Value**	
Test Frame Size (byte)	EMIX	
Test Frame Type	Unicast	
EMIX	abcdefgh	
Test Step Duration (T_{BWD})	10 sec	
Ingress Bandwidth Profile per OVC End Point – EIR Configuration Test (Color-aware) Result	**Results**	
		Verdict
ETE_1 One-way IR_{MEAS}-G	**100 Mb/s**	**PASS**
ETE_1 One-way IR_{MEAS}-Y	**32 Mb/s**	**N/A**
ETE_1 One-way IR_{MEAS}-T	**132 Mb/s**	**PASS**
ETE_1 One-way MFD_{MEAS}-G	**18**	**PASS**
ETE_1 One-way MFD_{MEAS}-Y	**22**	**N/A**
ETE_1 One-way $IFDV_{MEAS}$-G	**6**	**PASS**
ETE_1 One-way $IFDV_{MEAS}$-Y	**9**	**N/A**
ETE_1 One-Way FLR_{MEAS}-G	**0**	**PASS**
ETE_1 One-Way FLR_{MEAS}-Y	**5.625×10^{-1}**	**N/A**
ETE_2 One-way IR_{MEAS}-G	**100 Mb/s**	**PASS**
ETE_2 One-way IR_{MEAS}-Y	**16 Mb/s**	**N/A**
ETE_2 One-way IR_{MEAS}-T	**116 Mb/s**	**PASS**

ETE_2 One-way MFD_{MEAS}-G	**19**	**PASS**
ETE_2 One-way MFD_{MEAS}-Y	**25**	**N/A**
ETE_2 One-way $IFDV_{MEAS}$-G	**7**	**PASS**
ETE_2 One-way $IFDV_{MEAS}$-Y	**10**	**N/A**
ETE_2 One-Way FLR_{MEAS}-G	**0**	**PASS**
ETE_2 One-Way FLR_{MEAS}-Y	**6.8×10^{-1}**	**N/A**
Ingress Bandwidth Profile per OVC End Point – EIR Configuration Test Verdict	**-**	**PASS**

Table 47 – Ingress Bandwidth Profile per OVC End Point – EIR Configuration Test (Color-aware) Record Example

B.1.17 Ingress Bandwidth Profile per OVC End Point – Traffic Policing Test Record

Table 48 below provides an example of the ingress Bandwidth Profile per OVC End Point – Traffic Policing Test (color-aware) test record for an AP.

In the case of the color-blind Traffic Policing Test presented in Table 29, the ETE_1 would only list the different results without color (IR_{MEAS} and FLR_{MEAS}).

Ingress Bandwidth Profile per OVC End Point – Traffic Policing Test (Color-aware) Parameters	**Value**	
Test Frame Size (byte)	EMIX	
Test Frame Type	Unicast	
EMIX	abcdefgh	
Test Step Duration (T_{BWD})	10 sec	
Ingress Bandwidth Profile per OVC End Point – Traffic Policing Test (Color-aware) Result	**Results**	
		Verdict
ETE_1 One-way IR_{MEAS}-G	**100 Mb/s**	**PASS**
ETE_1 One-way IR_{MEAS}-Y	**32 Mb/s**	**N/A**
ETE_1 One-way IR_{MEAS}-T	**132 Mb/s**	**PASS**
ETE_1 One-way MFD_{MEAS}-G	**18**	**PASS**
ETE_1 One-way MFD_{MEAS}-Y	**22**	**N/A**
ETE_1 One-way $IFDV_{MEAS}$-G	**6**	**PASS**
ETE_1 One-way $IFDV_{MEAS}$-Y	**9**	**N/A**
ETE_1 One-Way FLR_{MEAS}-G	**0**	**PASS**
ETE_1 One-Way FLR_{MEAS}-Y	**5.625×10^{-1}**	**N/A**
ETE_2 One-way IR_{MEAS}-G	**100 Mb/s**	**PASS**
ETE_2 One-way IR_{MEAS}-Y	**16 Mb/s**	**N/A**
ETE_2 One-way IR_{MEAS}-T	**116 Mb/s**	**PASS**

ETE_2 One-way MFD_{MEAS}-G	**0**	**PASS**
ETE_2 One-way MFD_{MEAS}-Y	**6.8×10^{-1}**	**N/A**
ETE_2 One-way $IFDV_{MEAS}$-G	**19**	**PASS**
ETE_2 One-way $IFDV_{MEAS}$-Y	**25**	**N/A**
ETE_2 One-Way MFD_{MEAS}-G	**7**	**PASS**
ETE_2 One-Way MFD_{MEAS}-Y	**10**	**N/A**
Ingress Bandwidth Profile per OVC End Point – Traffic Policing Test (Color-aware) Verdict	**-**	**PASS**

Table 48 – Ingress Bandwidth Profile per OVC End Point – Traffic Policing Test (Color-aware) Record Example

B.1.18 Service Performance Tests Record – Access EPL

Table 49 below provides an example of the Service Performance test record for an AP.

In the case of the Access EVPL with multiple services presented in Table 31, the results would be listed for Service #1 to Service #i.

Service Performance Tests Parameters	**Value**	
Test Frame Size (byte)	EMIX	
Test Frame Type	Unicast	
EMIX	abcdefgh	
Test Duration (T_{SP})	15 min.	
Service Performance Tests Result	**Results**	
Service #1		**Verdict**
ETE_1 One-way IR_{MEAS}	**100 Mb/s**	**PASS**
ETE_1 One-way MFD_{MEAS}	**18**	**PASS**
ETE_1 One-way $IFDV_{MEAS}$	**6**	**PASS**
ETE_1 One-Way FLR_{MEAS}	**0**	**PASS**
ETE_2 One-way IR_{MEAS}	**100 Mb/s**	**PASS**
ETE_2 One-way MFD_{MEAS}	**19**	**PASS**
ETE_2 One-way $IFDV_{MEAS}$	**7**	**PASS**
ETE_2 One-Way FLR_{MEAS}	**0**	**PASS**
Service Performance Tests Verdict	**-**	**PASS**

Table 49 – Service Performance Tests Record – Access EPL Example

B.2 Service Provider Service Activation Testing Record

This part of the appendix covers SAT Record from a Service Provider's perspective. The complete SP SAT Record would merge all the different tables into a single record. Each sub-section provides an example of a record for each reportable service attribute or test configuration and results. Differences between different E-Access services [20] tested or from the AP SAT Record will be explained in each sub-section, when necessary, without having a table for each possible use case.

B.2.1 UNI Service Attributes Record

Table 50 below provides an example of the UNI service attributes record for an SP.

UNI Service Attribute	Value
UNI Identifier	MTRL333-Node3-Slot2-Port1

Table 50 – UNI Service Attribute Record Example

B.2.2 OVC per UNI Service Attributes Record

Table 51 below provides an example of the OVC per UNI service attributes record for an SP.

OVC per UNI Service Attribute	Value	
UNI OVC Identifier	MTRL333-Node3-Slot2-Port1-OVC-0001965-ACME-MEGAMART	
OVC End Point Map	CE VLAN ID	OVC EP
	All	1

Table 51 – OVC per UNI Service Attribute Record Example

B.2.3 OVC Service Attributes Record

Table 52 below provides an example of the OVC service attributes record for an SP.

OVC Service Attribute	Value
OVC Identifier	OVC-0001965-ACME-MEGAMART

Table 52 – OVC Service Attribute Record Example

B.2.4 OVC End Point per ENNI Service Attributes Record

There is no OVC End Point per ENNI service attribute record for Service Providers.

B.2.5 ENNI Service Attributes Record

There is no ENNI service attribute record for Service Providers.

B.2.6 Access EPL Service Definition Record

The example presented in section B.1.6 for the AP Access EPL Service Definition record applies for the SP.

B.2.7 Service Acceptance Criteria Record

The example presented in section B.1.7 for the AP Service Acceptance Criteria record applies for the SP.

B.2.8 EMIX Frame Size Configuration Test Record

The example presented in section B.1.8 for the AP EMIX Frame Size configuration test record applies for the SP.

B.2.9 OVC MTU Size Test Configuration Record

The example presented in section B.1.9 for the AP OVC MTU Size test record applies for the SP.

B.2.10 CE-VLAN ID Preservation Test Record – Access EPL

The example and differences presented in section B.1.10 for the AP CE-VLAN ID Preservation test record applies for the SP.

B.2.11 CE-VLAN CoS ID Preservation Test Record – Access EPL

The example presented in section B.1.11 for the AP CE-VLAN CoS ID Preservation test record applies for the SP.

B.2.12 Broadcast Delivery Test Record

The example presented in section B.1.12 for the AP Broadcast Delivery test record applies for the SP.

B.2.13 Unicast Delivery Test Record

The example presented in section B.1.13 for the AP Unicast Delivery test record applies for the SP.

B.2.14 Multicast Delivery Test Record

The example presented in section B.1.14 for the AP Multicast Delivery test record applies for the SP.

B.2.15 Ingress Bandwidth Profile per OVC End Point – CIR Configuration Test Record

The example presented in section B.1.15 for the AP ingress Bandwidth Profile per OVC End Point – CIR Configuration test record applies for the SP.

B.2.16 Ingress Bandwidth Profile per OVC End Point – EIR Configuration Test Record

The example and differences presented in section B.1.16 for the AP ingress Bandwidth Profile per OVC End Point – EIR Configuration Test (color-aware) record applies for the SP.

B.2.17 Ingress Bandwidth Profile per OVC End Point – Traffic Policing Test Record

The example and differences presented in section B.1.17 for the AP ingress Bandwidth Profile per OVC End Point – Traffic Policing Test (color-aware) record applies for the SP.

B.2.18 Service Performance Tests Record – Access EPL

The example and differences presented in section B.1.18 for the AP Service Performance Test record applies for the SP.