MEF Specification
MEF 62

Managed Access E-Line Service
Implementation Agreement

May 2018

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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.

- AT&T
- Bell Canada
- Canoga Perkins Corporation
- Ciena Corporation
- Cisco Systems
- HFR, Inc.
- Verizon Communications
- Zayo Group

2   Abstract

This Implementation Agreement (IA) defines an Access E-Line Service that includes a specific set of management and Class of Service capabilities. The service defined in this IA is based on applicable functionality and associated requirements from existing MEF specifications, including:

- Access E-Line Services, as defined in MEF 51 [15]

- Key Service Attributes not covered in MEF 51 [15], as specified in MEF 26.2 [11]

- General SOAM and SOAM Fault Management, as specified in MEF 30.1 [12]

- SOAM Performance Monitoring, as specified in MEF 35.1 [13]

- Latching Loopback, as specified in MEF 46 [14]

3 Terminology and Abbreviations

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 of the following table is used to provide the reference that is controlling, in other MEF or external documents.

In addition, terms defined in MEF 6.2 [5], MEF 10.3 [6], MEF 10.3.1 [7], MEF 10.3.2 [8], MEF 11 [9], MEF 26.1 [10], MEF 26.2 [11], MEF 30.1 [12], MEF 35.1 [13], MEF 46 [14] and MEF 51 [15] are included in this document by reference, and are not repeated in table below.

Term	Definition	Reference
MAEL MEG	A MEG associated with the MAEL MEP.	This document
MAEL MEP	An Up MEP at the OVC End Point at the Operator UNI, which is provided with a MAEL Service.	This document
MAEL MIP	A MIP at the OVC End Point at the ENNI, which is provided with a MAEL Service.	This document
MAEL Operator	An Operator that provides the MAEL Service.	This document
MAEL Service	Managed Access E-Line Service	This document
MAEL SMM	A Subscriber MEG MIP at the OVC End Point at the UNI, which can be provided with a MAEL Service.	This document
Managed Access E-Line Service	An Access E-Line service with a standard set of management and Class of Service capabilities.	This document
MAEL Sourced ENNI Frame	An egress ENNI Frame from the MAEL Operator CEN that is the result of a frame generated by a MAEL MEP, a MAEL MIP, a MAEL SMM (when enabled), or a Latching Loopback Function that is contained in the MAEL Operator CEN.	This document

Table 1 – Terminology and Abbreviations

4   Compliance Levels

The key words "**MUST**", "**MUST NOT**", "**REQUIRED**", "**SHALL**", "**SHALL NOT**", "**SHOULD**", "**SHOULD NOT**", "**RECOMMENDED**", "**MAY**", and "**OPTIONAL**" in this document are to be interpreted as described in BCP 14 (RFC 2119 [2], RFC 8174 [3]) when, and only when, they appear in all capitals, as shown here. All key words must be in 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.

5 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

6   Scope

This document specifies a Managed Access E-Line (MAEL) Service that an Operator can provide to a Service Provider or Super Operator.[1] A MAEL Service is based on Access E-Line Service, which uses a point-to-point OVC between a UNI and an ENNI, as defined in MEF 51 [15], and a MAEL Service also provides a standard set of management and Class of Service capabilities. Key characteristics of a MAEL Service are summarized below.

- Provides a standard set of SOAM FM, SOAM PM and Latching Loopback functions

- Provides a single Class of Service Name and single Color for the OVC

This document assumes interconnection between two Operators, i.e., an Operator providing the MAEL Service (referred to as the *MAEL Operator* in this document) and another CEN Operator. The entity purchasing a MAEL Service may be a Service Provider (SP) or Super Operator (SO). The term, "SP/SO," as defined in MEF 26.2 [11], is used throughout this document to refer to the Service Provider or Super Operator purchasing a MAEL Service.

The MAEL Service is required to respond to SOAM FM, SOAM PM and Latching Loopback messages but is not required to generate these messages. Therefore, if two back-to-back MAEL Services are used, SOAM and Latching Loopback capabilities could be limited.

This document allows a MAEL Service to be configured such that it meets the requirements of a Feeder OVC, as specified in MEF 26.2 [11].

Figure 1 below depicts three examples of MAEL Services.
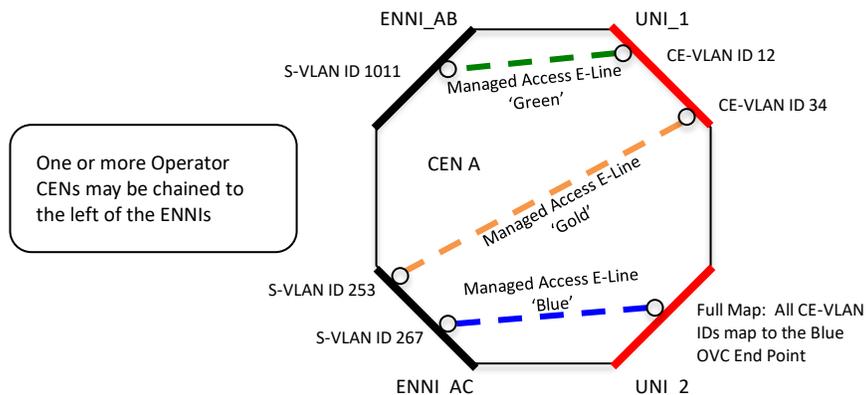
Figure 1 – Example of a CEN with Three MAEL Services

UNI_1 in the above example is dedicated to a single Service Provider, as per MEF 10.3 [6]. UNI_2 is also dedicated to a single Service Provider, which can be different from the Service Provider for UNI_1.

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[1] It is assumed the reader is familiar with the key concepts behind MEF Operator Services, as described in Section 8 of MEF 26.2 [11].

The OVC, OVC End Point at the UNI, and OVC End Point at the ENNI Service Attributes are in scope for this document, and draw from requirements in MEF 51 [15] and Service Attributes in MEF 26.2 [11]. Certain management functions at the OVC End Point at the UNI and ENNI for use by the SP/SO are also in scope for this document.

Since an ENNI could support other services besides a MAEL Service, an ENNI, as specified in either MEF 26.1 [10] or MEF 26.2 [11], can be used to support a MAEL Service. This document does not impose any additional constraints on the ENNI Service Attributes specified in MEF 26.1 [10]. This document does not impose any additional constraints on the ENNI Common Service Attributes, Operator Multilateral Attributes, or ENNI Service Attributes specified in MEF 26.2 [11].

Since a UNI could support other services besides a MAEL Service, a UNI, as specified in either MEF 26.1 [10] or MEF 26.2 [11], can be used to support a MAEL Service. This document does not impose any additional constraints on the UNI Attributes specified in MEF 26.1 [10]. This document does not impose any additional constraints on the Operator UNI Service Attributes specified in MEF 26.2 [11].

Reporting of SOAM results and other statistics to the SP/SO is not in scope for a MAEL Service. A MAEL Service provides SOAM capabilities that allow the SP/SO to directly monitor services and measure performance without any involvement or reporting from the MAEL Operator.

7   Introduction

Services often traverse multiple Operator networks and therefore require interconnection between Operators. When a SP/SO requires an OVC Service from an Operator, provisioning of the OVC Service can be challenging due to the need to specify an extensive number of Service Attributes, especially those associated with Class of Service and management. Furthermore, the SP/SO may need to deploy hardware at a Subscriber location for monitoring and managing end-to-end services when utilizing OVC Services from an Operator, which increases cost and provisioning times.

This document defines a MAEL Service to allow a SP/SO to monitor services by utilizing a standard set of management capabilities, including SOAM FM, SOAM PM, and Latching Loopback, in the MAEL Operator's network. By leveraging management capabilities in the MAEL Operator's network, a MAEL Service is intended to eliminate the need for the SP/SO to deploy hardware at the Subscriber's location.

Furthermore, this document specifies a set of requirements, e.g., allowing a single Class of Service Name per OVC, to simplify provisioning for an OVC Service.

This document is organized as follows:

- Section 8 specifies requirements for a MAEL Service for the OVC, OVC End Point per ENNI, OVC End Point per UNI Service Attributes

- Section 9 specifies the Management requirements for a MAEL Service,

- Appendix A contains several use cases for a MAEL Service.

- Appendix B compares SOAM terminology specified in IEEE 802.1Q [1] and ITU-T G.8013/Y.1731 [4].

For consistency with MEF 30.1 [12], this Implementation Agreement generally uses the SOAM terminology of ITU-T G.8013/Y.1731 [4], however, the terminology of IEEE 802.1Q [1] is used to specify requirements associated with Maintenance Association Identifier (MAID). Appendix B summarizes the terms from both specifications and identifies which ones are used in this Implementation Agreement.

This Implementation Agreement is based on existing MEF specifications and identifies requirements from these specifications that are mandated and recommended as well as those that are differences for a MAEL Service. Requirements from existing MEF specifications that are identified as differences for a MAEL Service are categorized into three Difference Types, as described in Table 3.

Difference Type	Description
Not used by MAEL	A requirement from an existing MEF specification that is not applicable to a MAEL Service, e.g., device requirement, requirement related to UNI-C, requirement related to the MAEL Operator's (internal) network. A requirement from an existing MEF specification that is not used for a MAEL Service in the interest of simplifying the service, e.g., UNI MEG. This includes mandatory requirements [Rx] that are not required for a MAEL Service and desirable requirements [Dx] that are not recommended for a MAEL Service.
Tightened for MAEL	A MAEL Service requirement that differs from an existing requirement and meeting the MAEL Service requirement meets the existing requirement. This includes an existing desirable requirement [Dx] that is mandated [Rx] for a MAEL Service.
Replacement	A MAEL Service requirement that replaces an existing requirement.

Table 3 – Requirement Difference Types

8   Service Definition for a MAEL Service

MEF 51 [15] specifies Access E-Line Service requirements for OVC Service Attributes, OVC End Point per ENNI Service Attributes, and OVC End Point per UNI Service Attributes. This section identifies requirements for Access E-Line Service from MEF 51 [15] that are mandated and recommended for a MAEL Service. It also identifies differences to Access E-Line Service requirements specified in MEF 51 [15]. New requirements for a MAEL Service are also identified.

While MEF 26.1 [10] provides the foundation for the Service Attribute definitions for Access E-Line Service as specified in MEF 51 [15], a MAEL Service includes additional requirements for some OVC Service Attributes and OVC End Point Service Attributes specified in MEF 26.2 [11].

It should be noted that when the term 'support' is used in a normative context in this document, it means that the MAEL Operator is capable of enabling the functionality upon agreement between the SP/SO and the MAEL Operator.

MEF 51 [15] requirements that are different for a MAEL Service are listed with a brief explanation in Table 4.

MEF 51 [15] Difference	Difference Type	Explanation
[R1]	Replacement	Replaced by [R1] in this document.
[R2], [R3]	Replacement	Replaced by General SOAM and SOAM FM requirements listed in Section 9.1.
[D1]	Tightened for MAEL	PM-1, as specified in MEF 35.1 [13], is mandatory for a MAEL Service. SOAM PM requirements for a MAEL Service are listed in Section 9.2 of this document.

Table 4 – MAEL Requirements Differences to MEF 51 [15]

New common requirements for a MAEL Service are listed below.

[R1]   For a Service Attribute referenced in this document that is specified in MEF 26.1 [10], the MAEL Operator CEN **MUST** meet the mandatory requirements in MEF 26.1 [10] that apply to the Service Attribute unless modified by this document.

[R2]   For a Service Attribute referenced in this document that is specified in MEF 26.2 [11], the MAEL Operator CEN **MUST** meet the mandatory requirements in MEF 26.2 [11] that apply to the Service Attribute unless modified by this document.

8.1   OVC Service Attributes

This section specifies OVC Service Attribute requirements for a MAEL Service. These requirements are generally based on the OVC Service Attributes for Access E-Line Service in MEF 51 [15]. In addition, some requirements for a MAEL Service are based on OVC Service Attributes from MEF 26.2 [11].

While a MAEL Service is derived from Access E-Line Service, as specified in MEF 51 [15], some OVC Service Attributes and associated requirements for Access E-Line Service in MEF 51 [15] are not used by a MAEL Service. These Service Attributes and associated requirements are listed in Table 5.

MEF 51 [15] OVC Service Attribute Not Used	MEF 51 [15] Service Attribute Requirement	Explanation
Color Forwarding	[D2]	Replaced by OVC End Point Egress Map Service Attribute, from MEF 26.2 [11], as specified in Section 8.2 of this document.
OVC MTU Size		Replaced by OVC Maximum Frame Size Service Attribute, from MEF 26.2 [11].

Table 5 – MEF 51 [15] OVC Service Attributes Not Used by a MAEL Service

OVC Service Attributes from MEF 26.2 [11] that are used by a MAEL Service are listed in Table 6.

MEF 26.2 [11] OVC Service Attribute Used	Explanation
OVC CE-VLAN DEI Preservation Service Attribute	Required to specify MAEL Service requirements but not included in MEF 51 [15].
OVC List of Class of Service Names Service Attribute	Required to specify MAEL Service requirements but not included in MEF 51 [15].

MEF 26.2 [11] OVC Service Attribute Used	Explanation
OVC Maximum Frame Size Service Attribute	Replaces OVC MTU Size Service Attribute in MEF 51 [15]. Used in [R57] in Section 9.2 of this document.

Table 6 – MEF 26.2 [11] OVC Service Attributes Used by a MAEL Service

[R3] A MAEL Service **MUST** meet the mandatory requirements in MEF 51 [15] that are listed in Table 7.

Mandatory OVC Service Attribute Requirements in MEF 51 [15] that are Applicable to a MAEL Service
[R5], [R18], [R19], [R20], [R21], [R22], [R26], [R27], [R28]

Table 7 – Mandatory MEF 51 [15] OVC Service Attribute Requirements for a MAEL Service

[D1] A MAEL Service **SHOULD** meet the recommended requirements in MEF 51 [15] that are listed in Table 8.

Recommended OVC Service Attribute Requirements in MEF 51 [15] that are Recommended for a MAEL Service
[D3], [D4], [D14]

Table 8 – Recommended MEF 51 [15] OVC Service Attribute Requirements for a MAEL Service

MEF 51 [15] requirements that are different for a MAEL Service are listed with a brief explanation in Table 9.

MEF 51 [15] Difference	Difference Type	Explanation
[R4], [D5]	Replacement	Replaced by [R4] in this document.
[R29]	Tightened for MAEL	Replaced by [R5] in this document.
[R30]	Tightened for MAEL	Replaced by [R6] in this document.
[D19]	Not used by MAEL	Service simplification. See [R5] in this document.
[D20]	Not used by MAEL	Service simplification. See [R6] in this document.

Table 9 – MAEL OVC Service Attribute Differences to MEF 51 [15]

New OVC Service Attribute requirements for a MAEL Service are listed below.

[R4] For a MAEL Service, the MAEL Operator **MUST** support a value of *5 or less* for the OVC Available MEG Level Service Attribute.

[R5] For a MAEL Service, the value of the CE-VLAN ID Preservation Service Attribute **MUST** be *Yes*.

[R6] For a MAEL Service, the value of the CE-VLAN CoS Preservation Service Attribute **MUST** be *Yes*.

[R7] For a MAEL Service, the value of the CE-VLAN DEI Preservation Service Attribute as defined in MEF 26.2 [11] **MUST** be *Enabled*.

[R8] For a MAEL Service, OVC Frame Transparency, as specified in MEF 26.2 [11] [R74], **MUST** be met.

[R9] For a MAEL Service, the value of the OVC List of Class of Service Names Service Attribute, as defined in MEF 26.2 [11], **MUST** contain exactly one Class of Service Name.

[R10] For a MAEL Service, the value of the OVC List of Class of Service Names Service Attribute, as defined in MEF 26.2 [11], **MUST NOT** include *Discard*.

8.2   OVC End Point per ENNI Service Attributes

This section specifies OVC End Point per ENNI Service Attribute requirements for a MAEL Service. These requirements are generally based on the OVC End Point per ENNI Service Attributes for Access E-Line Service in MEF 51 [15]. In addition, some requirements for a MAEL Service are based on OVC End Point Service Attributes from MEF 26.2 [11].

While a MAEL Service is derived from Access E-Line Service, as specified in MEF 51 [15], some OVC End Point per ENNI Service Attributes and associated requirements for Access E-Line Service in MEF 51 [15] are not used by a MAEL Service. These Service Attributes and associated requirements are listed in Table 10.

MEF 51 [15] OVC End Point per ENNI Service Attribute Not Used	MEF 51 [15] Service Attribute Requirement	Explanation
Ingress Bandwidth Profile per Class of Service Identifier	[R8], [D6]	Service Attribute in MEF 51 [15] is replaced for a MAEL Service by Ingress Bandwidth Profile per Class of Service Name Service Attribute from MEF 26.2 [11].
Maintenance End Point (MEP) List	[D8], [CR1], [CD1]	Condition does not apply to a MAEL Service since there are no OVC End Points at one or more other ENNIs.
Maintenance End Point (MEP) List	[D9], [CR2], [CD2], [CD3]	A MAEL Service does not include MEPs at OVC End Point per ENNI in the interest of service simplification.

Table 10 – MEF 51 [15] OVC End Point per ENNI Service Attributes Not Used by a MAEL Service

The External Network Network Interface (ENNI) Service Attributes that are specified for Access E-Line Service in MEF 51 [15] are not used by a MAEL Service. These Service Attributes and associated requirements are listed in Table 11.

MEF 51 [15] ENNI Service Attribute Not Used	MEF 51 [15] Service Attribute Requirement	Explanation
End Point Map	[R14]	Service Attribute in MEF 51 [15] is replaced for a MAEL Service by OVC End Point Map Service Attribute from MEF 26.2 [11].
Color Identifier Mode for OVC Services	[R15], [R16], [R17]	A MAEL Service is Color Blind, as specified in [R17] of this document, in the interest of service simplification.

Table 11 – MEF 51 [15] ENNI Service Attributes Not Used by a MAEL Service

OVC End Point Service Attributes from MEF 26.2 [11] that are used by a MAEL Service at an ENNI are listed in Table 12.

MEF 26.2 [11] OVC End Point Service Attribute Used	Explanation
OVC End Point Map Service Attribute	Replaces End Point Map (an ENNI Service Attribute) in MEF 51 [15].
OVC End Point Egress Map Service Attribute	Replaces Color Forwarding (an OVC Service Attribute) in MEF 51 [15]. Specifies OVC End Point Egress Map Form to be used for a MAEL Service.
Ingress Bandwidth Profile per Class of Service Name Service Attribute	Replaces Ingress Bandwidth Profile per Class of Service Identifier Service Attribute specified in MEF 51 [15]. Enables use of a Bandwidth Profile Flow Parameter for Token Request Offset.

Table 12 – MEF 26.2 [11] OVC End Point Service Attributes Used by a MAEL Service at an ENNI

[R11] A MAEL Service **MUST** meet the mandatory requirements in MEF 51 [15] that are listed in Table 13.

Mandatory OVC End Point per ENNI Service Attribute Requirements in MEF 51 [15] that are Applicable to a MAEL Service
[R6], [R7], [R9]

Table 13 – Mandatory MEF 51 [15] OVC End Point per ENNI Service Attribute Requirements for a MAEL Service

MEF 51 [15] requirements that are different for a MAEL Service are listed with a brief explanation in Table 14.

MEF 51 [15] Difference	Difference Type	Explanation
[D10]	Tightened for MAEL	Replaced by [R33] in Section 9.1 of this document.
[CR3]	Replacement	Replaced by [R34] in Section 9.1 of this document.

Table 14 – MAEL OVC End Point per ENNI Service Attribute Differences to MEF 51 [15]

New OVC End Point per ENNI Service Attribute requirements for a MAEL Service are listed below.

[R12] For a MAEL Service, Form E, as defined in MEF 26.2 [14], **MUST** be used for the OVC End Point Map Service Attribute at the ENNI.

[R13] For a MAEL Service, Service, the OVC End Point Map Service Attribute value, as defined in MEF 26.2 [11], at the ENNI **MUST** contain a single S-VLAN ID.

[R14] For a MAEL Service, the Class of Service Identifiers Service Attribute for the OVC End Point at the ENNI **MUST** map all S-Tag PCP values to a single Class of Service Name.

[R15] For a MAEL Service, for the OVC End Point at the ENNI, there **MUST** be an Ingress Bandwidth Profile with a Bandwidth Profile Flow based on Criterion 2 of [R230] in MEF 26.2 [11].

[R16] For a MAEL Service, the Ingress Bandwidth Profile Flow, as specified in MEF 26.2 [11], for the OVC End Point at the ENNI **MUST** be mapped to an Envelope that contains no other Bandwidth Profile Flows.

[R17] For a MAEL Service, the Ingress Bandwidth Profile, as specified in Section 16.10 of MEF 26.2 [11], for the OVC End Point at the ENNI **MUST** include the following parameter values: $CM^1 = $ *color-blind,* $CF^1 = 0$, $EIR^1 = 0$, $EIR^1_{max} = 0$, $EBS^1 = 0$.

Since there is an Ingress Bandwidth Profile as specified in [R15] and the Color Mode is Color Blind as specified in [R17] of this document, PCP and DEI values in the ingress ENNI frames are not used by the MAEL Operator CEN to identify color.

Since Color Blind is mandated for a MAEL Service to simplify ordering and provisioning, the SP/SO needs to shape traffic accordingly.

[R18] For a MAEL Service, for the OVC End Point at the ENNI, the following equality regarding values of the Bandwidth Profile Flow parameters **MUST** hold:

- $CIR^1_{max} = CIR^1$

[R19] For a MAEL Service, for the OVC End Point at the ENNI, the value of Token Request Offset bandwidth profile parameter per MEF 26.2 [11], F^1 **MUST** be 4.

The value of *4* is required to account for the 4-byte overhead associated with the S-Tag. See Appendix G of MEF 26.2 [11] for more information.

[R20] For a MAEL Service, for the OVC End Point at the ENNI, the value of the Egress Bandwidth Profile per Class of Service Identifier Service Attribute **MUST** be *No*.

[R21] For a MAEL Service, [R201] of MEF 26.2 [11] **MUST** be met when the OVC End Point is at an ENNI.

[R201] of MEF 26.2 [11] refers to Table 41 of that document. This table specifies the forms of OVC End Point Egress Map to be used under various conditions, including the OVC End Point Color Identifier *F* Value of the OVC End Point in the receiving CEN at the ENNI. In the case of a MAEL Service, this table simplifies to Table 15 shown below.

OVC End Point Color Identifier *F* Value in the Receiving CEN	OVC End Point Egress Map Form
S-Tag DEI	*CN→S-Tag PCP* and *CC→S-Tag DEI*
S-Tag PCP	*CC→S-Tag PCP*
Other	*CN→S-Tag PCP*

Table 15 – OVC End Point Egress Map Form Usage for an OVC End Point at an ENNI

The OVC End Point Egress Map can specify any S-Tag PCP value that is agreed to between the MAEL Operator and the SP/SO. Setting DEI to 0 for every egress ENNI frame is always valid regardless of how the receiving Operator specifies Color.

8.3 OVC End Point per UNI Service Attributes

This section specifies OVC End Point per UNI Service Attribute requirements for a MAEL Service. These requirements are generally based on the OVC End Point per UNI Service Attributes for Access E-Line Service in MEF 51 [15]. In addition, some requirements for a MAEL Service are based on OVC End Point Service Attributes and Operator UNI Service Attributes from MEF 26.2 [11].

While a MAEL Service is derived from Access E-Line Service, as specified in MEF 51 [15], some OVC End Point per UNI Service Attributes and associated requirements for Access E-Line Service in MEF 51 [15] are not used by a MAEL Service. These Service Attributes and associated requirements are listed in Table 16.

MEF 51 [15] OVC End Point per UNI Service Attribute Not Used	MEF 51 [15] Service Attribute Requirement	Explanation

MEF 51 [15] OVC End Point per UNI Service Attribute Not Used	MEF 51 [15] Service Attribute Requirement	Explanation
Ingress Bandwidth Profile per Class of Service Identifier	[R12], [D11]	Service Attribute in MEF 51 [15] is replaced for a MAEL Service by Ingress Bandwidth Profile per Class of Service Name Service Attribute from MEF 26.2 [11].

Table 16 – MEF 51 [15] OVC End Point per UNI Service Attributes Not Used by a MAEL Service

OVC End Point Service Attributes from MEF 26.2 [10] that are used by a MAEL Service at a UNI are listed in Table 17.

MEF 26.2 [11] OVC End Point Service Attribute Used	Explanation
Ingress Bandwidth Profile per Class of Service Name Service Attribute	Replaces Ingress Bandwidth Profile per Class of Service Identifier Service Attribute specified in MEF 51[15]. Uses similar Service Attribute as is used at OVC End Point per ENNI.

Table 17 – MEF 26.2 [11] OVC End Point Service Attributes Used by a MAEL Service at a UNI

Operator UNI Service Attributes from MEF 26.2 [11] that are used by a MAEL Service at a UNI are listed in Table 18.

MEF 26.2 [11] Operator UNI Service Attribute Used	Explanation
Operator UNI Default CE-VLAN ID Service Attribute	Used to specify OVC End Point Map requirement in [R23].

Table 18 – MEF 26.2 [11] Operator UNI Service Attributes Used by a MAEL Service at a UNI

[R22] A MAEL Service **MUST** meet the mandatory requirements in MEF 51 [15] that are listed in Table 19.

Mandatory OVC End Point per UNI Service Attribute Requirements in MEF 51 [15] that are Applicable to a MAEL Service
[R10], [R11], [R13], [R31], [R32]

Table 19 – Mandatory MEF 51 [15] OVC End Point per UNI Service Attribute Requirements for a MAEL Service

For the OVC End Point Map Service Attribute, [R22] of this document specifies that [R31] from MEF 51 [15] is required for a MAEL Service. As a result, a MAEL Operator needs to support mapping of one CE-VLAN ID to the OVC End Point at the UNI. [R22] of this document also specifies that [R32] from MEF 51 [15] is required for a MAEL Service. As a result, a MAEL Operator also needs to support mapping of all CE-VLAN IDs to the OVC End Point.

[D2] A MAEL Service **SHOULD** meet the recommended requirements in MEF 51 [15] that are listed in Table 20.

Recommended OVC End Point per UNI Service Attribute Requirements in MEF 51 [15] that are Recommended for a MAEL Service
[D21]

Table 20 – Recommended MEF 51 [15] OVC End Point per UNI Service Attribute Requirements for a MAEL Service

For the OVC End Point Map Service Attribute, [D2] of this document specifies that [D21] from MEF 51 [15] is recommended for a MAEL Service. As a result, it is recommended that a MAEL Operator supports mapping of more than one (but not all) CE-VLAN IDs to the OVC End Point at the UNI. (This recommendation is in addition to a MAEL Operator needing to support mapping of one CE-VLAN ID and all CE-VLAN IDs to the OVC End Point at the UNI.)

MEF 51 [15] requirements that are different for a MAEL Service are listed with a brief explanation in Table 21.

MEF 51 [15] Difference	Difference Type	Explanation
[D12]	Replacement	Replaced by [R31] in Section 9.1 of this document.
[CR4], [CD4]	Tightened for MAEL	Replaced by [R32] and [D3] in Section 9.1 of this document.
[D13]	Tightened for MAEL	Replaced by [D4] in Section 9.1 of this document.

MEF 51 [15] Difference	Difference Type	Explanation
[CD5]	Tightened for MAEL	Replaced by [CR2]< [D4] in Section 9.1 of this document.

Table 21 – MAEL OVC End Point per UNI Service Attribute Differences to MEF 51 [15]

New OVC End Point per UNI Service Attribute requirements for a MAEL Service are listed below.

> **[R23]** For a MAEL Service, the OVC End Point Map at the UNI **MUST NOT** contain the Operator UNI Default CE-VLAN ID, as specified in MEF 26.2 [11], unless the OVC End Point Map at the UNI contains all CE-VLAN IDs.

The purpose of [R23] is to simplify the MAEL Service by avoiding the complexities associated with the Default CE-VLAN ID. The consequence is that untagged frames at a UNI cannot be mapped to a MAEL Service unless all CE-VLAN IDs at the UNI are mapped to the MAEL Service.

> **[CR1]**<[D2] When mapping more than one (but not all) CE-VLAN IDs to the OVC End Point at the UNI, the MAEL Operator **MUST** support mapping of at least four CE-VLAN IDs.

> **[R24]** For a MAEL Service, the Class of Service Identifiers Service Attribute at the OVC End Point at a UNI **MUST** be based on OVC End Point.

With a MAEL Service, the OVC End Point at the UNI is mapped to a single Class of Service Name.

> **[R25]** For a MAEL Service, for the OVC End Point at the UNI, there **MUST** be an Ingress Bandwidth Profile with a Bandwidth Profile Flow based on Criterion 2 of [R230] in MEF 26.2 [11].

> **[R26]** For a MAEL Service, the Ingress Bandwidth Profile Flow, as specified in MEF 26.2 [11], for the OVC End Point at the UNI **MUST** be mapped to an Envelope that contains no other Bandwidth Profile Flows.

> **[R27]** For a MAEL Service, the Ingress Bandwidth Profile, as specified in Section 7.6.1 of MEF 26.2 [11], for the OVC End Point at the UNI **MUST** include the following parameter values: $CM^1 = color\text{-}blind$, $CF^1 = 0$, $EIR^1 = 0$, $EIR^1_{max} = 0$, $EBS^1 = 0$.

> **[R28]** For a MAEL Service, for the OVC End Point at the UNI, the following equality regarding values of the Bandwidth Profile Flow parameters **MUST** hold:
>
> - $CIR^1_{max} = CIR^1$

[R29] For a MAEL Service, for the OVC End Point at the UNI, the value of Token Request Offset bandwidth profile parameter per MEF 26.2 [11], F^1 **MUST** be 0.

A non-zero value for the Token Request Offset could be used by the receiving CEN at the ENNI.

[R30] For a MAEL Service, for the OVC End Point at the UNI, the value of the Egress Bandwidth Profile per Class of Service Identifier Service Attribute **MUST** be *No*.

9 Management Requirements for a MAEL Service

A MAEL Service is intended to provide SOAM FM, SOAM PM and Latching Loopback capabilities in the MAEL Operator's network, similar to those achieved by deploying a SP/SO Network Interface Device (NID).

This section specifies the management requirements for a MAEL Service.

9.1 General SOAM and SOAM Fault Management

A MAEL Service provides SOAM capabilities at the OVC End Point at the UNI and at the OVC End Point at the ENNI. An example of SOAM FM for a MAEL Service is shown in Figure 2.
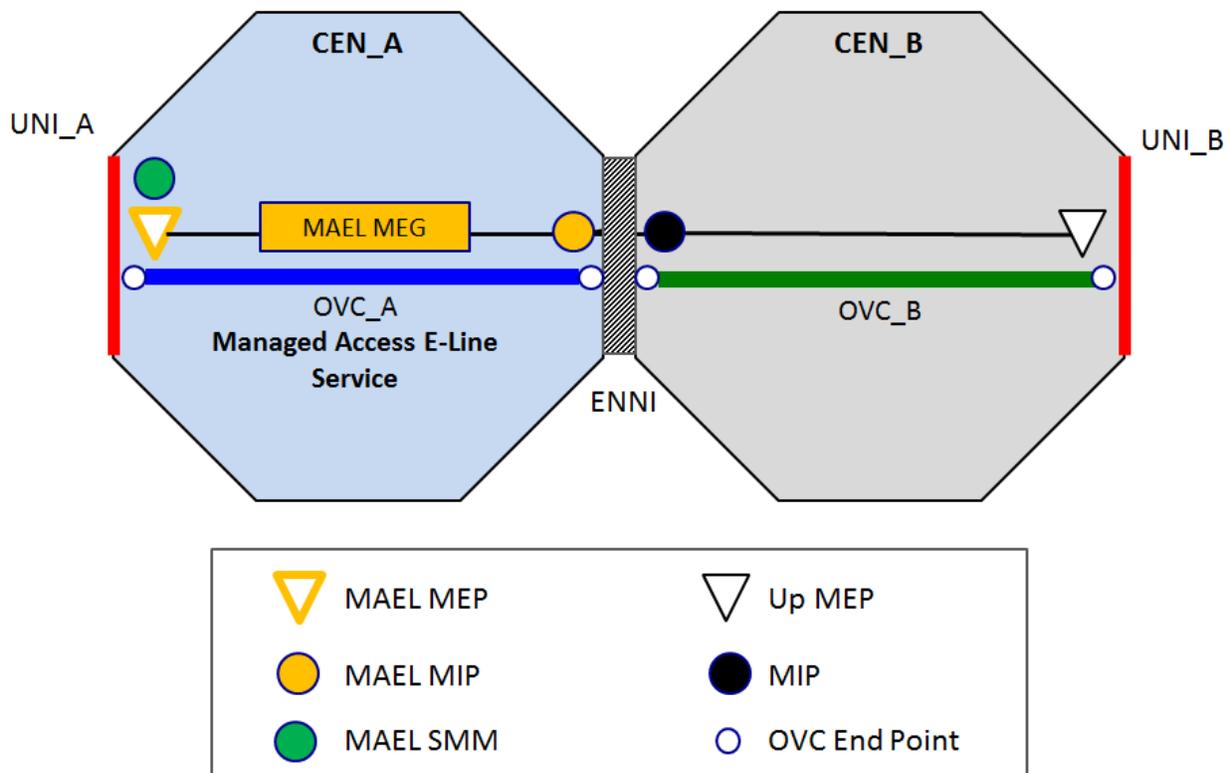
Figure 2 – MAEL Service – SOAM FM Example

In this figure, the MAEL Service shown in CEN_A uses OVC_A to connect the UNI_A to the ENNI. OVC_A and OVC_B (shown in CEN_B) create the EVC. CEN_B is shown in the above figure as an example, however, actual architectures may be more complex and include additional CENs. Some highlights of the general SOAM and SOAM FM capabilities included with a MAEL Service are summarized below.

- An Up MEP is provided at the OVC End Point at the UNI for use by the SP/SO. This is referred to as the *MAEL MEP* throughout this document. SOAM FM functionality

supported by the MAEL MEP includes CCM with a transmission period of 10 seconds, Interface Status TLV, and RDI. The MAEL MEP also responds to LBM and LTM.

- A MIP is provided at the OVC End Point at the ENNI for use by the SP/SO. This is referred to as the *MAEL MIP* throughout this document. The MAEL MIP is configured at the same MEG Level as the MAEL MEP and responds to LBM and LTM.

- A Subscriber MEG MIP can be provided at the OVC End Point at the UNI for use by the Subscriber. This is referred to as the *MAEL SMM* throughout this document. The MAEL SMM responds to LBM and LTM.

In order for a MAEL Service to provide management capabilities similar to those achieved by deploying a SP/SO NID, it is desirable for the MAEL MEP and MAEL SMM to be located as close to the UNI as possible.

In this document, *MAEL MEG* is defined as the MEG associated with the *MAEL MEP*. The scope of the MAEL MEG extends beyond the MAEL Operator CEN and is used by the SP/SO for service management. The SP/SO can use the MAEL MEG as any type of MEG provided that the requirements for that type of MEG's MEPs and MIPs do not contradict the requirements for MEPs and MIPs in an EVC or SP MEG. For example, the SP/SO can use the MAEL MEG as an EVC MEG or SP MEG, depending on SP/SO's services and required management scope. In some cases, a Super Operator may want to use the MAEL MEG as an Operator MEG to monitor an OVC that includes the MAEL Service as a constituent part of the Super Operator's OVC.

General SOAM and SOAM FM requirements for a MAEL Service are listed below.

> **[R31]** For a MAEL Service, exactly one MAEL MEP **MUST** be enabled.

> **[R32]** For a MAEL Service, the MAEL Operator **MUST** support a MAEL MEG Level value of *5*.

[R32] mandates that the MAEL Operator supports a standardized MEG Level that all SP/SO's can rely on MAEL Operators to provide. Support of MEG Level 5 is mandated to allow MAEL Operators to use lower MEG Levels for internal purposes.

> **[D3]** For a MAEL Service, the MAEL Operator **SHOULD** support a MAEL MEG Level value of *3* and *4*.

[D3] recommends that the MAEL Operator supports additional MEG Level values to allow the SP/SOs to use MEG Level values specified in MEF 30.1 [12] as default values for Service Provider use.

> **[D4]** For a MAEL Service, the Subscriber MEG MIP Service Attribute value **SHOULD** be *Enabled*.

[D4] means that a MAEL SMM is recommended at the OVC End Point at the UNI.

MEF 51 [15], Section 8.3.2, indicates that the Subscriber MEG MIP Service Attribute value only applies in cases when the OVC supports a single EVC. The number of EVCs supported by the MAEL OVC is not known by the MAEL Operator. Therefore, the SP/SO needs to be aware that Subscriber MEG MIP may not be viable and need not be used for a MAEL Service in some cases. For cases where the MAEL OVC supports more than a single EVC, a solution is to have a VUNI outside of the MAEL Operator's network provide the Subscriber MEG MIP for each EVC. This solution is outside the scope of a MAEL Service. The use cases in Appendix A briefly describe the applicability of a MAEL SMM based on various factors, e.g., whether or not all CE-VLAN IDs are mapped to the MAEL Service, and what type of end-to-end service that the MAEL Service is supporting.

> **[CR2]<**[D4] The MEG Level value for MAEL SMM **MUST** be *6*.

A single MEG Level value is specified for the MAEL SMM for service simplification. The value of 6 was selected since support of the MEG Level value of 5 is mandated for the MAEL MEG and the MEG Level value of 7 is left for providing SOAM transparency to the Subscriber.

> **[R33]** For a MAEL Service, the value of the MIP at OVC End Point per ENNI Service Attribute (specified in Section 8.2.2, MEF 51 [15]) **MUST** be *Enabled*.

[R33] means that a MAEL MIP is required at the OVC End Point at the ENNI.

> **[R34]** For a MAEL Service, the MEG Level value for the MAEL MIP **MUST** be the MAEL MEG Level.

> **[R35]** The MAEL MEP **MUST** support at least one peer MEP.

Since use of CCM is required of a MAEL MEP, the MAEL MEP needs to support at least one peer MEP. It is expected that the most common use cases will require a MAEL MEP to support only a single peer MEP, e.g., point-to-point services, access to IP services.

> **[D5]** The MAEL MEP **SHOULD** support at least 10 peer MEPs.

It is expected that the SP/SO will add/delete/change the peer MEPs of the MAEL MEP, however, the means to do so is outside the scope of this document.

> **[R36]** The rate at which the MAEL MEP can receive an LBM **MUST** be at least one PDU per second.

> **[R37]** The rate at which the MAEL MEP can transmit an LBR **MUST** be at least one PDU per second.

> **[R38]** The MAEL MEP **MUST** provide a processing capacity of at least *(20.1 x Number of Peer MEPs + 22)* PDUs per second for the aggregate of SOAM FM, SOAM PM and Latching Loopback Control Message PDUs.

The MAEL MEP processing requirement for responding to SOAM PDUs includes Proactive monitoring, as specified in MEF 35.1 [13], and On-Demand monitoring, as specified in MEF 35.1 [13].

To calculate the MAEL MEP processing requirement in [R38], the following symbols are defined.

Symbol	Definition	Value	Source
MMPR	MAEL MEP Processing Requirement (fps)	Calculated	
NUM_PMEP	Number of Peer MEPs per MAEL MEP	Input	
DMM_P	Proactive DMM Session frame rate (fps)	10	All Peer MEPs (functioning as PM-1 Controllers)
SLM_P	Proactive SLM Session frame rate (fps)	10	All Peer MEPs (functioning as PM-1 Controllers)
CCM	CCM frame rate (fps)	0.1	All Peer MEPs
DMM_O	On-Demand DMM Session frame rate (fps)	10	Single Peer MEP (functioning as PM-1 Controller)
SLM_O	On-Demand SLM Session frame rate (fps)	10	Single Peer MEP (functioning as PM-1 Controller)
LBMLTM	LBM/LTM frame rate (fps)	1	Single Peer MEP
LLM	Latching Loopback Message frame rate (fps)	1	Single Peer MEP (functioning as Latching Loopback Controller)

Table 22 – Symbols for Calculating MAEL MEP Processing Requirement

MMPR is dependent on the number of Peer MEPs associated with a MAEL MEP and is calculated using the following formula.

$$MMPR = NUM\_PMEP \times (DMM\_P + SLM\_P + CCM) + DMM\_O + SLM\_O + LBMLTM + LLM$$

$$MMPR = NUM\_PMEP \times (10 + 10 + 0.1) + 10 + 10 + 1 + 1$$

$$MMPR = 20.1 \times NUM\_PMEP + 22$$

For example, using the formula in [R38], if a MAEL MEP has only a single Peer MEP, the MAEL MEP needs to provide a PDU processing capacity of at least 42.1 fps. If a MAEL MEP has ten Peer MEPs, the MAEL MEP needs to provide a PDU processing capacity of at least 223 fps.

Separate MAEL MEP requirements for SOAM PM processing capacity are included in Section 9.2. MAEL MEP processing requirements for DMM and SLM are provided in [R60] and [R62], respectively.

[R39] The rate at which the MAEL MIP can receive an LBM **MUST** be at least one PDU per second.

[R40] The rate at which the MAEL MIP can transmit an LBR **MUST** be at least one PDU per second.

[D6] The MAEL MIP **SHOULD** support processing of at least 10 SOAM FM PDUs per second.

[D6] is based on the expectation that MIPs are used for SOAM less often than MEPs are used.

[CR3]<[D4] The rate at which the MAEL SMM can receive an LBM **MUST** be at least one PDU per second.

[CR4]<[D4] The rate at which the MAEL SMM can transmit an LBR **MUST** be at least one PDU per second.

[CD1]<[D4] The MAEL SMM **SHOULD** support processing of at least 10 SOAM FM PDUs per second.

[CD1]< [D4] is based on the expectation that MIPs are used for SOAM less often than MEPs are used.

[CR5]<[D4] For a MAEL Service where all CE-VLAN IDs map to the OVC End Point at the UNI, the MAEL SMM **MUST** properly respond to an ingress SOAM Service Frame that meets all of the following conditions.

- Is untagged at the UNI

- Is received at the MAEL SMM

- Is at the MEG Level of the MAEL SMM

- Is an LTM or is an LBM targeted to the MAEL SMM

[CR6]<[D4] For a MAEL Service where all CE-VLAN IDs map to the OVC End Point at the UNI, the MAEL SMM **MUST** properly respond to an ingress SOAM ENNI Frame, as defined in MEF 26.2 [11], Section 8.6.2, that meets all of the following conditions.

- Is single tagged at the ENNI

- Is received at the MAEL SMM

- Is at the MEG Level of the MAEL SMM

- Is an LTM or is an LBM targeted to the MAEL SMM

[CR5]< [D4] and [CR6]< [D4] are specified to simplify provisioning and ordering between Operator, Service Provider, Super Operator and/or Subscriber. These requirements are aligned with IEEE 802.1Q [1] and [D4] in MEF 30.1 [12]. IEEE 802.1Q [1] indicates that SOAM frames for a customer MD do not have a C-Tag when targeted for a MIP in the provider network. [D4] in MEF 30.1 recommends that SOAM frames on a Subscriber MEG monitoring an EVC to which untagged and priority-tagged Data Service Frames are mapped are not C-tagged at the UNI.

For a MAEL Service where all CE-VLAN IDs map to the OVC End Point at the UNI, the Subscriber can use SOAM transparently[2] across the MAEL Service by sending SOAM Service Frames at MEG Level 6 that are not processed by MIPs or by sending any SOAM Service Frames at MEG Level 7.

[CR7]<[D4] For a MAEL Service where not all CE-VLAN IDs map to the OVC End Point at the UNI, the MAEL SMM **MUST** properly respond to an ingress SOAM Service Frame that meets all of the following conditions.

- Is C-tagged at the UNI with a C-VID value equal to the lowest CE-VLAN ID that maps to the OVC End Point at the UNI

- Is received at the MAEL SMM

- Is at the MEG Level of the MAEL SMM

- Is an LTM or is an LBM targeted to the MAEL SMM

[CR8]< [D4] For a MAEL Service where not all CE-VLAN IDs map to the OVC End Point at the UNI, the MAEL SMM **MUST** properly respond to an ingress SOAM ENNI Frame that meets all of the following conditions.

- Is double tagged at the ENNI and with a C-VID value equal to the lowest CE-VLAN ID that maps to the OVC End Point at the UNI

- Is received at the MAEL SMM

- Is at the MEG Level of the MAEL SMM

- Is an LTM or is an LBM targeted to the MAEL SMM

[CR7]< [D4] and [CR8]< [D4] are specified to simplify provisioning and ordering between Operator, Service Provider, Super Operator and/or Subscriber. These requirements are aligned with [D5] in MEF 30.1 [12]. It should be noted that the lowest CE-VLAN ID mapped to the OVC End Point at the UNI can change if CE-VLAN IDs are added, deleted or changed in the future.

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[2]"Transparently" means a SOAM Service Frame is treated exactly the same as a Data Service Frame.

[CD2]<[D4] For a MAEL Service where not all CE-VLAN IDs map to the OVC End Point at the UNI, the MAEL SMM **SHOULD** properly respond to an ingress SOAM Service Frame that meets all of the following conditions.

- Is C-tagged at the UNI with a C-VID value equal to any CE-VLAN ID that maps to the OVC End Point at the UNI

- Is received at the MAEL SMM

- Is at the MEG Level of the MAEL SMM

- Is an LTM or is an LBM targeted to the MAEL SMM

[CD3]<[D4] For a MAEL Service where not all CE-VLAN IDs map to the OVC End Point at the UNI, the MAEL SMM **SHOULD** properly respond to an ingress SOAM ENNI Frame that meets all of the following conditions.

- Is double tagged at the ENNI and with a C-VID value equal to any CE-VLAN ID that maps to the OVC End Point at the UNI

- Is received at the MAEL SMM

- Is at the MEG Level of the MAEL SMM

- Is an LTM or is an LBM targeted to the MAEL SMM

For a MAEL Service where not all CE-VLAN IDs map to the OVC End Point at the UNI, the Subscriber can use SOAM transparently[3] across the MAEL Service by sending SOAM Service Frames at MEG Level 6 that are not processed by MIPs and are C-tagged with any C-VID included in the OVC End Point map or by sending any SOAM Service frames at MEG Level 7 that are C-tagged with any C-VID included in the OVC End Point map.

[R41] A SOAM frame targeted to the MAEL MEP or MAEL MIP **MUST** be single tagged at the ENNI.

Since there is no VUNI in the MAEL Operator's network, the VLAN ID in the S-Tag identifies the OVC. MEF 26.2 [11], Table 3 (ENNI Common Attributes) includes the ENNI Frame Format Service Attribute.

[R41] is applicable when mapping all or not all CE-VLAN IDs to the OVC End Point at the UNI. As described in Appendix B of MEF 30.1 [12], SOAM frames need to be single tagged in order for the MAEL MIP to process and respond to LTM messages and to LBM messages targeted for the MAEL MIP.

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[3] "Transparently" means a SOAM Service Frame is treated exactly the same as a Data Service Frame.

[R42] For the MAEL MEG, the Maintenance Domain Name Format field of the MAID[4] **MUST** have a value of 1 (Null), as defined in Table 21-19 of IEEE 802.1Q [1].

[R42] aligns with [D25] in MEF 30.1 [12] and is mandated to simplify the MAEL Service.

[R43] For the MAEL MEG, the Short MA Name Format field of the MAID **MUST** have a value of *2* or *32*.

A Short MA Name Format Field value of *2* indicates a Character String format, as specified in Table 21-20 of IEEE 802.1Q [1]. A value of *32* indicates an ITU Carrier Code (ICC) based MEG ID format, as specified in Table A.1 of ITU-T G.8013/Y.1731 [4].

[D7] For the MAEL MEG, the Short MA Name Format field of the MAID **SHOULD** have a value of *2*.

[D7] aligns with [D27] in MEF 30.1 [12]. Character String format is recommended to simplify the MAEL Service and improve interoperability.

[R44] CCM transmissions **MUST** be enabled on the MAEL MEP.

[R45] The MAEL MEP **MUST** support the CCM messages and processes for a MEP, as defined in IEEE 802.1Q [1].

[R46] The MAEL MEP **MUST** use a CCM PDU transmission period of 10 seconds.

The intended use of CCM is mainly for discovery and low intensity connectivity monitoring. Since a MAEL Service includes SOAM PM, SLM can be used by the SP/SO to monitor service availability and frame loss at a higher frequency.

[R47] The MAEL MEP **MUST** include Interface Status TLV in CCM PDUs.

The intent of [R47] is to reflect the interface status of the UNI link in CCM PDUs generated by the MAEL MEP.

[R48] The MAEL MEP **MUST** have the parameter, lowestAlarmPri, as specified in IEEE 802.1Q [1], Section 20.9.5, set to *3*.

[R48] means that the MAEL MEP sets the RDI bit in transmitted CCM messages when a defect of Priority 3 (Remote MEP CCM defect) or above, as specified in IEEE 802.1Q [1], Section 20.1.2, is detected.

The Remote MEP CCM defect level has been chosen as this is the lowest defect level that provides new information to other MEPs in most cases. The lower priority levels (MAC Status

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[4] For consistency with MEF 30.1 [12], Maintenance Domain and Maintenance Association terminology is used in this specification for some requirements that reference IEEE 802.1Q [1]. Equivalent terms based on Maintenance Entity Groups, as specified in ITU-T G.8013/Y.1731 [4], are provided in Appendix B.

and RDI) only signify reception of information from other MEPs, and thus information that other MEPs already have.

> **[R49]** The MAEL MEP **MUST** support Loopback functions for a MEP as defined in IEEE 802.1Q [1].

> **[R50]** The MAEL MIP **MUST** support Loopback functions for a MIP as defined in IEEE 802.1Q [1].

> **[CR9]<**[D4] The MAEL SMM **MUST** support Loopback functions for a MIP as defined in IEEE 802.1Q [1].

An LBR from the MAEL SMM could be in response to an LBM sent from the Customer Equipment at the UNI, or it could be in response to an LBM sent across the ENNI from a remote MEP.

> **[R51]** The MAEL MEP **MUST** process and respond to both Unicast and Multicast LBM frames.

> **[R52]** The MAEL MEP **MUST** support Linktrace functions for a MEP as defined in IEEE 802.1Q [1].

> **[R53]** The MAEL MIP **MUST** support Linktrace functions for a MIP as defined in IEEE 802.1Q [1].

> **[CR10]<**[D4] The MAEL SMM **MUST** support Linktrace functions for a MIP as defined in IEEE 802.1Q [1].

An LTR from the MAEL SMM could be in response to an LTM sent from the Customer Equipment at the UNI, or it could be in response to an LTM sent across the ENNI from a remote MEP.

9.2   SOAM Performance Management

A MAEL Service enables the SP/SO to perform performance monitoring by utilizing SOAM PM functions in the MAEL Operator's network. A MAEL Service supports the PM-1 Solution, as specified in MEF 35.1 [13]. For a MAEL Service, the MAEL MEP is the Responder MEP. The Controller MEPs reside outside of the MAEL Operator's network. An example of SOAM PM for a MAEL Service is shown in Figure 3.
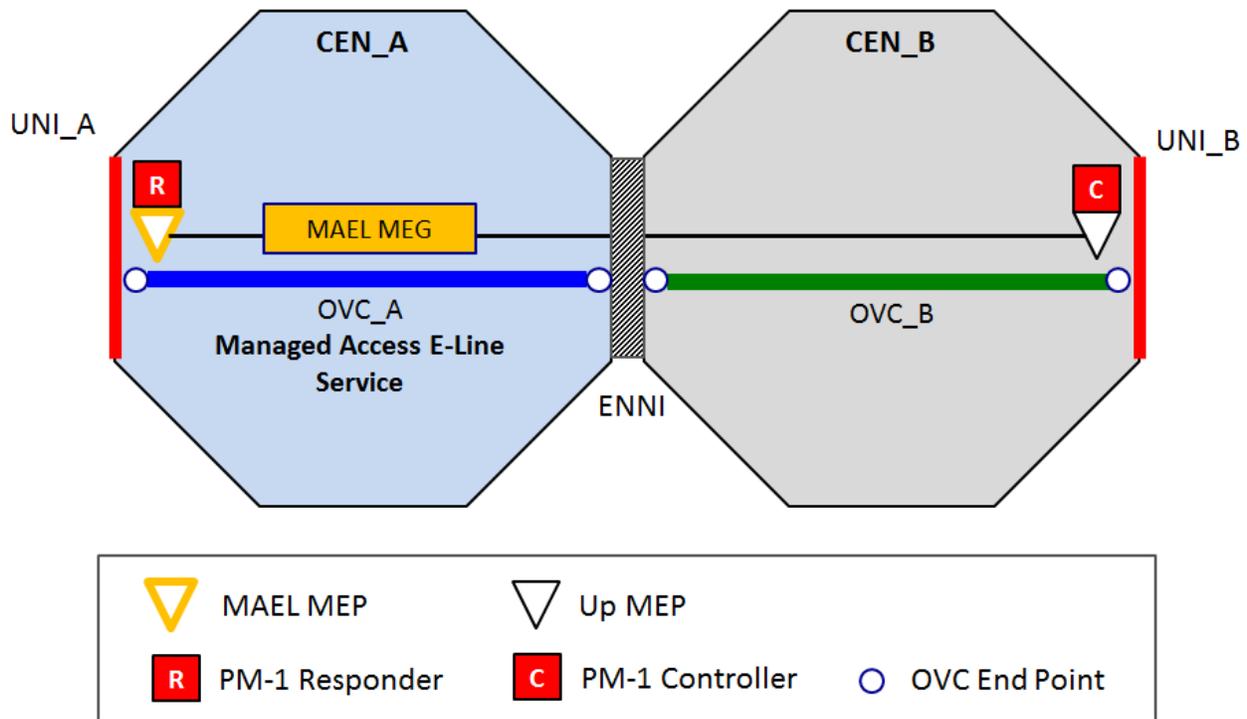
Figure 3 – MAEL Service – SOAM PM Example

CEN_B is shown in the above figure as an example, however, actual architectures may be more complex and include additional CENs. Both the Single-Ended Delay and the Single-Ended Synthetic Loss functions can be configured per pair of MEPs. The functions support both point-to-point and multipoint configurations. Since a MAEL Service supports only a single Class of Service Name per OVC, each unique pair of MEPs being measured results in one distinct PM Session.

SOAM Performance Monitoring requirements for a MAEL Service are listed below.

    [R54] The MAEL MEP **MUST** function as a Responder MEP for Single Ended Measurements, as specified in MEF 35.1 [13] (PM-1).

The above requirement means that the MAEL MEP will send SLR in response to SLM and DMR in response to DMM.

    [R55] SOAM PM response frames from the MAEL MEP **MUST NOT** be affected by the ingress bandwidth profile at the UNI-N.

    [R56] The MAEL MEP **MUST** generate and send the timestamp of DMM reception (RxTimeStampf), and the timestamp of DMR transmission (TxTimeStampb) in the DMR frame.

[R57] The MAEL MEP **MUST** support processing and responding to ingress SOAM ENNI Frames carrying SLM and DMM, of any length, up to a length such that the total length of the frame is equal to the value specified for the OVC Maximum Frame Size Service Attribute, as specified in MEF 26.2 [11], Section 12.6.

[R58] The MAEL MEP **MUST** process and respond to DMM PDUs that are Version 1 OAM PDUs, as specified in ITU-T G.8013/Y.1731 [4].

[R59] The MAEL MEP **MUST** process and respond to DMM PDUs generated with a unicast Destination Address.

[R60] The MAEL MEP **MUST** process and respond to at least *(10 x Number of Peer MEPs + 10)* DMM PDUs per second.

The MAEL MEP processing requirement for responding to DMM is based on Proactive monitoring, as specified in MEF 35.1 [13], for all PM-1 Controller MEPs sending DMM at 10 PDUs per second and On-Demand monitoring, as specified in MEF 35.1 [13], for a single PM-1 Controller MEP sending 10 PDUs per second.

To calculate the MAEL MEP processing requirement for DMM PDUs, the following symbols are defined.

Symbol	Definition	Value	Source
DMMPR	MAEL MEP Processing Requirement for the DMM PDUs (fps)	Calculated	
NUM_PMEP	Number of Peer MEPs per MAEL MEP	Input	
DMM_P	Proactive DMM Session frame rate (fps)	10	All Peer MEPs (functioning as PM-1 Controllers)
DMM_O	On-Demand DMM Session frame rate (fps)	10	Single Peer MEP (functioning as PM-1 Controller)

Table 23 – Symbols for Calculating MAEL MEP Processing Requirement for Responding to DMM PDUs

DMMPR is dependent on the number of Peer MEPS per MAEL MEP and is calculated using the following formula.

$DMMPR = NUM\_PMEP \ x \ DMM\_P + DMM\_O$

$DMMPR = 10 \ x \ NUM\_PMEP + 10$

For example, using the formula in [R60], if a MAEL MEP has only a single Peer MEP, the MAEL MEP needs to provide a PDU processing capacity of at least 20 fps. If a MAEL MEP has ten Peer MEPs, the MAEL MEP needs to provide a DMM PDU processing capacity of at least 110 fps.

[R61] The MAEL MEP **MUST** process and respond to SLM PDUs generated with a unicast Destination Address.

[R62] The MAEL MEP **MUST** process and respond to at least *(10 x Number of Peer MEPs + 10)* SLM PDUs per second.

The MAEL MEP processing requirement for responding to SLM frames is based on Proactive monitoring, as specified in MEF 35.1 [13], for all PM-1 Controller MEPs sending SLM frames at 10 PDUs per second and On-Demand monitoring, as specified in MEF 35.1 [13], for a single PM-1 Controller MEP sending 10 PDUs per second.

To calculate the MAEL MEP processing requirement for SLM PDUs, the following symbols are defined.

Symbol	Definition	Value	Source
SLMPR	MAEL MEP Processing Requirement for the SLM PDUs (fps)	Calculated	
NUM_PMEP	Number of Peer MEPs per MAEL MEP	Input	
SLM_P	Proactive SLM Session frame rate (fps)	10	All Peer MEPs (functioning as PM-1 Controllers)
SLM_O	On-Demand SLM Session frame rate (fps)	10	Single Peer MEP (functioning as PM-1 Controller)

Table 24 – Symbols for Calculating MAEL MEP Processing Requirement for Responding to SLM PDUs

SLMPR is dependent on the number of Peer MEPS per MAEL MEP and is calculated using the following formula.

SLMPR = NUM_PMEP x SLM_P + SLM_O

SLMPR = 10 x NUM_PMEP + 10

For example, using the formula in [R62], if a MAEL MEP has only a single Peer MEP, the MAEL MEP needs to provide a PDU processing capacity of at least 20 fps. If a MAEL MEP has ten Peer MEPs, the MAEL MEP needs to provide an SLM PDU processing capacity of at least 110 fps.

9.3   Latching Loopback

A MAEL Service provides the SP/SO with the ability to remotely activate and deactivate Latching Loopback at the UNI in order to perform service activation testing. The MAEL MEP (also used for SOAM FM and SOAM PM) provides the Latching Loopback Responder function as specified in MEF 46 [14]. The Latching Loopback Controller function resides in the SP/SO's network. An example of Latching Loopback for a MAEL Service is shown in Figure 4.
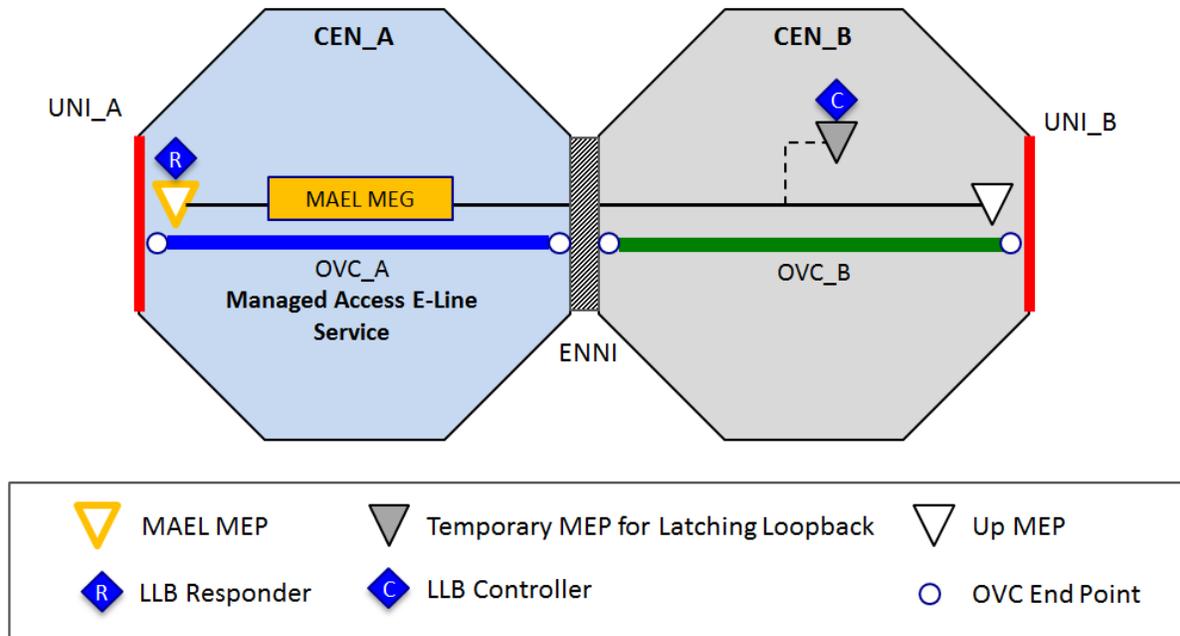
Figure 4 – MAEL Service – Latching Loopback Example

CEN_B is shown in the above figure as an example, however, actual architectures may be more complex and include additional CENs. Using the Message Protocol for Latching Loopback, the SP/SO will be able to remotely perform Loopback Activation and Deactivation from Ethernet Test Equipment that supports the Latching Loopback Controller function.

> **[R63]** A MAEL Service **MUST** provide Latching Loopback Responder functions specified in MEF 46 [14] that are listed in Table 25.

Mandatory Requirements in MEF 46 [14] that are Applicable to a MAEL Service [5]
[R1], [R4], [R5], [R11], [R12], [R14], [R15], [R16], [R17], [R18], [R19], [R20], [R21], [R22], [R23], [R24], [R25], [R26], [R28], [R29], [R30], [R31], [R32], [R33], [R34], [R35], [R36], [R37], [R38], [R39], [R40], [R41], [R43], [R44], [R45]

Table 25 – Mandatory MEF 46 [14] Requirements for MAEL

None of the recommended requirements in MEF 46 [14] are recommended for a MAEL Service.

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[5] In MEF 46 [14], [R28], [R29], and [R30] are device related but behavior is applicable to a MAEL Service therefore these requirements are not identified as Differences.

MEF 46 [14] requirements that are different for a MAEL Service are listed with a brief explanation in Table 26.

MEF 46 [14] Difference	Difference Type	Explanation
[R2]	Not used by MAEL	Latching Loopback Responder is not required for a MIP at an ENNI for a MAEL Service.
[R3]	Not used by MAEL	Latching Loopback Responder is not required for a MIP at a UNI for a MAEL Service.
[R6], [R7], [R8], [R9], [R10], [D1], [D2], [D3]	Not used by MAEL	Device related.
[R13]	Not used by MAEL	External loopback is not required by a MAEL Service.
[R27], [D4], [D5]	Not used by MAEL	Latching Loopback Controller is not required by a MAEL Service.
[R42]	Replacement	Replaced by [R68] in this document.

Table 26 – MAEL Differences to MEF 46 [14]

Latching Loopback Frame Set (LLFS) "case a" specified in MEF 46 [14] is applicable when all CE-VLAN IDs map to the OVC End Point at the UNI. ENNI frames need to be single tagged when LLFS "case a" is used.

LLFS "case b" specified in MEF 46 [14] is applicable when not all CE-VLAN IDs map to the OVC End Point at the UNI. ENNI frames need to be double tagged when LLFS "case b" is used. Furthermore, since LLFS "case b" is restricted to a single CE-VLAN ID, a separate LLFS is needed to test each CE-VLAN ID mapped to the OVC End Point at the UNI.

New Latching Loopback requirements for a MAEL Service are listed below.

> **[R64]** When one or more (but not all) CE-VLAN IDs map to the OVC End Point at the UNI, a MAEL Service **MUST** be able to activate a Latching Loopback test session for each CE-VLAN ID mapped to the OVC End Point at the UNI.

The intent of [R64] is not for a MAEL Service to be able to activate Latching Loopback test sessions for all CE-VLAND IDs mapped to the OVC End Point at the UNI at the same time but [R64] does not preclude this capability.

[R65] For a MAEL Service, the LLSM State for all LLSMs associated with the MAEL MEP **MUST** be configured as Latching Loopback Inactive.

[R66] For a MAEL Service, the MAEL Operator **MUST** support Internal Loopback.

[R67] The MAEL MEP **MUST** function as a Latching Loopback Responder.

[R68] For a MAEL Service, an LLF receiving a Latching Loopback Activate Request **MUST** support Expiration Timer TLV values of 60 (1 minute), 300 (5 minutes), 900 (15 minutes), 1,800 (30 minutes), 3,600 (60 minutes), and 7,200 (120 minutes).

9.4   S-Tag PCP and DEI Values for MAEL Sourced ENNI Frames

An egress ENNI Frame from the MAEL Operator CEN is said to be a *MAEL Sourced ENNI Frame* when it is the result of a frame[6] generated by a MAEL MEP, a MAEL MIP, a MAEL SMM (when enabled), or a Latching Loopback Function that is contained in the MAEL Operator CEN.

A MAEL Sourced ENNI Frame that is the result of a frame generated by a:

- MAEL MEP can be a CCM, LBR, LTR, DMR, SLR or LLR (Latching Loopback Reply) frame.

- MAEL MIP can be an LBR or LTR frame.

- MAEL SMM (when enabled) can be an LBR, LTR or forwarded LTM frame.

- Latching Loopback Function is a test frame looped back (via swapping of Source Address and Destination Address) during a Latching Loopback Session.

An ingress SOAM ENNI Frame needs to have an S-VID that maps to the MAEL Service OVC. Similarly, an ingress ENNI Frame for LLM (Latching Loopback Message) or an ingress Latching Loopback test frame needs to have an S-VID that maps to the MAEL Service OVC.

For a MAEL Service, the OVC List of Class of Service Names Service Attribute contains exactly one Class of Service Name, as specified in [R9] in Section 8.1 of this document. The value of this Service Attribute is applicable to MAEL Sourced ENNI Frames.

[R69] MAEL Sourced ENNI Frames **MUST** use the OVC End Point Egress Map form used for the OVC End Point at the ENNI in the MAEL Operator CEN, as specified in Table 15 in Section 8.2 of this specification.

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[6] MEF does not mandate the format of information that is generated and forwarded within a CEN. For simplicity of discourse, we say that a frame is generated but any method of encoding and forwarding the content within the CEN is acceptable.

[R70] The value of the S-Tag PCP and the value of the S-Tag DEI in a MAEL Sourced ENNI Frame **MUST** be based on the value of the OVC End Point Egress Map Service Attribute in the MAEL Operator CEN using the Class of Service Name specified in the OVC List of Class of Service Names Service Attribute and Green Color as input to the OVC End Point Egress Map Form.

The intent of [R70] is for MAEL Sourced ENNI Frames to have the same S-Tag PCP value and S-Tag DEI value (Green) as other egress ENNI Frames.

9.5 SOAM Parameters for a MAEL Service

This section identifies the SOAM parameters that need to be agreed upon by the MAEL Operator and the SP/SO for a MAEL Service.

While the MAEL MEP is always enabled with a MAEL Service, several SOAM parameters associated with the MAEL MEP need to be agreed upon. Since the MAEL SMM is recommended but not mandated for a MAEL Service, agreement is also needed whether the MAEL SMM is enabled or disabled when offered by a MAEL Operator. No additional parameters need to be agreed upon for SOAM PM (PM-1, Responder MEP) or for Latching Loopback (Responder).

Table 27 lists the SOAM parameters that need to be coordinated between the MAEL Operator and the SP/SO.

Service Attribute	Parameter	Description	Format	Valid Values
MEF 51, OVC End Point per UNI Service Attribute, Maintenance End Point (MEP) List: MAEL MEP	MEG Level	Indicates MEG Level assigned to the MAEL MEP.	Integer	*3-5* Note: MAEL Operator support for 5 is required; support for 3 and 4 is recommended.
	MEP ID	Indicates identifier for MAEL MEP.	Integer	*1-8191*

Service Attribute	Parameter	Description	Format	Valid Values
	Short MA Name Format[7]	Indicates the Short MA Name Format of the MAID.	Integer	*2 or 32* Note: *2* indicates Character String format, and *32* indicates ICC format.
	Short MA Name[8]	Indicates identifier for the MAEL MEG.	Text string	Text string. [9] Note: Maximum length is dependent on Short MA Name Format as follows: 45 characters for Character String format, 13 characters for ICC format.
	List of Peer MEP IDs	Provides identifier for each Peer MEP that is in the same MEG as the MAEL MEP. Note: Per ITU-T G.8013/Y.1731 [4], Peer MEP does not include MAEL MEP itself.	List of integers	*1-8191* Note: Each Peer MEP ID value needs to be unique within the MEG and cannot be the same as the MEP ID for the MAEL MEP.

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[7] This parameter uses IEEE 802.1Q [1] terminology. MEG ID Format is the equivalent term specified in ITU-T G.8013/Y.1731 [4]. Additional information is provided in Appendix B.

[8] This parameter uses IEEE 802.1Q [1] terminology. MEG ID is the equivalent term specified in ITU-T G.8013/Y.1731 [4]. Additional information is provided in Appendix B.

[9] The MEG ID ought to be globally unique. It can be related to OVC ID or EVC ID. If the MEG ID is globally unique, the likelihood of detecting misconfigurations that cause cross-connect errors is increased.

Service Attribute	Parameter	Description	Format	Valid Values
MEF 51, OVC End Point per UNI Service Attribute, Subscriber MEG MIP	MAEL SMM	Indicates whether a MAEL SMM is enabled.	Text	*Enabled* or *Disabled* Note: *Enabled* is recommended, not mandated.

Table 27 – SOAM Parameters for a MAEL Service

Note that there are many SOAM parameters whose values are fixed for a MAEL Service and therefore do not need to be agreed upon by the MAEL Operator and SP/SO.

10 References

[1] IEEE Std 802.1Q – 2014, *IEEE Standard for Local and metropolitan area networks-- Bridges and Bridged Networks*, December 2014.

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

[3] IETF RFC 8174, *Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words*, May 2017.

[4] ITU-T, Recommendation G.8013/Y.1731, *Global information infrastructure, internet protocol aspects and next-generation networks, Internet protocol aspects – Operation, administration and maintenance*, August 2015.

[5] MEF Forum, MEF 6.2, *Ethernet Services Definitions - Phase 3*, July 2014.

[6] MEF Forum, MEF 10.3, *Ethernet Services Attributes Phase 3*, October 2013.

[7] MEF Forum, MEF 10.3.1, *Composite Performance Metric (CPM) Amendment to MEF 10.3*, February 2015.

[8] MEF Forum, MEF 10.3.2, *Amendment to MEF 10.3 - UNI Resiliency Enhancement*, November 2015.

[9] MEF Forum, MEF 11, *User Network Interface (UNI) Requirements and Framework*, November 2004.

[10] MEF Forum, MEF 26.1, *External Network Network Interface (ENNI) – Phase 2*, January 2012.

[11] MEF Forum, MEF 26.2, *External Network Network Interfaces (ENNI) and Operator Service Attributes*, August 2016.

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

[13] MEF Forum, MEF 35.1, *Service OAM Performance Monitoring Implementation Agreement*, May 2015.

[14] MEF Forum, MEF 46, *Latching Loopback Protocol and Functionality*, July 2014.

[15] MEF Forum, MEF 51, *OVC Services Definitions*, July 2015.

Appendix A Use Cases (Informative)

This section describes several use cases associated with a MAEL Service. Table 28 summarizes these use cases, which are further elaborated in the following subsections of this Appendix.

Use Case	SP Service	MAEL Service, OVC End Point Map at UNI_1	Transit CEN	VUNI in Non-MAEL CEN	SP Use of MAEL MEG
1a	1 EVPL	All	None	No	EVC
1b	1 EVPL	All	None	No	SP
2	2 EVPLs	All	None	Yes	SP
3	2 EVPLs	< All	None	No	EVC
4	EP-LAN	All	One	No	EVC
5	IP Access	All	None	No	SP

Table 28 – Summary of MAEL Use Cases

There are six MAEL use cases described in this appendix. The end-to-end services include EVPL, EP-LAN and IP-VPN access. The CEN_A Operator provides the MAEL Service for all of the use cases. In Use Cases 1a, 1b, 2, 4 and 5, the OVC End Point Map at the UNI in CEN_A maps all CE-VLAN IDs to the OVC End Point. In Use Case 3, the OVC End Point Map at the UNI in CEN_A maps a subset of CE-VLAN IDs to the OVC End Point.

The following assumptions apply to all of the use cases:

- The CEN_A Operator provides one or more MAEL Services between the UNI and the ENNI. The focus of these use cases is on the MAEL Services in CEN_A. OVC services in other networks are briefly described.

- On ingress at the UNI-N in CEN_A, a MAEL Operator's NID hosting the UNI (the NID is not shown in the use case figures) stacks an S-Tag or an equivalent transport tag on all of the ingress Service Frames mapped to the OVC End Point and all of the MAEL Sourced SOAM PDUs from the MAEL MEP for that OVC End Point. It is assumed that similar functionality is used at UNIs in the other CENs.

- On egress at the UNI-N in CEN_A, a MAEL Operator's NID hosting the UNI (the NID is not shown in the Use Case figures) removes the S-Tag or an equivalent transport tag before sending the resultant egress Service Frames mapped to the OVC End Point onto the UNI.

- The MAEL Operator's NID provides the MAEL MEP, MAEL SMM and Latching Loopback Responder functions.

- For the purpose of this appendix, when it is said that the ENNI frame format is *double tagged*, it means that a given ENNI frame associated with the MAEL Service OVC End Point at the ENNI could be *double tagged,* per MEF 26.2 [11]. When it is said that the ENNI frame format is *single tagged*, it means that each ENNI frame associated with the MAEL Service OVC End Point at the ENNI is *single tagged,* per MEF 26.2 [11].

- When the term *port-based UNI* is used, it means that the OVC End Point Map at the Operator UNI maps all CE-VLAN IDs to the OVC End Point. When the term *VLAN-based UNI* is used, it means that the OVC End Point Map at the Operator UNI maps one or more, but not all, CE-VLAN IDs to the OVC End Point.

A SP/SO using a MAEL Service for access to a Subscriber location may require a VUNI, as specified in MEF 26.2 [11], in another CEN to instantiate the EVC service(s) carried over the MAEL Service. Some instances where a VUNI function might be needed are listed below:

- When the OVC End Point Map at the Operator UNI for the MAEL Service has more than one EVC associated with it (see Use Case 2).

- When CE-VLAN ID, PCP or DEI preservation is disabled for the EVC (see Use Case 2). Note that since the MAEL Service requires that the CE-VLAN ID, PCP and DEI preservation Service Attributes have a value of *Enabled* for the OVC, a VUNI function in another CEN is needed when values in the CE-VLAN tag need to be different at the different UNIs.

For the MAEL MEP, the following SOAM configurations are used in all use cases and are agreed between the SP/SO and the MAEL Operator:

Functionality	Parameter	Value
SOAM FM	MAID (MEG ID)	Service ID[10]
	MEG Level	*5*
	MEP ID	*1*
	List of Peer MEP IDs	Uniquely different integer value for each Peer MEP between *2* and *8191*
	CCM: transmission period	10 sec
	CCM: RDI	*Enabled*
	CCM: Interface Status TLV	*Enabled*
	LBM	Responds to LBM
	LTM	Responds to LTM
SOAM PM	PM-1	PM-1 Responder
	Supported protocols	ETH-SLM/SLR and ETH-DMM/DMR
Latching Loopback	Latching Loopback functionality	Latching Loopback Responder

Table 29 – Management Configurations for the MAEL MEP for All Use Cases

In addition, the MAEL MIP in CEN_A is configured at the same MEG Level as the MAEL MEP and responds appropriately to LBMs and LTMs in all use cases. SOAM ENNI Frames targeted to the MAEL MEP and MAEL MIP are *single tagged*.

Since the MAEL SMM is recommended but not mandated for a MAEL Service, the applicability of the MAEL SMM is briefly described in the use cases.

Note that in the following use cases, the OVC End Point Map is in the context of the SP/SO to Operator and the EVC End Point Map, shorthand for 'CE-VLAN ID to EVC Map', is in the context of the Subscriber to SP (i.e., the Operator doesn't need to know about the EVC End Point Map).

A.1 Use Case 1: Single EVPL Service

The Subscriber, *Omega 3*, needs to connect a remote site to headquarters and asks SP *Alpha* for a solution using a typical hub and spoke arrangement based on EVPL services. Figure 5 below depicts the EVC connectivity agreed to by *Omega 3* and *Alpha* for one of the remote sites.

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[10] The Service ID is assumed to be either the EVC ID when an EVC MEG is used or the OVC ID when an SP MEG is used.
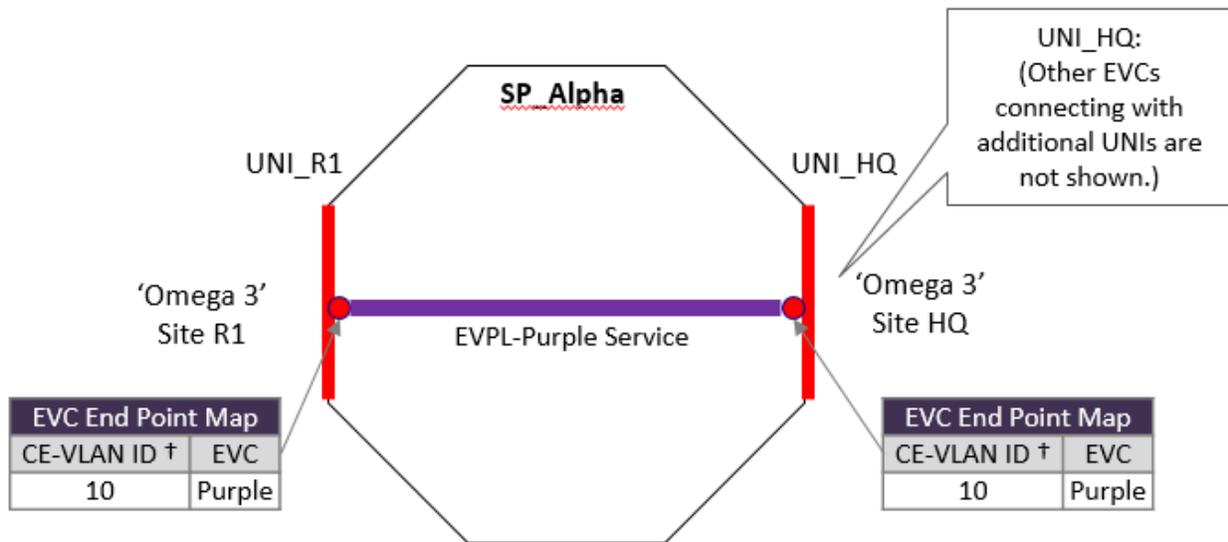
† C-VID 10 is not the CE-VLAN ID for untagged and priority tagged frames.

Figure 5 – Single EVPL Service, Subscriber View

In this example, the Purple EVC connects the UNI at the Headquarters site, UNI_HQ, with the UNI at the remote site, UNI_R1. Note that in this example, the customer equipment configuration at each site is simplified since the same CE-VLAN ID is used for mapping to the EVC at each.

The EVPL service requires a single Bandwidth Profile Flow for the Envelope at each EVC End Point, based on the Class of Service Name, CoS Label H. The Envelope is configured with ID of *ABC* and $CF^0 = 0$. The Ingress Bandwidth Profile configured at each EVC End Point is shown in Table 30 below.

Ingress Bandwidth Profile Parameters	Ingress Bandwidth Profile Parameter values for Purple EVC at	
	UNI_HQ	UNI_R1
CM (Color Mode)	*color-blind*	*color-blind*
CF (Coupling Flag)	0	0
CIR	500 Mbps	500 Mbps
CBS	40 kB	40 kB
CIR_{max}	500 Mbps	500 Mbps
EIR	0	0
EBS	0	0
EIR_{max}	0	0
ER (Envelope and Rank)	<ABC,1>	<ABC,1>

Table 30 – Ingress Bandwidth Profile Parameter Values for EVPL Service (Purple EVC)

Alpha considers two alternative service management models using the MAEL Service to provide the EVC Service. The first model, using an EVC MEG, is described in Use Case 1a and the second model, using an SP MEG, is described in Use Case 1b.

Use Case 1a: Single EVPL Service, Port-based UNI; EVC MEG

Alpha, who is also is the Operator for CEN_B, uses a MAEL Service offered by the CEN_A Operator to reach site R1. Figure 6 depicts the set of OVCs needed for carrying the EVC.
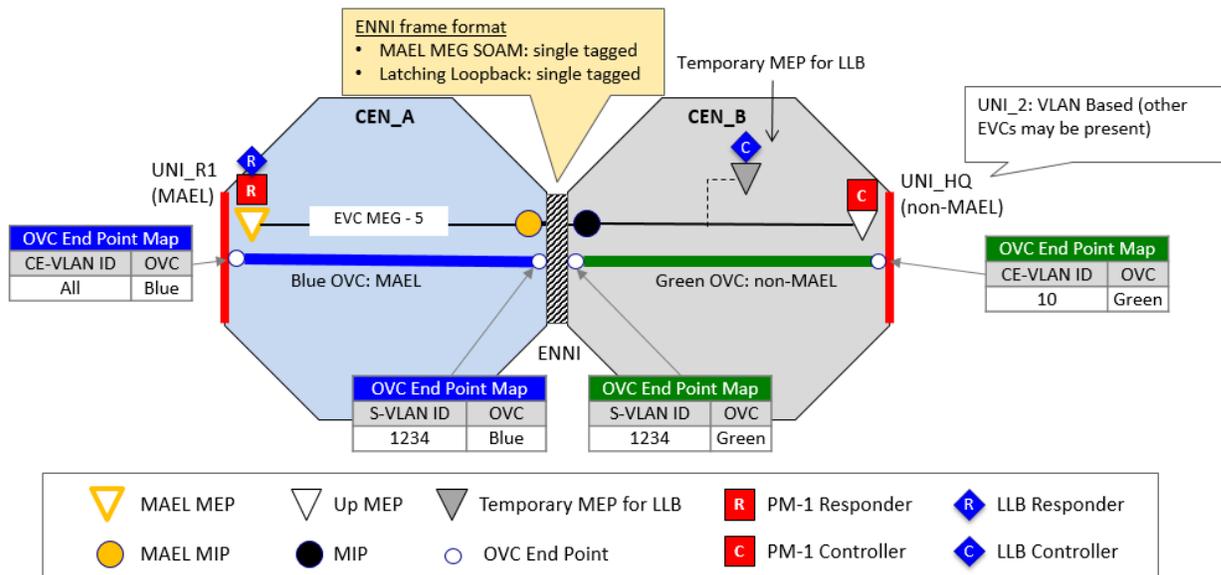

Figure 6 – Single EVPL Service, Service Provider View

The Purple EVC is put together with two OVC Services, as follows:

- The MAEL Service uses the Blue OVC in CEN_A to connect UNI_R1, with the ENNI. Since *Alpha* tends to use a *port-based UNI* for all MAEL Services in CEN_A, the OVC End Point Map at the Operator UNI is configured to map all CE-VLAN IDs to the Blue OVC End Point.

- An Access E-Line Service uses the Green OVC in CEN_B to connect UNI_HQ with the ENNI.

An EVC MEG is used for monitoring the EVC. Since the MAEL MEP at UNI_R1 is not required to support SOAM PM-1 Controller functions, *Alpha* uses the Up MEP associated with the Green OVC End Point at UNI_HQ as a SOAM PM-1 Controller. This allows for comprehensive performance monitoring for the EVC.

A MAEL SMM would not provide the behavior expected by the Subscriber with this use case. The MAEL SMM cannot respond to untagged SOAM Service Frames sent by the Subscriber at UNI_HQ since the EVC End Point map does not include untagged frames.

A centralized Latching Loopback Controller is used in CEN_B, enabling out of service testing (e.g., SAT) of the MAEL Service from CEN_B.

Note that CEN_B filters any frame coming across the ENNI from CEN_A that has no C-Tag or has a C-Tag with a C-VID value other than 10, ensuring that only Service Frames with CE-VLAN ID = 10 egress UNI_HQ. Such filtering can be accomplished by using a conditional delivery value for the OVC Frame Delivery Service Attribute for Broadcast, Multicast and Unicast frames.

The MAEL Service uses a single Bandwidth Profile Flow for the Envelope at each OVC End Point, based on the Class of Service Name, CoS Label H. The Envelope is configured with ID of *XYZ* and $CF^0 = 0$. The Ingress Bandwidth Profiles configured at each OVC End Point for the Blue OVC are shown in Table 31 below.

Ingress Bandwidth Profile Flow Parameter	Ingress Bandwidth Profile Flow Parameter values for CoS Label H for Blue OVC at	
	UNI_R1	ENNI
CM (Color Mode)	*color-blind*	*color-blind*
CF (Coupling Flag)	0	0
CIR	500 Mbps	500 Mbps
CBS	40 kB	40 kB
CIR_{max}	500 Mbps	500 Mbps
EIR	0	0
EBS	0	0
EIR_{max}	0	0
ER (Envelope and Rank)	<XYZ,1>	<XYZ,1>
F (Token Request Offset)	0	4

Table 31 – Ingress Bandwidth Profile Parameter Values for Blue OVC

For the MAEL Service, an Ingress Bandwidth Profile for the Blue OVC End Point at the ENNI is configured with 500 Mbps of CIR and 40 kB of CBS (EIR=0 and EBS=0), and with a Token Request Offset (F) value of 4 Bytes. Note that since the ENNI frame format is *double tagged*, F=4 allows the SP to compensate for the additional 4 Byte overhead associated with the ENNI frames. Appendix G of MEF 26.2 [11] describes examples in more detail of using the Token Request Offset parameter.

Use Case 1b: Single EVPL Service, Port-based UNI, SP MEG

Use Case 1b uses the same set of OVCs to carry the EVC as in Use Case 1a. The only difference with Use Case 1b is that *Alpha* decides to use an SP MEG to monitor the MAEL Service. Figure 7 depicts this arrangement.
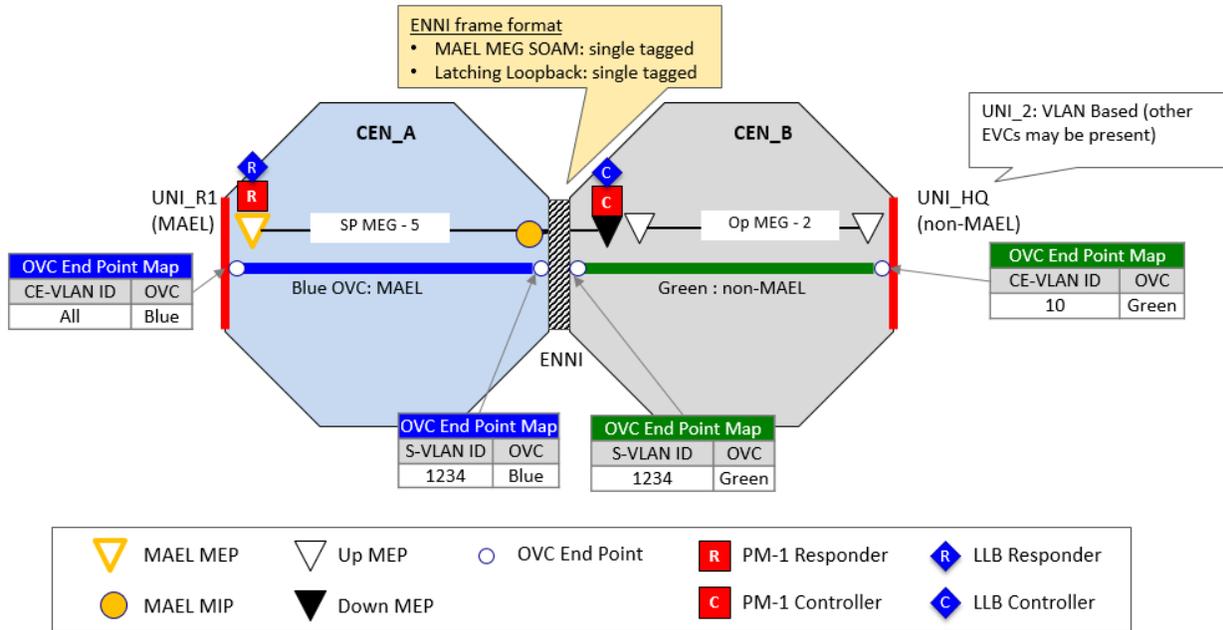
Figure 7 – Single EVPL Service (SP MEG), Service Provider View

Alpha uses a Down MEP to monitor the MAEL Service across the ENNI. Since the SP MEG is used for monitoring the MAEL Service from CEN_B, *Alpha* uses the Down MEP at the ENNI in CEN_B as a SOAM PM-1 Controller. This allows for comprehensive performance monitoring for the MAEL service from CEN_B. *Alpha* also uses the Down MEP at the ENNI to provide the Latching Loopback Controller function.

An Operator MEG is used to monitor the Green OVC in CEN_B. Up MEPs are located at the ENNI and UNI_HQ in CEN_B.

As described in Use Case 1a, a MAEL SMM would not provide the behavior expected by the Subscriber with this use case.

Note that there is no standard way for an SP MEG fault to propagate from the SP MEG Down MEP to the Operator MEG Up MEP in CEN_B. It is assumed that *Alpha* may use a non-standard implementation for fault propagation.

A.2 Use Case 2: Two EVPL Services using a Port-based UNI

The Subscriber, *Omega 3,* needs to connect two spoke sites to a hub site and asks SP, *Alpha,* for a solution using a typical hub and spoke arrangement based on EVPL services. Figure 8 below depicts the EVC connectivity agreed to by *Omega 3* and *Alpha* for these three sites.
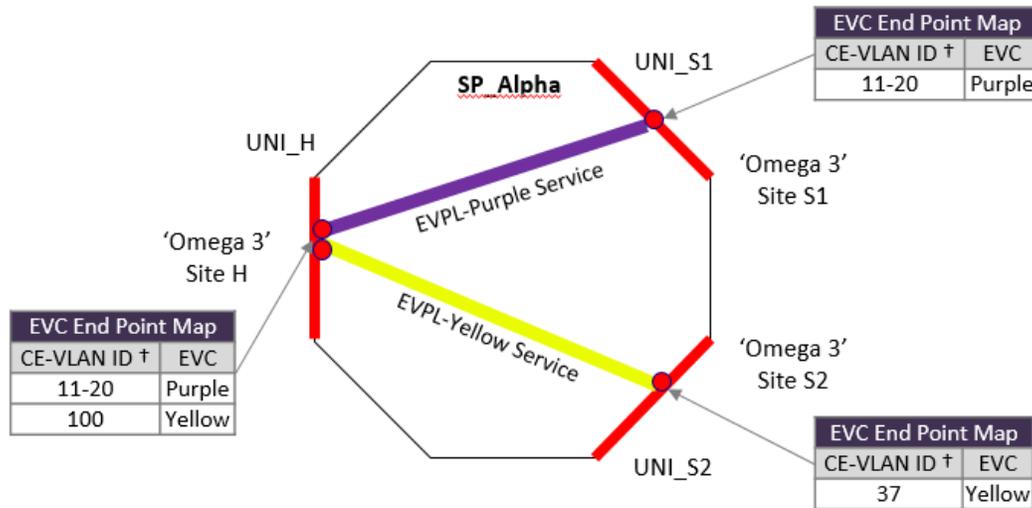
Figure 8 – Two EVPL Services, Subscriber View

In this example, the Purple EVC connects the UNI at the Hub site, UNI_H, with the UNI at site S1, UNI_S1. The Yellow EVC connects the UNI at the Hub site, UNI_H, with the UNI at site S2, UNI_S2. The Purple EVC maps to CE-VLAN IDs 11 through 20 at both UNI_H and UNI_S1. Since multiple CE-VLAN IDs map to the Purple EVC, the same CE-VLAN IDs are used for mapping to the EVC at each site. The Yellow EVC maps to CE-VLAN ID 100 at UNI_H and maps to CE-VLAN ID 37 at UNI_S2. A different CE-VLAN ID is used for mapping to the Yellow EVC at each site, providing CE-VLAN ID mapping flexibility to the Subscriber.

Each EVPL service requires a single Bandwidth Profile Flow for the Envelope at each EVC End Point, based on the Class of Service Name, CoS Label H. The Envelope for the Purple EVC is configured with ID of *ABC* and $CF^0 = 0$. The Envelope for the Yellow EVC is configured with ID of *DEF* and $CF^0 = 0$. The Ingress Bandwidth Profile configured at each EVC End Point is shown in Table 32 below.

Ingress Bandwidth Profile Parameters	Ingress Bandwidth Profile Parameter values for Purple EVC at		Ingress Bandwidth Profile Parameter values for Yellow EVC at	
	UNI_H	UNI_S1	UNI_H	UNI_S2
CM (Color Mode)	*color-blind*	*color-blind*	*color-blind*	*color-blind*
CF (Coupling Flag)	0	0	0	0
CIR	200 Mbps	200 Mbps	100 Mbps	100 Mbps
CBS	40 kB	40 kB	40 kB	40 kB
CIR_{max}	200 Mbps	200 Mbps	100 Mbps	100 Mbps
EIR	0	0	0	0
EBS	0	0	0	0
EIR_{max}	0	0	0	0
ER (Envelope and Rank)	<ABC,1>	<ABC,1>	<DEF,1>	<DEF,1>

Table 32 – Ingress Bandwidth Profile parameter values for Two EVPL Services (Purple EVC and Yellow EVC)

Alpha, who is also the Operator for CEN_B, uses a MAEL Service offered by the CEN_A Operator to reach site H. Figure 9 depicts the set of OVCs needed for carrying the EVC Services.
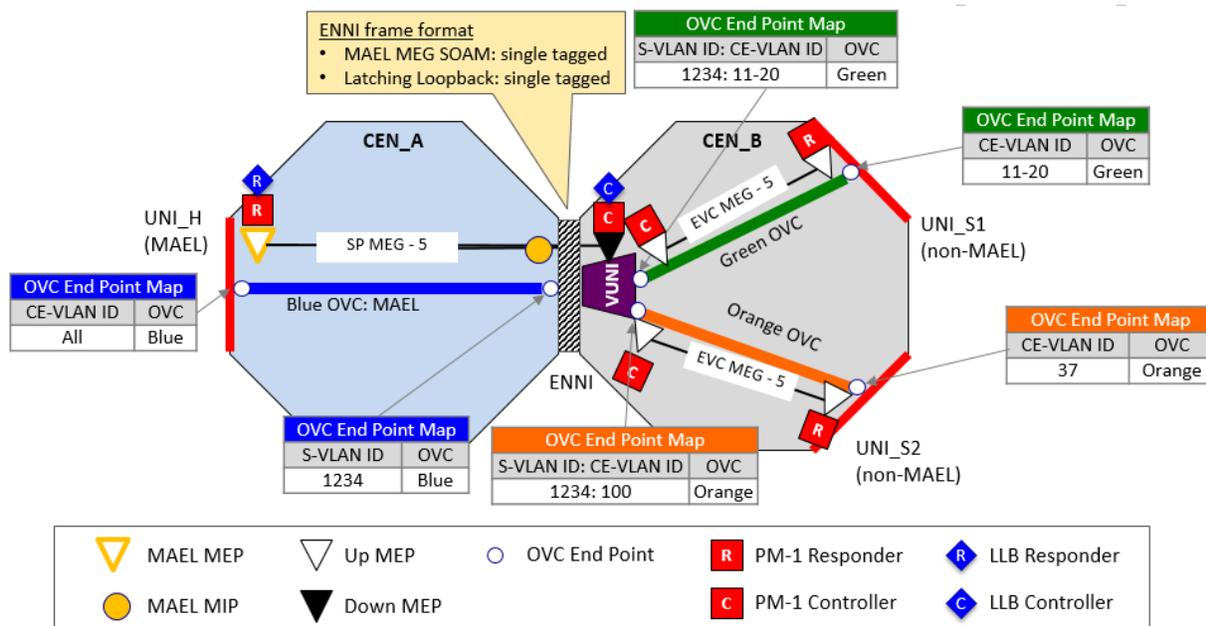

Figure 9 – Two EVPL Services, Port-Based UNI, Service Provider View

A VUNI is used in CEN_B, allowing *Alpha* to use the MAEL Service to create two EVCs. The two EVC Services are put together with three OVC Services, as follows:

- The MAEL Service uses the Blue OVC in CEN_A to connect UNI_H, with the ENNI. Since *Alpha* tends to use a *port-based UNI* for all MAEL Services in CEN_A, the OVC

End Point Map at the Operator UNI is configured to map all CE-VLAN IDs to the Blue OVC End Point.

- An Access E-Line Service uses the Green OVC in CEN_B to connect UNI_S1 with the ENNI.

- An Access E-Line Service uses the Orange OVC in CEN_B to connect UNI_S2 with the ENNI.

From a SOAM perspective, *Alpha* uses a Down MEP configured with an SP MEG at the VUNI to monitor the MAEL Service across the ENNI. The Down MEP has full SOAM FM functionality. Since the MAEL MEP at UNI_H is not required to support SOAM PM-1 Controller or Latching Loopback Controller functions, the Down MEP provides these functions. This allows for performance monitoring between the VUNI and UNI_H.

The Down MEP at the VUNI also provides the Latching Loopback Controller function in CEN_B, enabling out of service testing (e.g., SAT) to UNI_H, with the MAEL MEP providing the Latching Loopback Responder in CEN_A. It is important to note that Latching Loopback activation at UNI_H impacts all traffic on the Blue OVC, i.e., both EVCs. Latching Loopback testing is not shown for the Green and Orange OVCs since *Alpha* has various options for testing of OVCs.

Up MEPs (EVC MEG) are used at the VUNI and UNI_S1 for monitoring the Green OVC in CEN_B. Similarly, Up MEPs (EVC MEG) are used at the VUNI and UNI_S2 for monitoring the Orange OVC in CEN_B. The Up MEPs at the VUNI have full SOAM FM functionality and are also PM-1 Controller MEPs for performance monitoring between the VUNI and UNI_S1 and VUNI and UNI_S2.

Note that there is no standard way for an SP MEG fault to propagate from the SP MEG Down MEP to the EVC MEG Up MEPs at the VUNI. It is assumed that *Alpha* may use a non-standard implementation for fault propagation.

A MAEL SMM would not provide the behavior expected by the Subscriber with this use case. A Subscriber MEG MIP is only applicable for cases where a single EVC is mapped to the OVC End Point. For cases where more than a single EVC are mapped to the OVC End Point at the UNI, the expected solution is that the VUNI (as shown in CEN_B in Figure 9) would provide the Subscriber MEG MIP for each EVC.

The VUNI in CEN_B filters frames coming across the ENNI from CEN_A to ensure that only Service Frames with CE-VLAN ID = 11-20 egress UNI_S1. The VUNI in CEN_B also filters and translates frames coming across the ENNI from CEN_A to ensure that only Service Frames coming from CEN_A that have a C-Tag with CE-VLAN ID = 100 egress UNI_S2 with CE-VLAN ID = 37 since the Yellow EVC does not preserve CE-VLAN ID.

The MAEL Service uses a single Bandwidth Profile Flow for the Envelope at each OVC End Point, based on the Class of Service Name, CoS Label H. The Envelope is configured with ID of

XYZ and CF^0 = 0. The Ingress Bandwidth Profiles configured at each OVC End Point for the Blue OVC are shown in Table 33 below.

Ingress Bandwidth Profile Flow Parameter	Ingress Bandwidth Profile Flow Parameter values for CoS Label H for Blue OVC at	
	UNI_H	ENNI
CM (Color Mode)	*color-blind*	*color-blind*
CF (Coupling Flag)	0	0
CIR	300 Mbps	300 Mbps
CBS	40 kB	40 kB
CIR$_{max}$	300 Mbps	300 Mbps
EIR	0	0
EBS	0	0
EIR$_{max}$	0	0
ER (Envelope and Rank)	<XYZ,1>	<XYZ,1>
F (Token Request Offset)	0	4

Table 33 – Ingress Bandwidth Profile Parameter Values for Blue OVC

For the MAEL Service, an Ingress Bandwidth Profile for the Blue OVC End Point at the ENNI is configured with 300 Mbps of CIR and 40 kB of CBS (EIR=0 and EBS=0), and with a Token Request Offset (F) value of 4 Bytes. Note that since the ENNI frame format is *double tagged*, F=4 allows the SP to compensate for the additional 4 Byte overhead associated with the ENNI frames. Appendix G of MEF 26.2 [11] describes examples in more detail of using the Token Request Offset parameter.

A.3 Use Case 3: Two EVPL Services using a VLAN-based UNI

From an EVC perspective, the only difference from Use Case 2 is that for Use Case 3, the Yellow EVC has CE-VLAN ID preservation enabled (in Use Case 2 it was disabled to allow for CE-VLAN ID translation). This updated service arrangement is depicted in Figure 10 below.
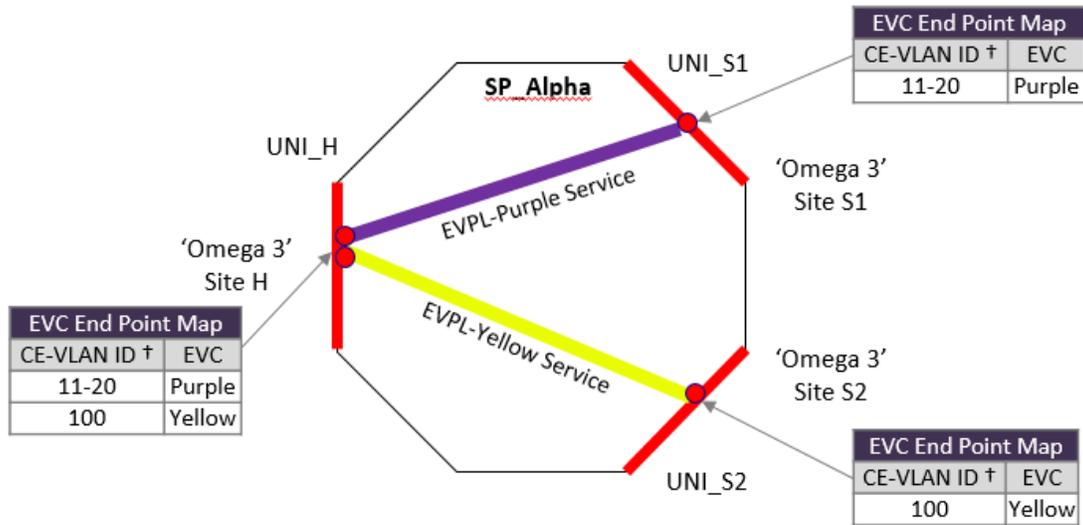
† None of the C-VID values included in the EVC End Point Maps are the CE-VLAN ID for untagged and priority tagged frames.

Figure 10 – Two EVPL Services (with CE-VLAN ID Preservation), Subscriber View

Figure 11 below depicts the set of OVCs needed for carrying the two EVCs. In this example, *Alpha* also operates CEN_B.
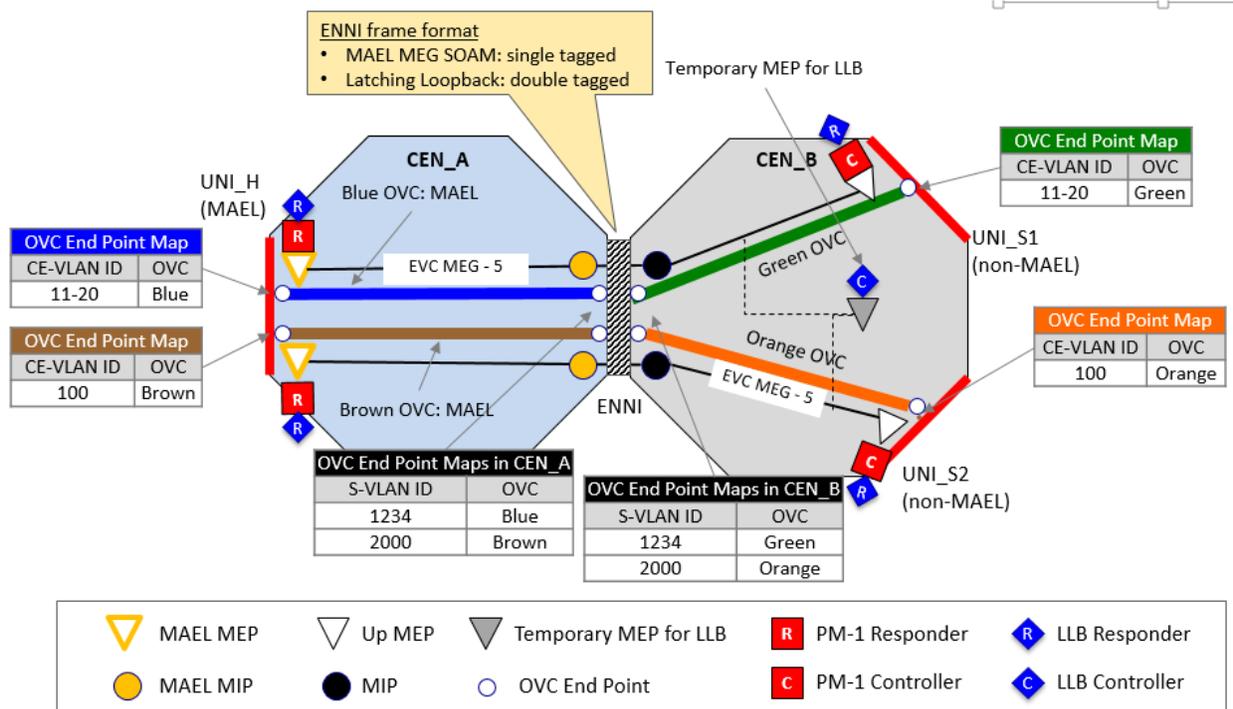

Figure 11 – Two EVPL Services, VLAN-Based UNI, Service Provider View

In this use case, *Alpha* uses a VLAN-based UNI for the MAEL Services in CEN_A. The two EVC Services are put together with four OVC Services, as follows:

- A MAEL Service uses the Blue OVC in CEN_A to connect UNI_H, with the ENNI. The MAEL Operator maps CE-VLAN IDs 11-20 to the Blue OVC End Point at UNI_H, and S-VLAN ID 1234 to the Blue OVC End Point at the ENNI.

- A second MAEL Service uses the Brown OVC in CEN_A to connect UNI_H, with the ENNI. The MAEL Operator maps CE-VLAN ID 100 to the Brown OVC End Point at UNI_H and S-VLAN ID 2000 to the Brown OVC End Point at the ENNI.

- An Access E-Line Service uses the Green OVC in CEN_B to connect UNI_S1 with the ENNI.

- An Access E-Line Service uses the Orange OVC in CEN_B to connect UNI_S2 with the ENNI.

From a SOAM perspective, the key difference with Use Case 2 is that in Use Case 3, *Alpha* uses an EVC MEG for each EVC for end-to-end management. A separate MAEL MEP is used for each OVC End Point at UNI_H to monitor the EVCs. Also, since no VUNI is involved in the end-to-end services, *Alpha* uses an Up MEP for the Green OVC End Point at UNI_S1 and an Up MEP for the Orange OVC End Point at UNI_S2. Each of these Up MEPs is configured as a PM-1 Controller. This allows for performance monitoring for each EVC, from UNI-to-UNI.

A MAEL SMM could be supported with this use case. For LBM/LTM PDUs targeted for the MAEL SMM, the Subscriber at UNI_H, UNI_S1 and UNI_S2 can send SOAM Service Frames at MEG Level 6 that are C-tagged with the lowest C-VID value mapped to the OVC End Point.

A centralized Latching Loopback Controller is used in CEN_B, enabling out of service testing (e.g., SAT) of the MAEL Service from CEN_B.

Each MAEL Service uses a single Bandwidth Profile Flow for the Envelope at each OVC End Point, based on the Class of Service Name, CoS Label H. The Ingress Bandwidth Profiles configured at each OVC End Point for the both OVCs are shown in Table 34 below.

Ingress Bandwidth Profile Flow Parameter	Ingress Bandwidth Profile Flow Parameter values for CoS Label H for Blue OVC at		Ingress Bandwidth Profile Flow Parameter values for CoS Label H for Brown OVC at	
	UNI_H	ENNI	UNI_H	ENNI
CM (Color Mode)	*color-blind*	*color-blind*	*color-blind*	*color-blind*
CF (Coupling Flag)	0	0	0	0
CIR	200 Mbps	200 Mbps	100 Mbps	100 Mbps
CBS	40 kB	40 kB	40 kB	40 kB
CIR_{max}	200 Mbps	200 Mbps	100 Mbps	100 Mbps
EIR	0	0	0	0
EBS	0	0	0	0
EIR_{max}	0	0	0	0
ER (Envelope and Rank)	<XYU,1>	<XYE,1>	<PQU,1>	<PQE,1>
F (Token Request Offset)	0	4	0	4

Table 34 – Ingress Bandwidth Profile Parameter Values for Blue and Brown OVCs

Similar to Use Case 2, the Ingress Bandwidth Profiles for the Blue and Brown OVC End Points at the ENNI are each configured with a Token Request Offset (F) value of 4 Bytes. Note that since the ENNI frame format is *double tagged*, F=4 allows the SP to compensate for the additional 4 Byte overhead associated with the ENNI frames. Appendix G of MEF 26.2 [11] describes examples in more detail of using the Token Request Offset parameter.

A.4 Use Case 4: EP-LAN Service

The Subscriber *Omega 3* needs to connect two remote sites and its headquarters site with any-to-any connectivity, and asks SP, *Alpha,* to offer a solution using a transparent, E-LAN type service. *Alpha* offers an EP-LAN service, as shown in Figure 12 below.
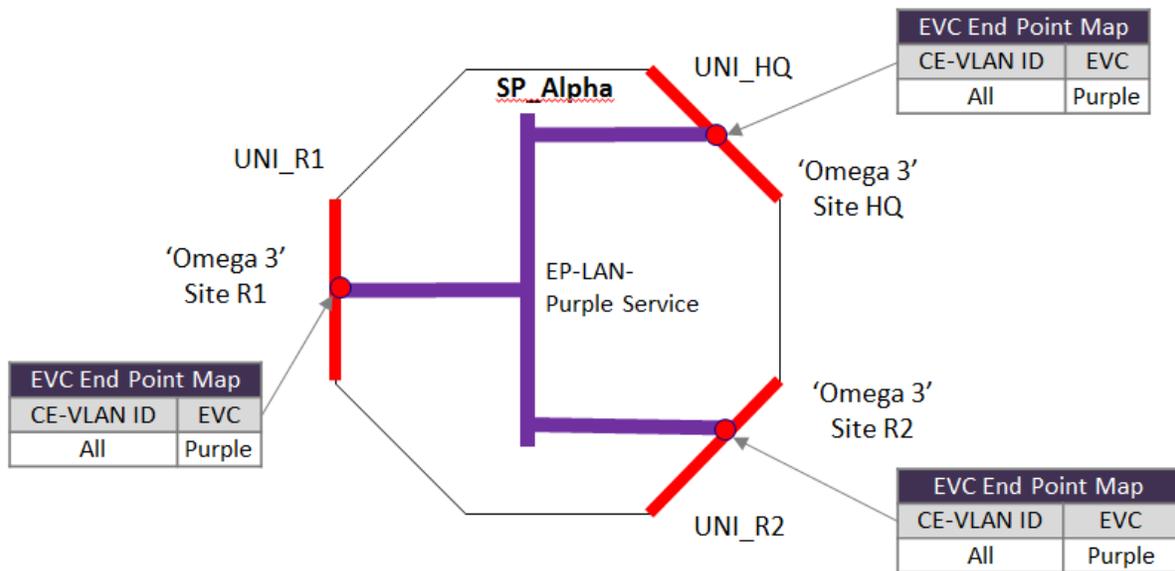
Figure 12 – EP-LAN Service, Subscriber View

In this example, the Purple EVC connects the three UNIs at Site HQ, Site R1 and Site R2. All to One Bundling is enabled at each of the UNIs, providing CE-VLAN ID, CE-VLAN PCP and CE-VLAN DEI preservation for the EVC.

The EP-LAN service requires two Classes of Service, CoS Label H and CoS Label L. The EP-LAN service uses two Envelopes at each EVC End Point, with a single Bandwidth Profile Flow for each Envelope. The Ingress Bandwidth Profile configured for each CoS Label at each EVC End Point is shown in Table 35 below.

Ingress Bandwidth Profile Parameters	Ingress Bandwidth Profile Parameter values for Purple EVC			
	UNI_HQ CoS Label H	UNI_HQ CoS Label L	UNI_R1 & R2 CoS Label H	UNI_R1&R2 CoS Label L
CM (Color Mode)	*color-blind*	*color-blind*	*color-blind*	*color-blind*
CF (Coupling Flag)	0	0	0	0
CIR	40 Mbps	500 Mbps	20 Mbps	300 Mbps
CBS	40 kB	60 kB	40 kB	60 kB
CIR_{max}	40 Mbps	500 Mbps	20 Mbps	300 Mbps
EIR	0	100 Mbps	0	280 Mbps
EBS	0	20 kB	0	20 kB
EIR_{max}	0	100 Mbps	0	280 Mbps
ER (Envelope and Rank)	<ABC,1>	<DEF,1>	<ABC,1>	<DEF,1>

Table 35 – Ingress Bandwidth Profile Parameter Values for EP-LAN Service (Purple EVC)

Figure 13 below depicts the set of OVCs needed for carrying the Purple EVC, which spans across three CENs. In this example, *Alpha* also operates CEN_T.
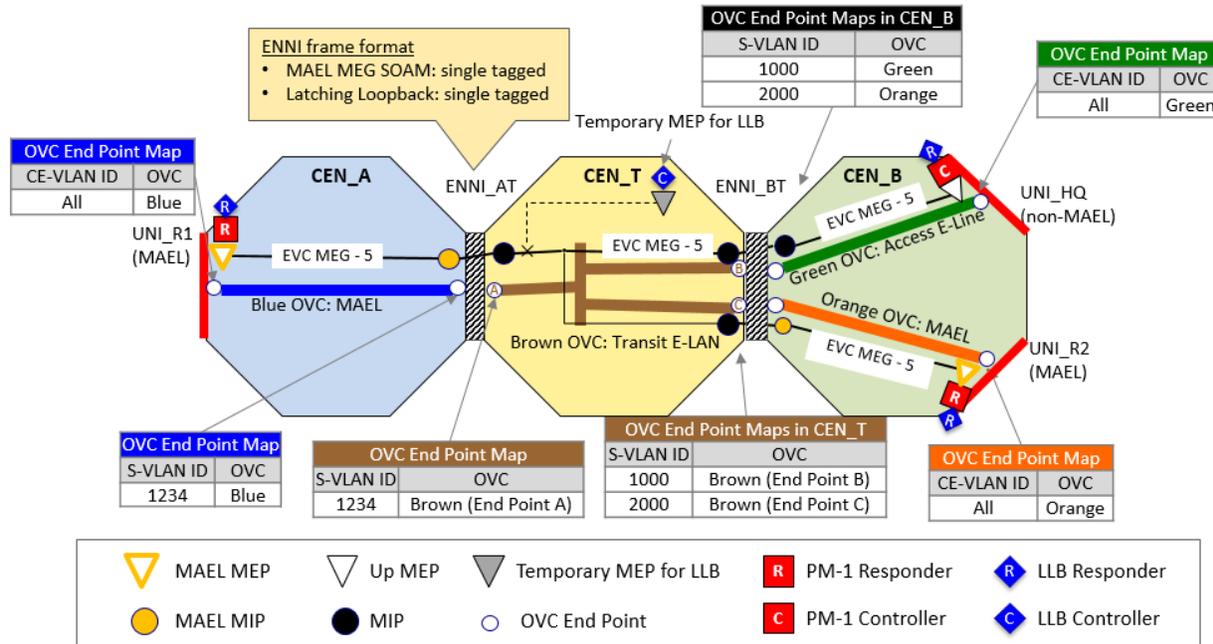
Figure 13 – EP-LAN Service, Service Provider View

The Purple EVC is put together with four OVC Services as follows:

- A MAEL Service uses the Blue OVC in CEN_A to connect UNI_R1 with ENNI_AT. The MAEL Operator maps all CE-VLAN IDs to the Blue OVC End Point at UNI_R1, and S-VLAN ID 1234 to the Blue OVC End Point at ENNI_AT.

- Another MAEL Service uses the Orange OVC in CEN_B to connect UNI_R2 with ENNI_BT.

- An Access E-Line Service (non-MAEL) uses the Green OVC to connect UNI_HQ with ENNI_BT.

- A Transit E-LAN Service uses the Brown OVC in CEN_T to connect three OVC End Points: Brown OVC End Point A at ENNI_AT, Brown OVC End Point B at ENNI_BT and Brown OVC End Point C also at ENNI_BT. This service is used to provide the bridging function for the EP-LAN service and provides hairpin switching at ENNI_BT.

An EVC MEG is used for monitoring SOAM FM and SOAM PM among the UNIs in the EVC. The Up MEPs at UNI_R1 and UNI_R2 are PM-1 Responders only, and the Up MEP at UNI_HQ is a PM-1 Controller. Thus, PM is constrained to monitoring the following subset of ordered UNI pairs: HQ-R1, R1-HQ, HQ-R2, and R2-HQ. Performance between UNI_R1 and UNI_R2 cannot be monitored.

From a SOAM FM perspective, CCM can be used to monitor connectivity of the EVC. Since the Up MEP at UNI_HQ also has full SOAM FM functionality, this Up MEP can be used for generating Loopback and Linktrace messages to other MEPs and MIPs.[11]

A MAEL SMM could be supported with this use case. For LBM/LTM PDUs targeted for the MAEL SMM, the Subscriber at UNI_HQ, UNI_R1 and UNI_R2 can send SOAM Service Frames that are untagged at MEG Level 6.

A Latching Loopback Controller is centralized in CEN_T, enabling out of service testing (e.g., SAT) for the MAEL Service in CEN_A (Blue OVC) as well as for the Green OVC and Orange OVC in CEN_B.

The MAEL Service in CEN_A uses a single Bandwidth Profile Flow mapped to CoS Label H for the Envelope at each Blue OVC End Point. The Ingress Bandwidth Profiles configured at each OVC End Point for the Blue OVC are shown in Table 34 below.

Ingress Bandwidth Profile Flow Parameter	Ingress Bandwidth Profile Flow Parameter values for CoS Label H for Blue OVC at	
	UNI_R1	ENNI_AT
CM (Color Mode)	*color-blind*	*color-blind*
CF (Coupling Flag)	0	0
CIR	600 Mbps	600 Mbps
CBS	80 kB	80 kB
CIR_{max}	600 Mbps	600 Mbps
EIR	0	0
EBS	0	0
EIR_{max}	0	0
ER (Envelope and Rank)	<XYU,1>	<XYE,1>
F (Token Request Offset)	0	4

Table 36 – Ingress Bandwidth Profile Parameter Values for Blue OVC

The Ingress Bandwidth Profiles for the Blue OVC at UNI_R1 and ENNI_AT use a single Class of Service (CoS Label H) that has CIR and CBS values sufficient to carry traffic with both CoS Labels associated with the Purple EVC. How *Alpha* constructs the two CoS Labels for the EVC is beyond the scope of this use case. The Ingress Bandwidth Profile for the Blue OVC End Point at ENNI_AT is configured with a Token Request Offset (F) value of 4 Bytes. Note that since the ENNI frame format is *double tagged*, F=4 allows the SP to compensate for the additional 4 Byte overhead associated with the ENNI frames. Appendix G of MEF 26.2 [11] describes examples in more detail of using the Token Request Offset parameter.

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[11] Methods of SOAM generation coordination between *Alpha* and the Operator of CEN_B for this non-MAEL OVC are outside the scope of this document.

A.5 Use Case 5: Access to IP Service

The Subscriber, *Omega 3*, contracts with SP, *Alpha,* to connect his site at UNI_IP-A into an IP-VPN service. See Figure 14 below.
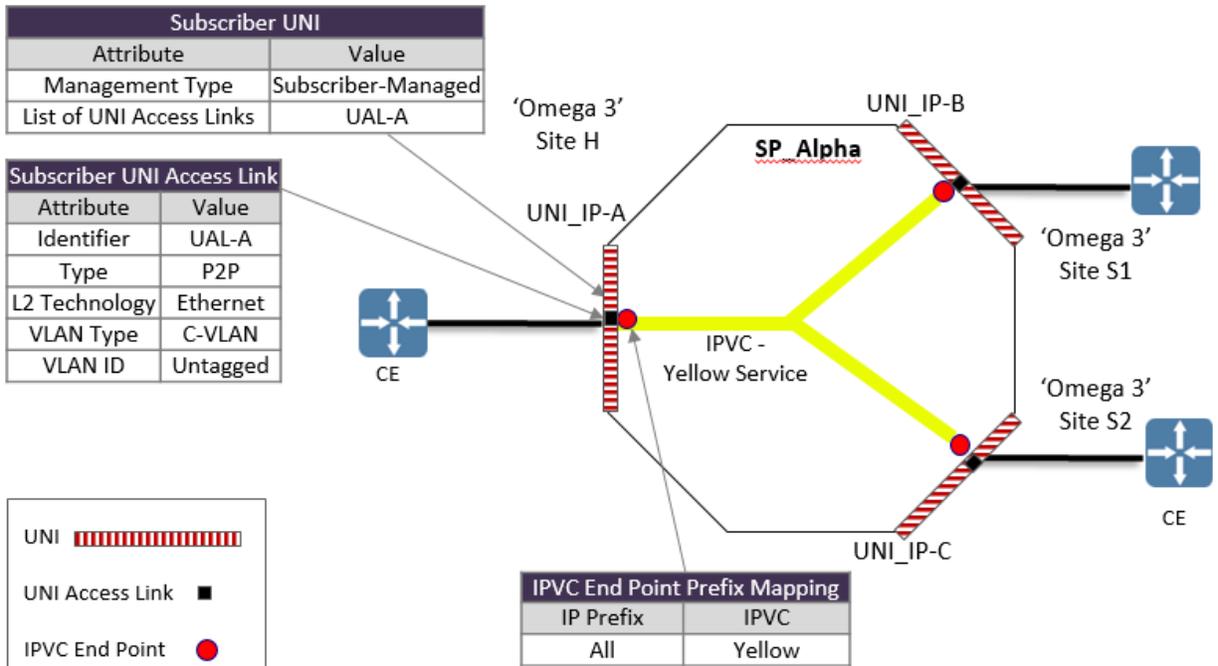

Figure 14 – Access to IP-VPN Service, Subscriber View

For this use case, the Customer Edge (CE) device is owned and managed by the Subscriber and connects to UNI_IP-A. At UNI_IP-A, a UNI Access Link, UAL-A, connects the Subscriber's network to *Alpha's* network using an Ethernet connection. Untagged packets that arrive on UAL-A are mapped to a single IP Virtual Connection (IPVC) End Point, and hence to the Yellow IP-VPN service. UAL-A also corresponds to the L3 Attachment Circuit for the IP-VPN Service, which is configured to provide 200 Mbps bandwidth, on ingress and egress to the IP-VPN service. The Subscriber has four IP traffic classes (EF, AF4, AF-2 and DF) that share the L3 Attachment Circuit bandwidth. Details related to this bandwidth sharing are irrelevant to this use case, and therefore are not further described.

Alpha contracts with the CEN_A Operator for a MAEL Service to provide the access from UNI_A to the ENNI. UNI_A is used by *Alpha* to provide UNI_IP-A to the Subscriber. Figure 15 below depicts the connectivity required to access the Yellow IP-VPN service. In this example, *Alpha* also operates the SP Network.
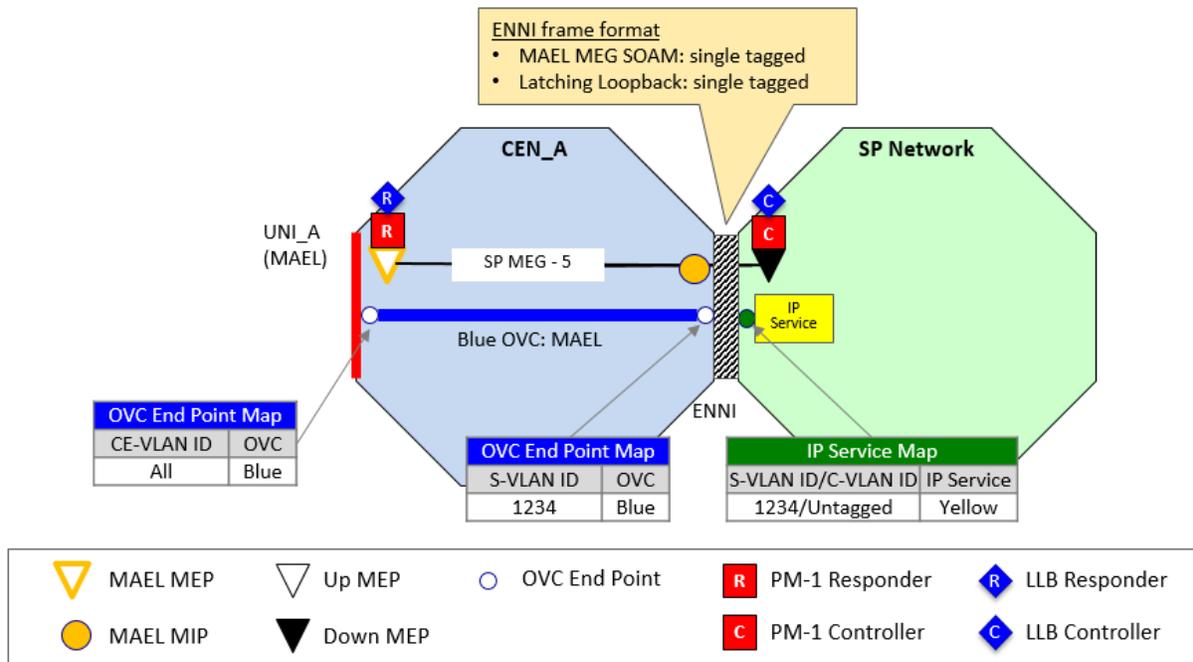
Figure 15 – Access to IP-VPN Service, Service Provider View

The SP network, including the ENNI shown above, is capable of supporting Ethernet or IP services. In this use case, *Alpha* is providing an IP-VPN service, and is using the MAEL Service in CEN_A as an access method. Note that this same solution could be used for an Internet or Private Cloud access service.

The Blue OVC is used for the MAEL Service between UNI_1 and the ENNI in CEN_A. In this example, UNI_A is a *port-based* UNI, allowing *Alpha* to assign untagged customer frames to *Omega 3* for this service without involving the MAEL Operator in that assignment.

In addition to supporting appropriate IP access and routing functions, the IP service shown above terminates the Ethernet flow. On ingress, it maps ENNI frames with the appropriate S-VID (1234) and C-VID (untagged) and then strips the Ethernet fields (e.g., MAC DA, MAC SA, S-tag, C-tag, FCS), and processes the IP packets. On egress, the IP service inserts each IP packet into an ENNI frame, using the appropriate Ethernet fields (i.e., S-VID = 1234, C-VID = untagged) for transiting across the ENNI.

An SP MEG is used for SOAM between the Up MEP at UNI_A and the Down MEP at the ENNI in the SP network. The Down MEP in the SP network is the Controller MEP for PM-1 and Latching Loopback and has full SOAM-FM functionality.

The MAEL Service in CEN_A uses a single Bandwidth Profile Flow mapped to CoS Label H for the Envelope at each Blue OVC End Point. The Ingress Bandwidth Profiles configured at each OVC End Point for the Blue OVC are shown in Table 37 below.

Ingress Bandwidth Profile Flow Parameter	Ingress Bandwidth Profile Flow Parameter values for CoS Label H for Blue OVC at	
	UNI_A	ENNI
CM (Color Mode)	*color-blind*	*color-blind*
CF (Coupling Flag)	0	0
CIR	200 Mbps	200 Mbps
CBS	80 kB	80 kB
CIR$_{max}$	200 Mbps	200 Mbps
EIR	0	0
EBS	0	0
EIR$_{max}$	0	0
ER (Envelope and Rank)	<XYU,1>	<XYE,1>
F (Token Request Offset)	0	4

Table 37 – Ingress Bandwidth Profile parameter values for Blue OVC

The Ingress Bandwidth Profiles for the Blue OVC End Point at UNI_A use a single Class of Service (CoS Label H) that has CIR and CBS values sufficient to carry the L3 Attachment Circuit. The same is true for the Blue OVC End Point at the ENNI. The Ingress Bandwidth Profile for the Blue OVC End Point at the ENNI is configured with a Token Request Offset (F) value of 0 Bytes. Note that since the UNI frame format is untagged and the ENNI frame format is *single tagged* for this use case, F=4 allow the SP to compensate for the additional 4 Byte overhead associated with the ENNI frames. Appendix G of MEF 26.2 [11] describes examples in more detail of using the Token Request Offset parameter.

Appendix B   IEEE and ITU-T SOAM Terminology (Informative)

Table 38 summarizes equivalent terms associated with the Maintenance Domain (MD) and Maintenance Association (MA) in IEEE 802.1Q [1] and Maintenance Entity Group (MEG) in ITU-T G.8013/Y.1731 [4]. Table 38 also identifies which terms are used in this Implementation Agreement. For consistency with MEF 30.1 [12], MD and MA terminology is used in this specification for some requirements that reference IEEE 802.1Q [1].

IEEE 802.1Q [1] Term	ITU-T G.8013/Y.1731 [4] Term	Usage in this Implementation Agreement
Maintenance Domain (MD)	No equivalent term	This document does not use MD.
Maintenance Domain Name	No equivalent term	This document does not use Maintenance Domain Name.
Maintenance Domain Name Format	No equivalent term	This document uses Maintenance Domain Name Format.
Maintenance Association (MA)	Maintenance Entity Group (MEG)	This document uses MEG.
Maintenance Association Identifier (MAID)	MEG ID	This document uses MAID.
Short MA Name Format	MEG ID Format	This document uses Short MA Name Format.
Short MA Name	MEG ID Value	This document uses Short MA Name.
MD Level	MEG Level	This document uses MEG Level.

Table 38 – Comparison of IEEE and ITU-T SOAM Terminology

While the format chosen (i.e., Short MA Name Format or MEG ID Format) may conform to either IEEE or ITU-T specifications, the mandated format values are the same for a MAEL Service. For example, a value of *2* is used to specify Character String format in both the Short MA Name Format and the MEG ID Format fields. Similarly, a value of *32* is used to specify ICC format. While format value *2* is specified in IEEE 802.1Q [1], ITU-T G.8013/Y.1731 [4] references IEEE 802.1Q [1] and also allows this value. Conversely, while format value *32* is

specified in ITU-T G.8013/Y.1731 [4], IEEE 802.1Q [1] references ITU-T G.8013/Y.1731 [4] and also allows this value.

The values for the Short MA Name and MEG ID Value fields are also the same. The types of characters and number of characters allowed in these fields are dependent on the format specified in the Short MA Name Format or MEG ID Format fields.