Technical Specification

MEF 12.1.1

Carrier Ethernet Network Architecture Framework

Part 2: Ethernet Services Layer - External Interface Extensions

October 14, 2011

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Foreword

This Amendment to MEF 12.1 specifies models in support of External Interface extensions for the Ethernet Service Layer Architecture. The amendment provides the following new material for Section 9 of MEF12.1:

1. topological and functional models in support of the UNI Tunnel Access (UTA) based services (see MEF 28 [32]),
2. ETH layer architecture concepts in support of Network Interface Devices' (NID) based services.

The amendment also provides required updates to the Terminology (Section 2), Scope (Section 3) and Reference (Section 10) sections.

Technical updates to other aspects of MEF 12.1 are outside the scope of this document.

1 Introduction

This amendment makes the following updates to MEF12.1:

- Section 2: Updates the terminology list in MEF 12.1/Section 2 to incorporate new acronyms defined in this document.
- Section 3: Expands MEF 12.1/Section 3 (Scope) to cover topological and functional models in support of UTA and NID based services.
- Section 9: Replaces MEF 12.1/Section 9 with new material introducing topological and functional models in support of UTA and NID based services
- Section 10: Expands the reference list in MEF 12.1/Section 10
- Appendix I: Updates MEF 12.1/Appendix I with a functional model for the Service OAM entities associated with UTA and NID based services

2 Acronyms

This table replaces Table 1 in MEF12.1

Terms	Definitions	Reference
AF	Adaptation Function	MEF 4
APP	Application Layer	MEF 4
B-FP	Branch Flow Point	This Document
BR-FP	Branch-Root Flow Point	This Document
BWP	Bandwidth Profile	MEF 10.2
C-VLAN	Customer VLAN	IEEE 802.1Q
CE	Customer Edge	MEF10.2
CEN	Carrier Ethernet Network	This Document
CI	Characteristic Information	MEF 4
CoS	Class of Service	MEF 10.2
CoS ID	Class of Service Identifier	MEF 10.2
DEI	Discard Eligibility Indicator	IEEE 802.1Q
E-NNI / ENNI	External Network-to-Network Interface[1]	MEF 4 / MEF 26
EAF	ETH Adaptation Function	MEF 4
EC	ETH Connection	This Document

[1] Note that MEF4 uses "E-NNI" as the acronym for the same interface.

ECF	ETH Connection Function	This Document
ECS	EC Segment	This Document
ECT	Ethernet Connectionless Trail/Ethernet Connection-oriented Trail	MEF 4
EETF	ETH EVC Termination Function	This Document
EFCF	ETH Flow Conditioning Function	This Document
EFD	ETH Flow Domain	This Document
EFTF	ETH Flow Termination Function	This Document
EI	External Interface	MEF 4
ENNI	External Network-to-Network Interface[1]	MEF 26
ENNI-N	ENNI – Network (Functional Element)	MEF 26
EPCF	ETH Provider Conditioning Function	This Document
ESCF	ETH Subscriber Conditioning Function	This Document
ETF	ETH Termination Function	This Document
ETH	Ethernet Services Layer	MEF 4
EtherType	Ethernet Length/Type	IEEE 802a
EVC	Ethernet Virtual Connection	MEF 10.2
FCS	Frame Check Sequence	IEEE 802.1Q
FP/FPP	Flow Point/Flow Point Pool	ITU-T G.809
H-FP	Hairpin Flow Point	This Document
H-NID	Hybrid NID	This Document
HNS	Hybrid NID Service	This Document[2]
II	Internal Interface	MEF 4
L2CP	Layer Two Control Protocols	MEF 10.2
L2DP	Layer Two Data Plane	This Document
LAN	Local Area Network	IEEE 802
LLC	Logical Link Control	ISO/IEC 8802-2
MAC	Media Access Control	IEEE 802
MCF	MAC Convergence Function	IEEE 802.1Q
MEG	Maintenance Entity Group	ITU-T Y.1731
MEL	Maintenance Entity Level	ITU-T Y.1731
MEN	Metro Ethernet Network	MEF 4
MGT EC	Management EC	This Document
MTP	Multipoint	This Document
NE	Network Element	MEF 4
NID	Network Interface Device	This Document
NMI	NID-MEN Interface	This Document
NMI-C	NMI - Client (Functional Element)	This Document
NMI-N	NMI - Network (Functional Element)	This Document
NNI	Network-Network Interface	MEF 4
NUNI	NID UNI	This Document
O-EC	Operator EC	This Document
P2P	Point-to-point	MEF 10.2
PDU	Protocol Data Unit	This Document
PE	Provider Edge	This Document
RMI	Remote Management Interface	This Document
RMP	Rooted Multipoint	MEF 10.2
RUNI-N	Remote UNI-N (Functional Element)	This Document
S-EC	Subscriber EC	This Document
S-VLAN	Service VLAN (also referred to as Provider VLAN)	IEEE 802.1Q
S-NID	Service NID	This Document
SLS	Service Level Specification	MEF 10.2
SP-EC	Service Provider EC	This Document

[2] Name envisioned for this type of service at the time of writing of this document.

T-FP	Trunk Flow Point	This Document
T-NID	Transport NID	This Document
TAF	Transport Adaptation Function	MEF 4
TF	Termination Function	MEF 4
TAP	Tunnel Attachment Process	This Document
TAP-N	TAP – Network (Functional Element)	This Document
TFP	Termination Flow Point	MEF 4
TL-FP	Trunk Leaf Flow Point	This Document
TRAN	Transport Layer	MEF 4
UNI	User-Network Interface	MEF 4
UNI-C	UNI - Client (Functional Element)	MEF 4
UNI-N	UNI - Network (Functional Element)	MEF 4
UP/PCP	User Priority/Priority Code Point	IEEE 802.1Q
UTA	UNI Tunnel Access	MEF 28
VLAN	Virtual LAN	IEEE 802.1Q
VLAN ID	VLAN Identifier	IEEE 802.1Q
VPLS	Virtual Private LAN Service	RFC 4761
VUNI	Virtual UNI	MEF 28
VUNI-N	VUNI – Network (Functional Element)	This Document
WAN	Wide Area Network	MEF 4
WEN	Wide Area Ethernet Network	MEF 4

Table 1: Acronyms

3 Scope

This text expands the Scope of the Ethernet Service Layer Architecture document (Section 3 of MEF12.1):

4. Topological and functional models in support of the UNI Tunnel Access (UTA) service. The UTA service as specified in MEF 28 [32] is comprised of a UTA OVC Component in the intermediary Network Operator, an associated VUNI Component in the VUNI Provider, and a remote UNI in the intermediate Network Operator. Capabilities specified for the UTA components include:
    a. support a point-to-point frame forwarding service between a remote UNI and a VUNI Provider. This Network Operator oriented Ethernet Service is referred to as a UNI Tunnel Access (UTA) OVC service,
    b. support the service interface functions at the ENNI-N of the VUNI Provider necessary for the delivery of E-Line, E-LAN or E-Tree Subscriber oriented Ethernet Services over the UTA components.

5. Topological and functional models in support of a compound functional entity referred to as Network Interface Device (NID), and its associated service models. Capabilities envisioned for NIDs include, among others:
    a. support TRAN Layer demarcation between a CEN and a Subscriber site under a single Network Operator control (Transport NID),
    b. support TRAN and ETH Layer demarcation between a CEN and a Subscriber site under a single Network Operator control (Service NID),
    c. support a TRAN and ETH Layer demarcation between a Service Provider, one or more intermediate Network Operators and a Subscriber under shared control of the Service Provider and intermediate Network Operator (Hybrid NID).

Note that the terms NID and Hybrid-NID are used in this document as a generic functional entity supporting UNI demarcation functions, not necessarily as a physical network element. Implementation Agreements for NIDs and Technical Specifications for NID based services are outside the scope of this document.

9 ETH Layer Interface Extensions and Their Functional Elements

This section introduces other ETH Layer external interfaces intended to extend the means to interconnect Ethernet Service Providers and Ethernet Network Operators to deliver Ethernet-based services to Subscribers and other CENs. Figure 19 illustrates the reference model for these ETH layer interfaces. They include[3]:

- the ETH Virtual UNI
- the ETH Remote UNI
- the ETH NID UNI (NUNI)
- the ETH NID-MEN Interface (NMI)

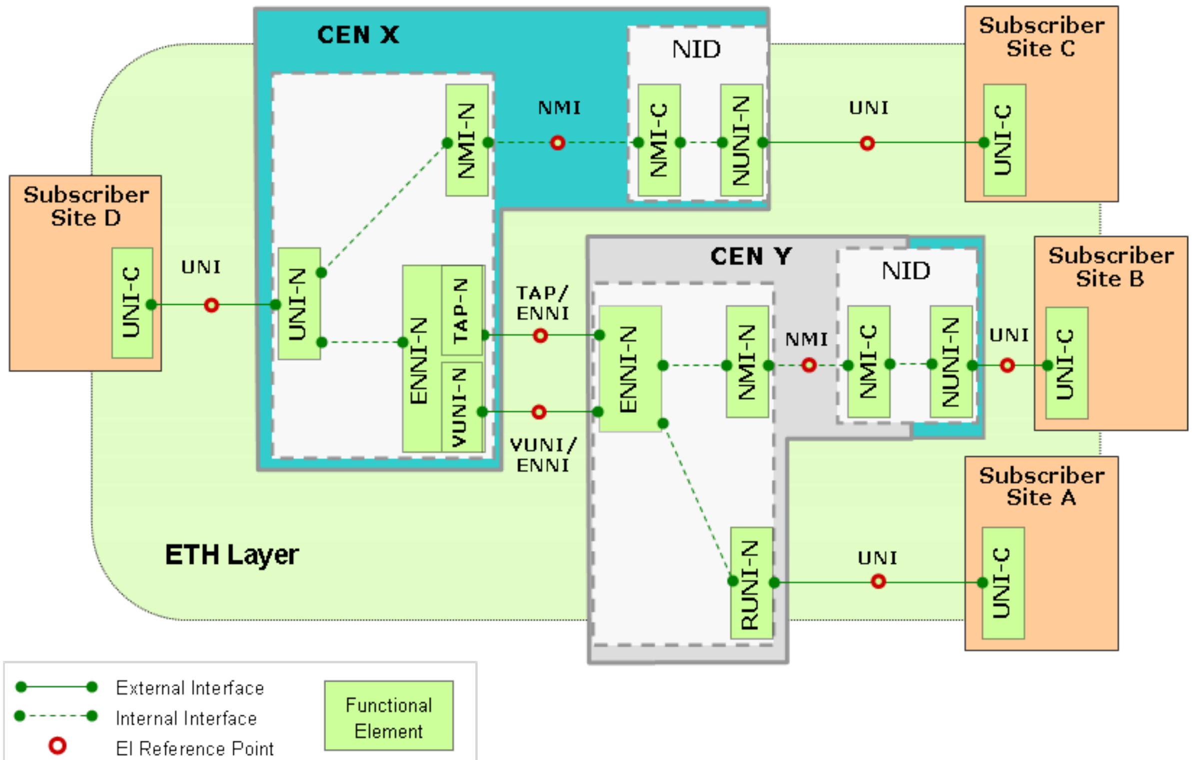

Figure 19: A reference model of the ETH Layer interface extensions and reference points

The reference model for the ETH Layer interface extensions defined in this document, and their associated functional elements, are as follows:

Reference Scenario A: This scenario represents a realization of a UTA based service. A Network Operator (CEN X) interconnects to Subscriber Site A through at least one intermediate Network Operator (CEN Y). CEN Y, the Access Provider, creates an OVC, and associated Tunnel EC, to exchange Service Frames between Subscriber Site A and CEN X, the VUNI Provider. The reference point for the service instance between CEN X and Subscriber Site A is referred to as the VUNI and it is collocated with the ENNI reference point between CEN X and CEN Y. The functional element representing the processing functions required to instantiate the interface between Subscriber Site A and the intermediate Access Provider (CEN Y) is referred to as the Remote UNI-N (RUNI-N). The functional element representing the processing functions required to implement the VUNI is referred to as the VUNI-N. The Access Provider service instance between the UNI and VUNI/ENNI is referred to as the UNI Tunnel Access (UTA) Service. The associated Tunnel EC is referred to as the UTA EC.

[3] For simplicity the prefix ETH is dropped from the name of a Functional Element whenever the Network Layer context is unambiguous from the text.

Reference Scenario B: This scenario represents a realization of an H-NID based service. The Service Provider (CEN X) uses a NID to interconnect to Subscriber Site B through at least one intermediate Network Operator (CEN Y). CEN Y, the Access Provider, creates an OVC, and associated Tunnel EC, to exchange Subscriber frames between Subscriber Site B and CEN X. The NID is referred to as a Hybrid NID as it is co-managed by the Service Provider and the Access Provider via separate management channels. The service instance between the UNI and the ENNI is generically referred to as the H-NID Service (HNS). The associated Tunnel EC is referred to as the HNS EC. The functional element representing the processing functions required to instantiate the HNS from a Service Provider perspective is referred to as the Tunnel Attachment Process - Network (TAP-N).

Reference Scenario C: This scenario represents a realization of a conventional NID based service. The Service Provider (CEN X) uses a NID to interconnect to Subscriber Site C. The NID provides a means for the Service Provider to implement, and potentially distribute, the UNI-N processing functions between the NID and other NEs. The NID can be as simple as a transport device or as complex as a standalone NE with partial or complete UNI capabilities. The NID here is managed by a single operator.

An Ethernet Network Operator supporting remote UNI capabilities for an Ethernet Service Provider is generically referred to as an Ethernet Access Provider.

The interface between a NID and other ETH Layer domain components of the Network Operator CEN is generically referred to as the NID-MEN Interface (NMI). In some realizations the NMI could just be an Internal Interface (II) of a CEN. The specification of an Implementation Agreement for the NMI is outside the scope of this document.

The sections below further describe the interfaces and functional elements associated with the extended ENNI functions in support of the UTA and NID based services.

9.1 The Virtual UNI (VUNI) and Remote UNI

The VUNI is the ETH Layer "virtual" interface at an ENNI providing the demarcation point between the responsibilities (and associated processing functions) of the VUNI Operator delivering a MEF Ethernet Service and the remote Subscriber. The VUNI provides the reference point for the OVC End Points associated with the Service Provider OVCs and the UTA OVC conveying the Subscriber frames across the ENNI. The VUNI reference point coincides with the ENNI reference point. The remote UNI is the ETH Layer "virtual" interface providing the demarcation point for the UTA OVC and an individual Subscriber. The remote UNI demarks the responsibilities of the Access Provider to the intermediate Network Operator (to the VUNI Provider) and the Subscriber with respect to the UTA service.

The VUNI-N is the functional element adjunct to the ENNI-N associated with the VUNI. It represents the set of processing functions dealing with the handling of tunneled Service Frames in support of the UTA Service. The RUNI-N is the functional element representing the set of processing functions to be applied to Service Frames at the UNI in support of the UTA Service. Service Frames across the UNI are "tunneled" between the VUNI-N and RUNI-N using a Tunnel EC. This Tunnel EC is referred to as the UTA SP-EC. Note that the presence of a VUNI-N on a given ENNI-N does not require new processing functionality on the peer ENNI-N of the intermediate Network Operator(s). There **MUST** be a one-to-one relationship between an RUNI-N and its associated VUNI-N.

A UTA Service instance implies the presence of two or more SP-EC instances:

- one Point-to-point SP-EC instance consisting of the O-ECs associated with the SLS between the Service Provider and the intermediate Network Operator (the UTA SP-EC), and
- one or more SP-ECs instances, bounded at one end by the VUNI Provider network and the other end by Remote UNI Access Provider, and each of them consisting of the O-ECs associated with a given EVC in the SLS between the Service Provider and the Subscriber.

From a topological viewpoint a UTA SP-EC consists of:

- one point-to-point O-EC for each traversed Network Operator, and
- one Link EC to interconnect the O-ECs across each pair of peered ENNI-Ns, including the Link EC attaching to the VUNI-N.

Similarly, the SP-EC(s) associated with the Subscriber service(s) consists of at least:

- one Point-to-point, Multipoint or Rooted-Multipoint O-EC for each traversed partner CEN behind the VUNI-N, and
- one Link EC to interconnect the O-ECs across each pair of peered ENNI-Ns across these partner CENs.

Figure 20 shows a UTA SP-EC (UTA SP-EC X8Y5) traversing CEN Y and interconnecting CEN X (the Service Provider) with Subscriber A - Site 1. There are two EVCs (hence, two SP-ECs) associated with the UNI for Subscriber A - Site 1: one Point-to-point EVC/SP-EC to the UNI for Subscriber A - Site 2, and another Point-to-point EVC/SP-EC to the UNI for Subscriber A - Site 3. Figure 20 also shows another UTA SP-EC (UTA SP-EC X7Z2) traversing CEN Z and CEN Y and interconnecting CEN X with the UNI for Subscriber B - Site 1. There is a single EVC/SP-EC associate with the UNI at Subscriber B - Site 1, leading to the UNI for Subscriber B - Site 2. This topological model generalizes to larger number of intermediate CENs traversed either by the UTA SP-EC or the SP-ECs associated with the EVCs.

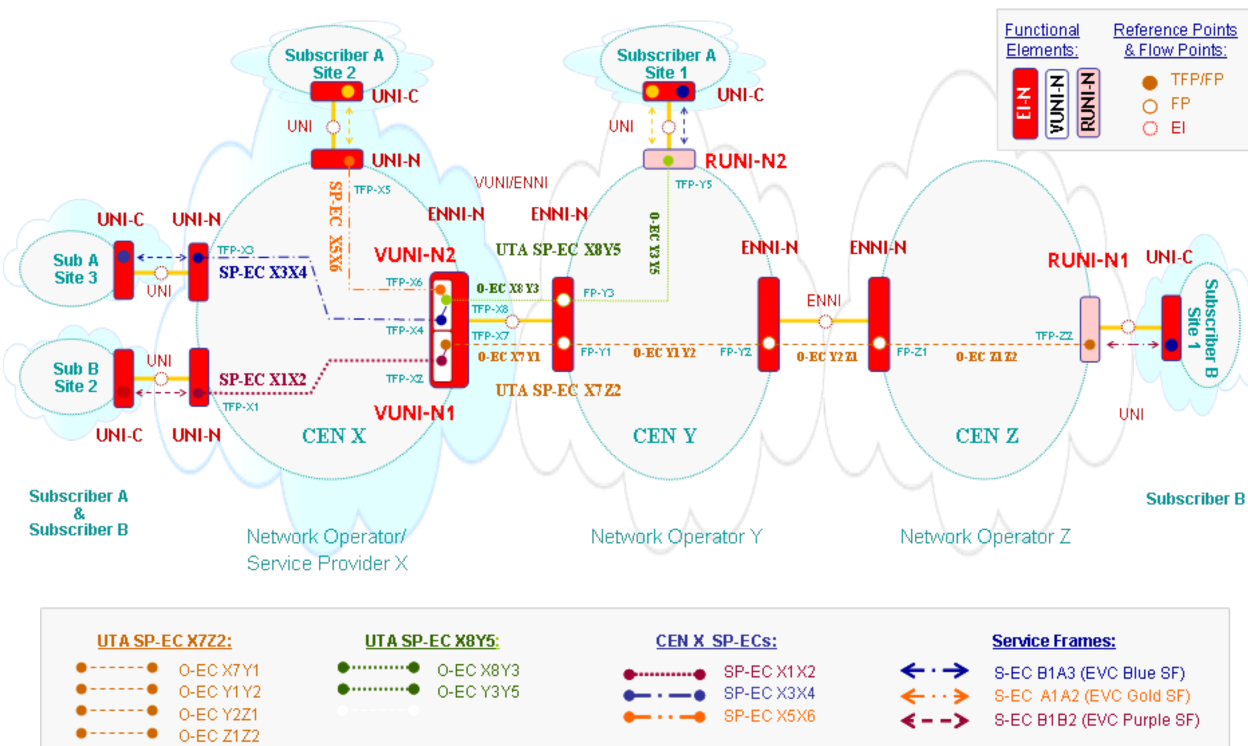

Figure 20: Topological representation of UTA SP-ECs via VUNI-Ns and RUNI-Ns

9.1.1 The Remote UNI-N

The main role of a Remote UNI-N (RUNI-N) is to associate a Subscriber UNI-C with a UTA SP-EC in the intermediate Network Operator.

The RUNI-N functional element consists of the following processing functions:

- a TRAN Termination function (TTF), and associated Adaptation Function (TAF), instantiating the UNI ETH Link towards the UNI-C,
- an ETH Subscriber Conditioning Function (ESCF) at the RUNI-N end of the UNI ETH Link handling the Service Frames according to the contracted SLS between the Service Provider and the intermediate Network Operator for the UTA SP-EC, and
- an ETH EC Termination Function (EETF), and associated Adaptation Function (EEAF), instantiating the UTA SP-EC connecting the RUNI-N to the ENNI-N leading to the VUNI Operator.

Note that the RUNI-N implements a specific profile of the UNI-N as defined in MEF 12.1/Section 8.1 adapted to instantiate a UTA SP-EC to interconnect the RUNI-N with the VUNI-N/ENNI-N.

9.1.2 The Virtual UNI-N

The main roles of a Virtual UNI-N (VUNI-N) are to i) instantiate the UTA SP-EC across the ENNI leading to the RUNI-N, and to ii) instantiate one or more Operator ECs within the VUNI Provider domain to deliver the Subscriber service to the target UNIs.

A VUNI-N consists of the following processing functions:

- an ETH EC Termination Function (EETF), and associated Adaptation Function (EEAF) instantiating the UTA SP-EC connecting to the RUNI-N,
- an ETH Subscriber Conditioning Function (ESCF) to condition the ETH PDUs exchanged between the ETH VUNI-N and the RUNI-N, and
- an ETH EC Termination Function (EETF), and associated Adaptation Function (EEAF), for each Operator EC associated with an EVC as per the SLS between the Service Provider and the Subscriber.

Figure 21 illustrates a functional representation of an ENNI-N with an adjunct VUNI-N based on the scenario described by the topological representation in Figure 20. As before, CEN Y refers to the intermediate Network Operator/Access Provider and CEN X refers to the VUNI Provider. NE Y at CEN Y implements a conventional ENNI-N function as per MEF12.1/Section 8.2. It instantiates O-EC Y3Y5 and O-EC X7Y3 associated with the UTA SP-EC as well as any other O-ECs traversing the ENNI-N, such as O-EC X9Y4 and O-EC X7Y3. NE X at CEN X, in addition to the ENNI-N functions in support of conventional O-ECs, such as O-EC X10X9 and O-ECX9Y4, also implements the adjunct VUNI-N functions in support of the UTA SP-EC. They include the functions required to instantiate the O-EC X7Y3 for the UTA SP-EC, and the O-ECs associated with the SP-ECs for the various EVC service instances, i.e., O-EC X3X 4 and O-EC X5X6.

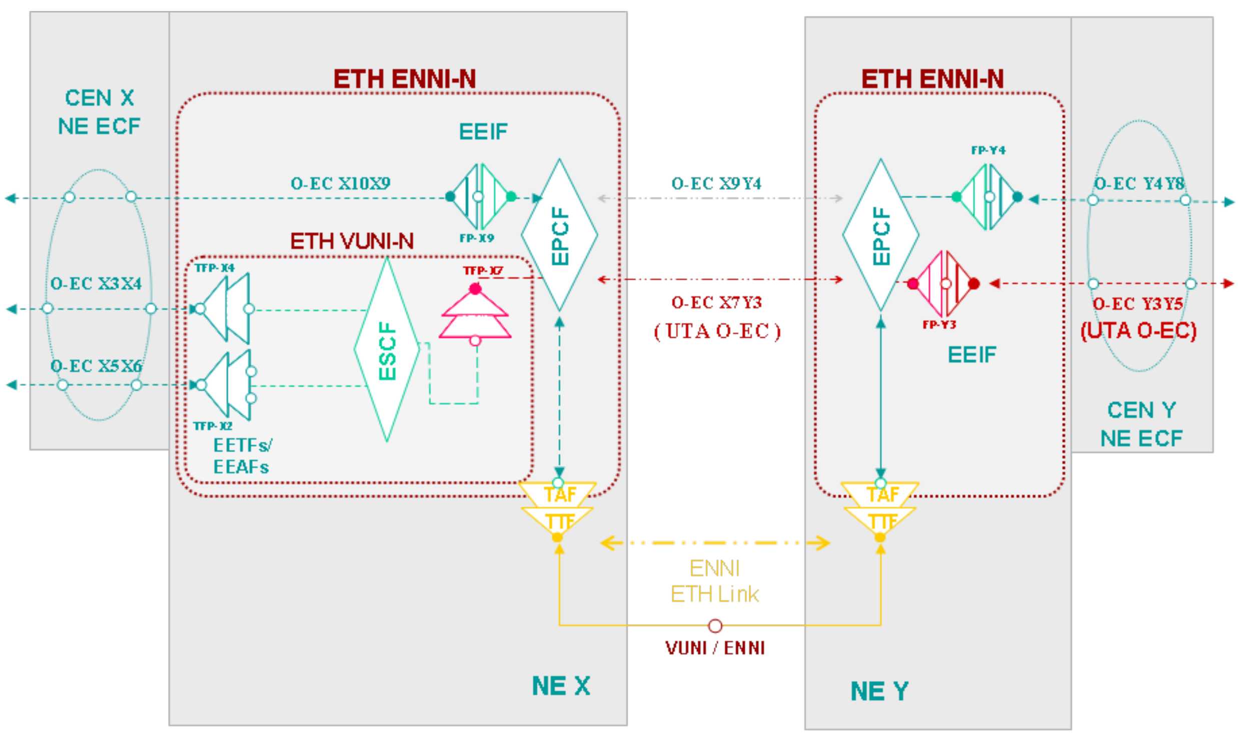

Figure 21: Functional representation of an ENNI-N with an adjunct VUNI-N

9.2 The NID Models and Associated Interfaces

A Network Interface Device (NID) refers to a wide class of compound functional elements intended to connect a Subscriber site to a MEN/CEN. The ETH Layer reference model for a NID is illustrated in Figure 19. The reference point for the NID interface facing the Subscriber UNI, the NID UNI (NUNI), coincides with the reference point for the MEF UNI. The functional element on the NID associated with the NUNI is referred to as the NUNI-N. The reference point for the NID interface toward the Operator MEN/CEN is referred to in this document as the NMI. Note that the NMI represents a realization of a CEN's Internal Interface as per MEF 12.1. The functional element on the NE attached to a NID is referred to as an NMI-N. The functional element on the NID associated with the NMI is referred to as either an NMI-N, if the interface specification is the same as for its peer NE, or an NMI-C, if the interface specification differs from the specification for the peer NE. Specification of an implementation agreement for the NMI is outside the scope of this document.

A NID is envisioned as a compound functional entity delimited by a UNI and an NMI. The functional relationship between a NID port and the Subscriber UNI **MUST** be one-to-one. A physical realization of a NID as a network element **MAY** consist of multiple independent NMI/UNI logical entities.

One or more management channels **MAY** be provided across the NMI. One of such management channels **MAY** be used to interconnect the Management Entity of a NID to the Management Entity of the Network Operator. The O-EC associated with this management channel is referred to here as the NID Management EC (MGT EC). Another of such management channels **MAY** be used to interconnect the NID Management Entity associated with the Service Provider functions with the Service Provider Management Entity. The O-EC associated with this management channel is referred to here as the NID Remote Management Interface EC (RMI EC).The Management Entities are not considered functional elements in the ETH Layer but are significant components of the Hybrid NID Model. Note it is also possible to implements these management channels by means outside the ETH Layer.

Multiple NID types could be envisioned according to different service interconnect models and business relationships among the Network Operators participating in the Subscriber Service, the Service Provider and the Subscriber. In some instances the NUNI-N may be a standard UNI-N as specified in MEF13/MEF20. In other instances, the standard UNI functions realizing the Service Attributes specified in MEF 10.2 and MEF26 could be distributed across External Interfaces and the NUNI-N may only include a subset of the UNI-N functions. Similar considerations apply to a realization of an NMI. Thus, a number of variations of the associated NMI and NUNI functional elements could be specified.

Three NID types are described in this document:

- the Transport NID,
- the Service NID,
- the Hybrid NID.

Topological and functional representation of the functional elements and ECs associated with these NID types are described in the next sections. Other variations of the NID concept may also be defined. Implementation Agreements for NIDs and Technical Specification of NID based services is outside the scope of this document.

9.2.1 The Transport NID

A Transport NID (T-NID) represents a class of transport-level demarcation functions between a MEN/CEN and a Subscriber. A Transport NID is primarily intended as an ETH/TRAN Layer demarcation entity with very limited ETH Layer demarcation capabilities other than those required for operational visibility into the Network Operator/Subscriber ETH Link. In particular, a T-NID is not intended to provide demarcation for individual EVCs. It is envisioned that a Transport NID would commonly provide media conversion functions between the Subscriber's UNI-C and the Network Operator's NMI-N. For instance, a T-NID could provide media conversion from an IEEE 802.3 100Base-T interface on the UNI to an Ethernet over PDH interface on the NMI. Implementation Agreements for T-NIDs and Technical Specifications for T-NID based services are outside the scope of this document.

Figure 22 illustrates a topological representation of a CEN with a T-NID acting as a media convertor. Here, a T-NID is employed to interconnect Subscriber Site A and CEN X and, from there, to Subscriber Site B and Subscriber Site C. The are two ETH Links associated with the T-NID in this scenario: i) the UNI ETH Link at the NUNI connecting to Subscriber Site A, and ii) the NMI ETH Link connecting to the rest of the CEN X over the NMI. The Subscriber ECSs (namely, S-ECS X5A1 and S-ECS X6A2) are forwarded through an ETH PDU relay function in the T-NID. Yet, these S-ECSs are not relevant to the NUNI-N or NMI-C processing functions. There is no ETH Layer functionality on the T-NID other than that required to adapt the Subscriber PDUs from the physical media of the UNI to the physical media of the NMI. This is represented by the absence of FPs in the NUNI-N and NMI associated with the individual Subscriber ECs[4]. All other EVC demarcation functions are implemented at the NMI-N, as represented by the TFP(s) on the NMI-N associated with the SP-ECs for the Subscriber EVCs (SP-EC X7X5 and SP-EC X8X6). Note the separate O-EC, the MGT EC, used to convey the NID management channel across the NMI.

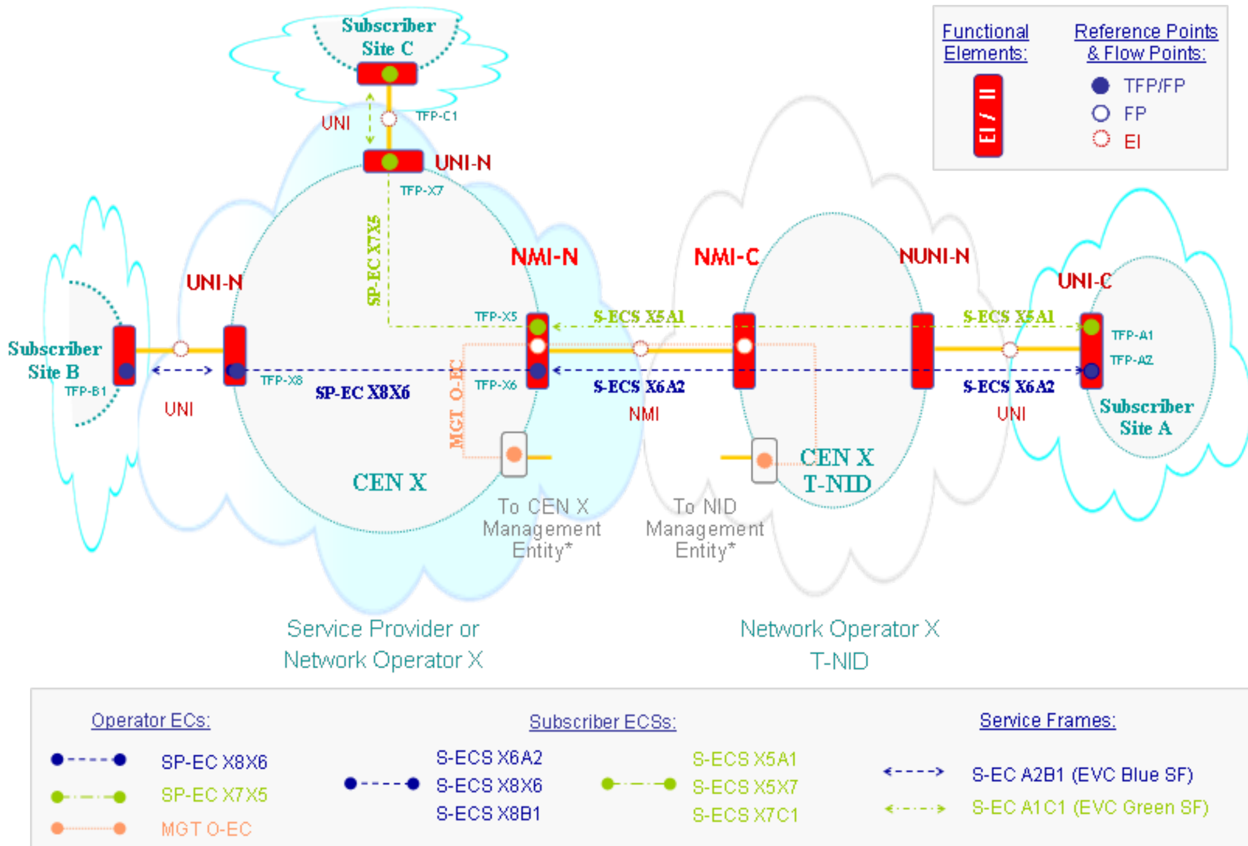

Figure 22: Topological representation of ETH Layer services via a Transport NID

9.2.2 The Service NID

A Service NID (S-NID) represents a class of service-level demarcation functions between a Service Provider and a Subscriber. A Service NID is intended to provide similar transport level demarcation capabilities as a T-NID. In addition, a Service NID is also intended to provide service-level demarcation capabilities for individual EVCs. Some S-NID types could offer a complete set of UNI-N capabilities at its NUNI-N as specified in MEF13/MEF20. Other S-NID types could just provide a subset of UNI-N capabilities, with the rest of the UNI-N capabilities being provided by the NMI-N. This configuration is referred as a partial UNI-N. Implementation Agreements or for S-NIDs and Technical Specifications for S-NID based services are outside the scope of this document.

Figure 23 illustrates a topological representation of a CEN with an S-NID offering a partial UNI-N based on the same service scenario used for the T-NID example in Figure 22. The S-NID is employed instead to interconnect Subscriber Site A to CEN X and, from there, to Subscriber Site B and Subscriber Site C. In this scenario the two Subscriber ECSs traversing the UNI ETH Link connecting Subscriber Site A with CEN X (namely, S-ECS X5A1

[4] Formally, there would be a single FPP associated with the bundle of S-ECSs across the NUNI-N and NMI-C.

and S-ECS X6A2) are of relevance to the NUNI-N and NMI-C processing functions. In particular, the S-NID provides the ETH Layer functions required to demark, manage and monitor the Subscriber EC segments associated with the EVCs, as illustrated by the FPs for S-ECS X3X1/S-ECS X5X3 and S-ECS X4X2/S-ECS X6X4 on the NUNI-N and NMI-C. Each Subscriber ECS is forwarded as a single service entity through an ETH PDU relay function at the S-NID (S-NID ECF). All other EVC specific service demarcation functions are implemented at the NMI-N, as illustrated by the TFPs on the NMI-N associated with the SP-ECs for the Subscriber EVCs (SP-EC X7X5 and SP-EC X8X6). Note also the separate MGT EC used to convey the S-NID management channel across the NMI.

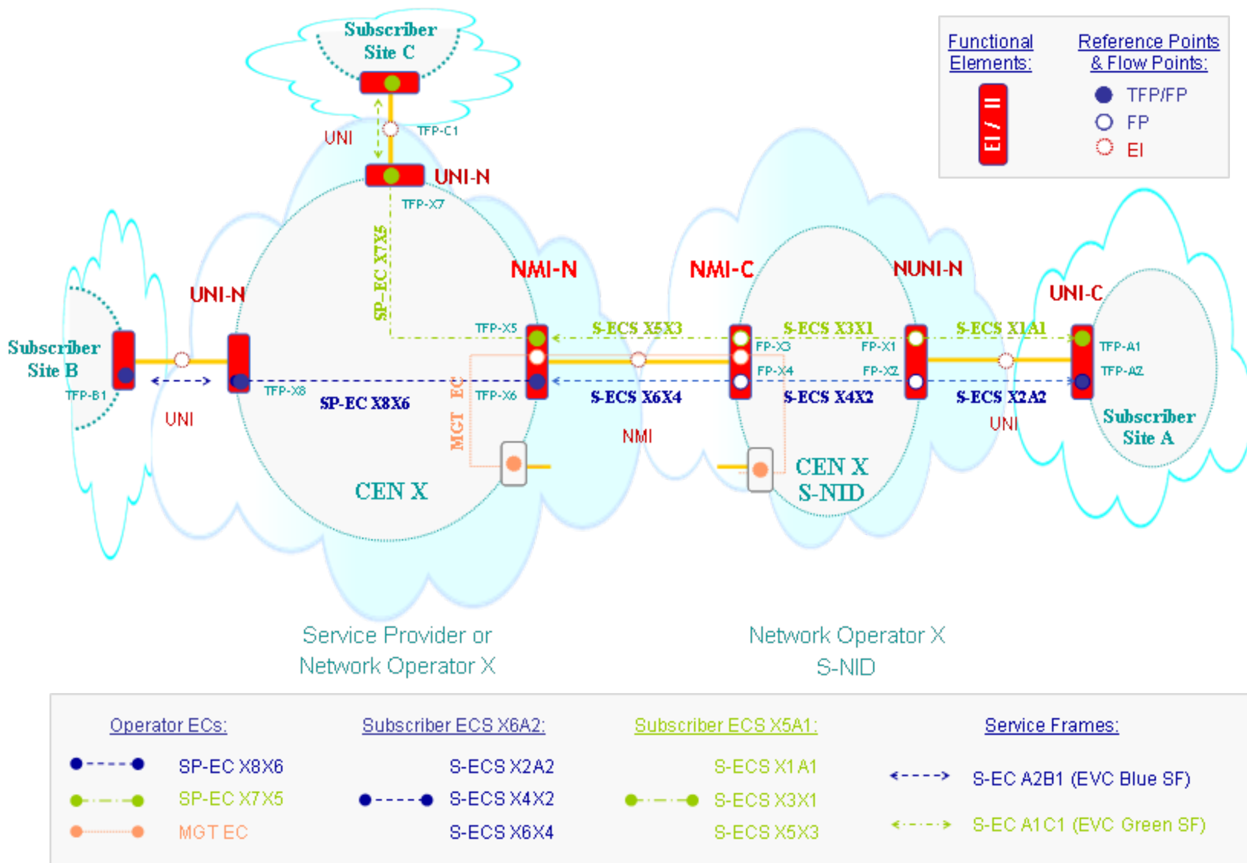

Figure 23: Topological representation of ETH Layer services via an S-NID with a partial UNI-N

9.2.2.1 The Service NID UNI-N

The S-NID UNI-N (SUNI-N) represents the set of ETH Layer processing functions required to provide the transport and service level demarcation capabilities for an S-NID. An SUNI-N is expected to support a subset of the processing capabilities of a UNI-N as per MEF 12.1/Section 8.1. Nonetheless, the usage of an S-NID is not envisioned to modify the service interface presented by MEF complaint MEN/CEN Network Operators to the Subscribers of the Ethernet Service, but it might constrain the service options offered by the Service Provider to its Subscribers.

At a minimum, an SUNI-N supporting a partial UNI-N consists of the following processing functions:

- a TRAN Termination Function (TTF), and associated Adaptation Function (TAF), instantiating the UNI ETH Link towards the UNI-C, and
- an S-NID ETH Flow Conditioning Function (S-EFCF) handling the ETH PDUs for the Subscriber ECs across the UNI ETH Link.

The S-EFCF connects directly to an ECF (S-NID ECF) implementing the MAC frame forwarding functions across the S-NID ports. The S-EFCF also provides the set of service delimiting capabilities envisioned for the S-NID for Subscriber flow classification and conditioning purposes.

Figure 24 illustrates a functional representation of an SUNI-N for an S-NID with a partial UNI-N based on the service scenario depicted in Figure 23. Here, the SUNI-N attaches the S-NID to the Subscriber UNI-C via a UNI ETH Link. An S-EFCF provides the required ingress/egress flow classification and conditioning functions required on the Service Frames to associate each S-ECS (i.e., S-ECS X1A1 and S-ECS X2A2) with additional S-ECS segments (i.e., S-ECS X3X1 and S-ECS X4X2) to be propagated and monitored across CEN X. The S-EFCF connects directly to the connection function of the S-NID (S-NID ECF).

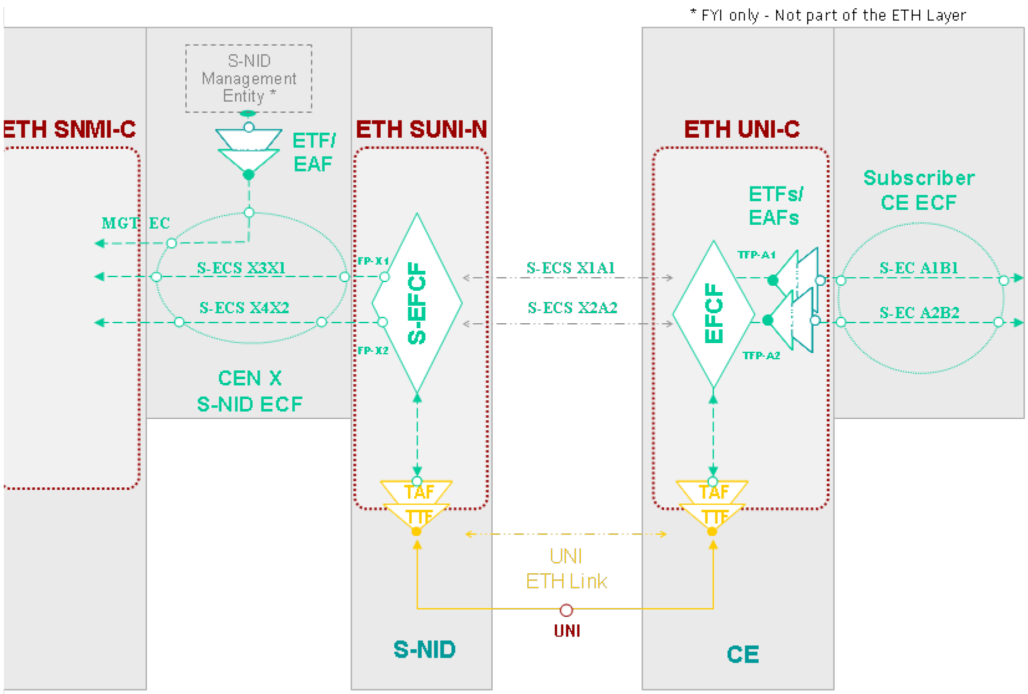

Figure 24: Functional representation of an ETH SUNI-N with a partial UNI-N

9.2.2.2 The Service NMI-N & NMI-C

The Service NMI is the specified ETH Layer interface between a CEN NE and an S-NID. The Service NMI-C (SNMI-C) represents the ETH Layer functional element, and associated processing functions, required to interconnect an S-NID to a CEN. The Service NMI-N (SNMI-N) represents the ETH Layer functional element, and associated processing functions, required to interconnect a CEN NE to an S-NID.

At a minimum, an SNMI-C consists of the following processing functions:

- a TRAN Termination Function (TTF), and associated Adaptation Function (TAF), instantiating the NMI ETH Link toward the ETH NMI-N,
- an S-NID ETH Flow Conditioning Function (S-EFCF) at the NMI-C end of the NMI ETH Link, and
- an (optional) EETF/EEAF pair for each O-EC Link instantiated across the NMI when the NMI frames are associated with O-ECs not using a C-VLAN based ETH Sublayer.

The MGT EC can be instantiated either in a C-VLAN based ETH Sublayer or any ETH Sublayer use to exchange frames at the NMI. The processing functions required to implement the MGT O-EC need not be part of the SNMI-C.

At a minimum, a SNMI-N consists of the following processing functions:

- a TRAN Termination Function (TTF), and associated Adaptation Function (TAF), instantiating the NMI ETH Link towards the NMI-C,
- an S-NID ETH Subscriber Conditioning Function (S-ESCF) at the NMI-N end of the NMI ETH Link,
- an ETH EC Termination Function (EETF), and associated Adaptation Function (EEAF), for each Service Provider EC/Operator EC associated with a set of Subscriber ECs as per the SLS with the Subscriber, and
- an (Optional) EETF/EEAF pair for each O-EC Link instantiated across the NMI when the NMI frames are associated with O-ECs outside a C-VLAN based ETH Sublayer.

Note that the SNMI-N can be considered a superset of the UNI-N as defined in MEF12.1/Section 8.1 enhanced to support the Subscriber ECS instantiated across the SNMI-C.

Figure 25 illustrates a functional representation of the SNMI-N and the SNMI-C associated with an S-NID with a partial UNI-N based on the service scenario depicted in Figure 23. On the S-NID, the SNMI-C attaches the S-NID to the NE via the NMI ETH Link. An S-EFCF provides the ingress/egress flow classification and conditioning functions required to aggregate Subscriber ECSs (i.e., S-ECS X5X3 and S-ECS X6X4) with the MGT EC on the NMI. The S-EFCF connects directly to the ETH PDU relay function of the S-NID (S-NID ECF). On the CEN X NE, the SNMI-N attaches to the S-NID via the NMI ETH Link. An S-ESCF provides the ingress/egress flow classification and condition functions required on the Subscriber frames according to the SLS for each Subscriber. The EETF/EEAF pair provides termination/adaptation of the O-ECs (i.e., O-EC X7X5 and O-EC X8X6) required to convey the Subscriber frames across CEN X. The EETF/EEAF connects directly to the connection function of the NE (NE ECF).

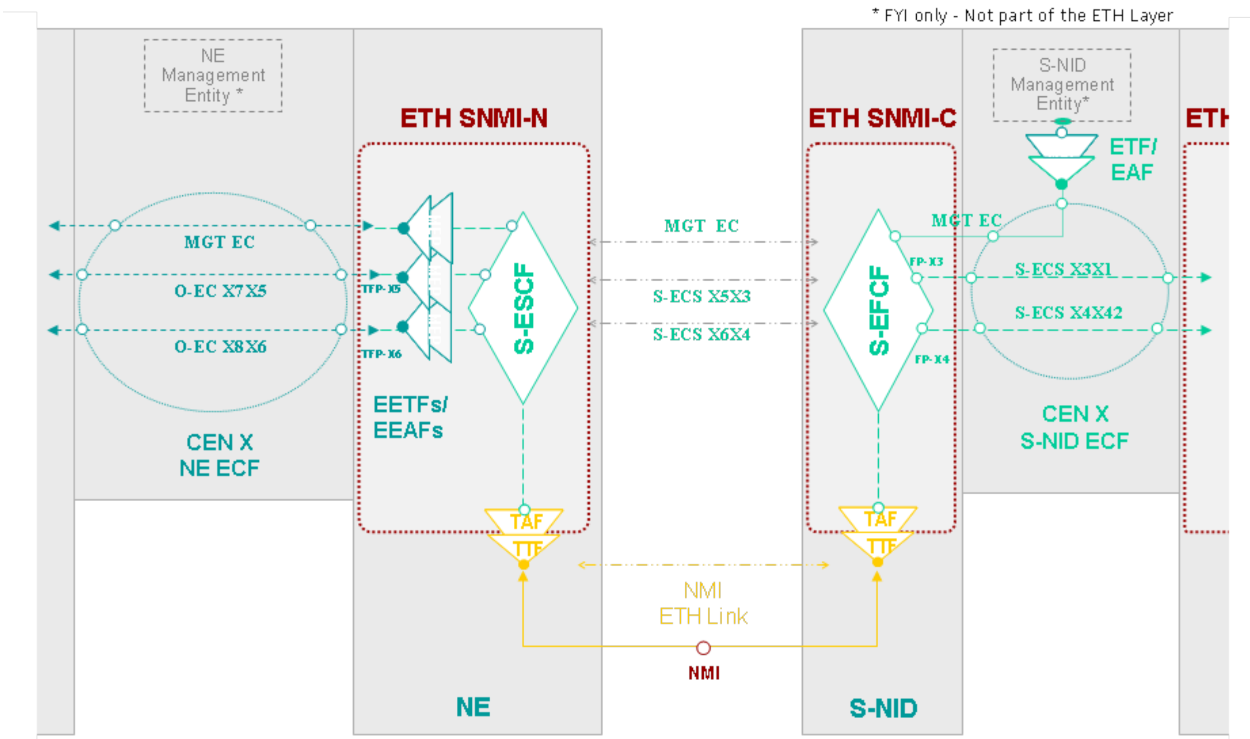

Figure 25: Functional representation of an ETH SNMI-N and SNMI-C

9.2.3 The Hybrid NID

A Hybrid NID (H-NID) represents a wide class of transport/service-level demarcation functional entities between a Service Provider, a Subscriber, and an intermediate Network Operator - the Access Provider. Specifically, a Hybrid NID is intended to enable frame forwarding among two Ethernet Network Operators: one acting as the Service Provider for the Subscriber service, and the other acting as the access link provider between the Service Provider and the Subscriber, that is, the Access Provider.

The Hybrid NID UNI is intended to provide a wide range of service demarcation capabilities for EVCs and OVCs consistent with MEF6, MEF13/MEF20 and MEF26. But, unlike the T-NID and S-NID, the NMI of an H-NID is under operational control of the Access Provider, not the Service Provider. Hence, a significant operational aspect of the H-NID concept is the ability to offer separate access to the management functions under control of the Access Provider and those under control of the Service Provider.

There are a number of approaches that can be envisioned to instantiate H-NID functionality. One approach would require a Tunnel EC to be instantiated between the H-NID UNI-N and an ENNI-N on a Network Operator designated by the Service Provider. This Tunnel EC traversing the Access Provider's network is referred to as the HNS SP-EC. Another approach is to use a similar service model as in MEF26 and split the NUNI-N configuration, provisioning and maintenance aspects between the Service Provider and the Access Provider using functionality equivalent to a (virtual) ENNI. In this approach, there is no additional Tunnel EC based service required to instantiate the service. Other approaches may be envisioned. Note that Implementation Agreements for H-NIDs and Technical Specifications of H-NID based services are outside the scope of this document.

The HNS SP-EC is intended to convey not only the frames associated with the Subscriber ECs, but also the management channel associated with the component of the Management Entity in the H-NID responsible for configuration, provisioning and maintenance of the Service Provider specific functions, the RMI EC. Note the RMI EC is distinct from the O-EC for the management channel associated with the component of the H-NID Management Entity responsible for the Access Provider functions (the MGT EC). Alternatively, it is also possible to convey the RMI EC as a separate O-EC from the O-EC associated with the HNS SP-EC. The specification of the implementation of these management channels is outside the scope of this document.

10 References

These references update and expand the Reference Section for MEF 12.1:

[32] Metro Ethernet Forum, MEF 28, "External Network-Network Interface (ENNI) Support for UNI Tunnel Access and Virtual UNI." October 2010.

[33] Metro Ethernet Forum, MEF 30, "Service OAM Fault Management Implementation Agreement" January 2011

[34] IEEE Std 802-2001, IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture. February 2002.

[35] ISO/IEC 8802-2: 1998, Information technology -- Telecommunications and information exchange between systems -- Local and metropolitan area networks -- Specific requirements -- Part 2: Logical link control.

Appendix I: ETH Layer Model for Service OAM

This appendix provides an ETH Layer functional model for the MEF Service OAM (SOAM) framework as specified in MEF 17 and MEF 30. It identifies the relative placement for OAM functional components (MEPs and MIPs) with respect to other functional components of the ETH Layer in order to achieve the OAM coverage intended by the maintenance domains specified in the MEF SOAM framework. This appendix focuses on the functional model of SOAM entities as applicable to functional elements associated with the UNI, ENNI and the adjunct ENNI functions, the VUNI and TAPs.

The appendix is structured as follows: Section I.1 overviews the SOAM reference model from MEF17, the Ethernet OAM terminology in IEEE and ITU-T, and modeling conventions used here for the functional representation of the OAM processing entities. Section I.2 describes the OAM functional entities in support of the base EI functional elements, i.e., UNI and ENNI. Section I.3 describes the OAM functional model in support of the extended EI functional elements i.e., remote UNI and VUNI and TAPs.

I.1 Definitions and Modeling Conventions

The Appendix addresses the OAM functional elements associated with the UNI and ENNI. The relationship between the MEF Service model and the Architecture constructs are discussed in MEF 12.1/Section 5.4.3.

I.1.1 Mapping between IEEE and ITU OAM Terminology

The MEF SOAM framework is based on the Ethernet OAM models specified by IEEE 802.1ag [6] and ITU-T Y.1731 [15]. There are some differences in terminology between the two documents. Table I.1 provides a mapping between some common terms used in this appendix.

IEEE 802.1ag	ITU-T Y.1731
Maintenance Association (MA)	Maintenance Entity Group (MEG)
Maintenance Association Identifier (MAID)	Maintenance Entity Group Identifier (MEGID)
Maintenance Domain (MD)	“Domain”[5]
Maintenance Domain Level (MDL)	Maintenance Entity Group Level (MEG Level or MEL)

Table I.1: Mapping between IEEE and ITU OAM Terms

I.1.2 Representing MEPs and MIPs

ITU-T G.8021 [12] provides a more detailed functional description of the processing entities used by Ethernet Networks, including OAM components. In the ITU-T models, OAM components are typically represented as a combination of AFs and TFs with dedicated OAM related processing. Typically:

- A MEP is represented as an Adaptation Function / Termination Function (AF/TF) pair
- A MIP is represented as “back-to-back” Adaptation Functions.

Depending on the placement of the OAM functions with respect to the monitored transport entity and the use of Shared vs. Independent MELs, that is, whether the MEL field in the OAM PDU is shared or not across a number of Ethernet Networks (see ITU-T Y.1731 Sec 6.2), the AF component of the associated transport entity may be reused in the instantiation of MEGs. This Appendix follows a similar convention for the representation of MIPs/MEPs with the following exceptions:

[5] Not a formal term used in the OAM functional descriptions.

- a “circle” is used as the icon to represent a MIP. This is done to provide a similar representation style as in MEF17,
- a TF/AF pair is used as the icon to represent a MEP,
- a shadowed TF/AF pair is used as the icon to represent a MEP instantiated to monitor a segment of an EC rather than the end-to-end EC.
- These representation conventions for MEPs and MIPs are illustrated in Figure I.1.

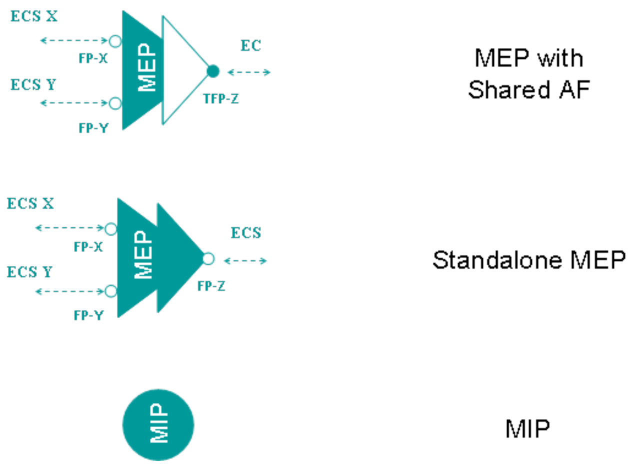

Figure I.26: Diagrammatic representation of OAM processing entities in the ETH Layer

I.2 SOAM Functional Model for the ETH Layer

The representation of the SOAM entities requires visibility of the monitored EVC/OVC, and hence, corresponding ECs, at the relevant EIs. Yet, not all ECs traversing a CEN need be visible by all traversed EIs. As an example, Subscriber ECs conveyed via Tunnel ECs, such as the UTA EC, are not visible to intermediate Network Operators.

The following subsections describe a functional representation of the SOAM model for the ETH Layer. They identify suitable placement for the OAM processing entities (MEPs and MIPs) with respect to other processing elements that apply to the functional elements such as the UNI-N and ENNI-N.

I.2.1 SOAM Reference Model for the Base EIs

MEF17 specifies the MEF SOAM framework for both single CEN and multi CEN scenarios. Figure I.2, adapted from MEF 17/Figure 5[6], illustrates the SOAM framework for the base EIs: the UNI and the ENNI. As noted in MEF17, when an EVC or an OVC is provisioned to instantiate an Ethernet Service, a number of MEGs are expected to be instantiated to enable the fault management and performance monitoring functions associated with the EVC/OVC. In a single CEN scenario, the minimum set of MEG types associated with a Subscriber EC includes:

- a Subscriber MEG,
- an EVC MEG, and
- a UNI MEG.

[6] Note that MEF17/Figure 5 refers to Point-to-point MEG. Thus, the use of MEG vs. ME is equivalent.

In a multi CEN scenario, three additional MEG types may be associated with a Subscriber EC:

- an Operator MEG, and
- an ENNI MEG, and
- an SP MEG.

For services requiring base EI functionality the EVC MEG and SP MEG have the same OAM coverage and can be used for the same OAM purposes. The next sections describe placement expectations associated with OAM entities for each of these MEGs at a UNI and ENNI.

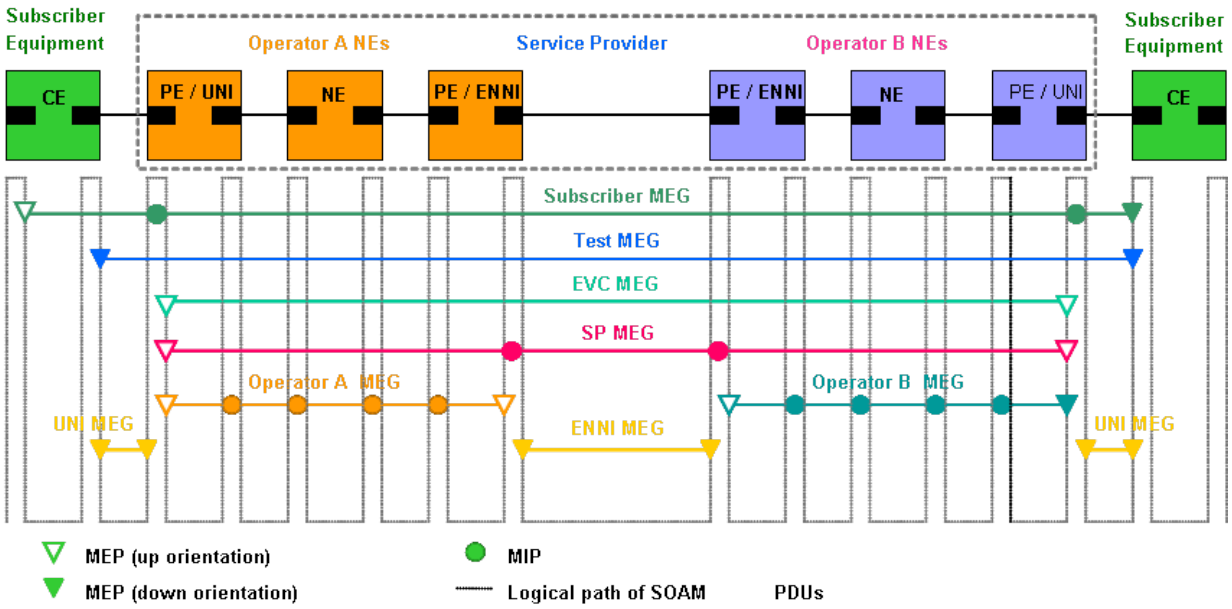

Figure I.27: Example of SOAM Framework for the UNI and ENNI (derived from MEF 30, Figure 1)

The sections below describe placement conventions for the MEPs and MIPs for MEGs specified in the MEF17 and MEF30 Service OAM framework. Note, however, that all Ethernet networking technologies may not have the capability to support MEP/MIPs at the locations specified by the SOAM framework. In particular, MIPs associated with C-VLANs may not be visible at intermediate External Interfaces, such as ENNI-Ns, if the NE only handles Ethernet frames at ETH Sublayers other than a C-VLAN based sublayer. Specification of SOAM implementation agreements for EIs is outside the scope of this document.

I.2.1.1 OAM Entities at a UNI

Figure I.3 depicts a functional representation of a UNI and the relative placement of OAM entities at the UNI-N and UNI-C in order to instantiate OAM functions for the Subscriber, EVC, Operator and UNI MEGs.

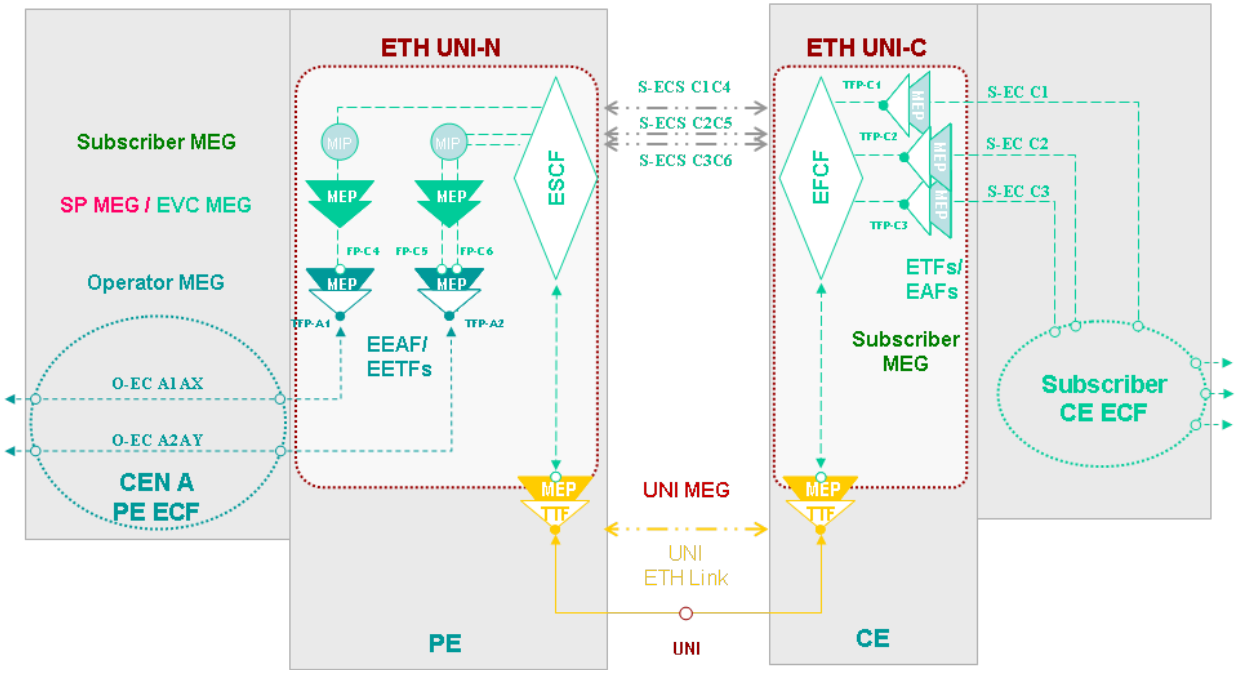

Figure I.28: Functional representation of MEPs & MIPs at a UNI

I.2.1.1.1 UNI MEG

The UNI MEG is intended to cover the OAM requirements for the UNI ETH Link. Specifically, a UNI MEG is intended to monitor a link connection between the PE port in the Network Operator domain and the CE port in the Subscriber domain. A MEP instantiating a UNI MEG is expected to be placed as close as possible to the monitored UNI ETH Link.

I.2.1.1.2 Subscriber MEG

The Subscriber MEG is intended to cover the OAM requirements for an EVC from the Subscriber perspective. Specifically, a Subscriber MEG is intended to monitor the Subscriber ECs between a CE port at a UNI-C and a PE port at another UNI-C associated with the same EVC.

Placement of a Subscriber MEP is primarily dictated by the need to associate Service Frames with EVCs across a UNI. A MEP instantiating a Subscriber MEG is expected to be placed as close as possible to the ETF/EAF pair(s) instantiating the Subscriber EC(s) to be monitored.

There could be a MIP associated with the Subscriber MEG at a UNI-N. If present, it is expected to be placed as close as possible to the ESCF responsible for classification, conditioning and mapping of the Subscriber ECs at the UNI-N with the corresponding EVC.

I.2.1.1.3 EVC MEG

The EVC MEG is intended to cover the OAM requirements for an EVC from the Service Provider perspective. Specifically, an EVC MEG is intended to monitor the Subscriber ECs across the traversed Network Operator domain(s).

Placement of an EVC MEP is primarily dictated by the need to associate Service Frames with an EVC. A MEP instantiating an EVC MEG is expected to be placed as close as possible to the EETF/EEAF pair instantiating the associated Operator EC[7] for the EVC but outside the domain of the corresponding Operator MEG.

I.2.1.1.4 SP MEG

The SP MEG is intended to cover the OAM requirements for Tunnel ECs, if present. Specifically, an SP MEG is intended to monitor bundles of ECs across the traversed Network Operator domain(s).

Placement of an SP MEP is primarily dictated by the need to associate Frames with a Tunnel EC. A MEP instantiating a SP MEG is expected to be placed as close as possible to the EETF/EEAF pair instantiating the associated Tunnel EC. For most retail-based services the SP MEG overlaps in coverage with the EVC MEG, and hence, it need not be present or it shares location with the corresponding EVC MEP (see Figure I.3).

I.2.1.1.5 Operator MEG

The Operator MEG is intended to cover the OAM requirements for an Operator EC within a CEN. As an example, an Operator MEG can be used to monitor the Operator EC associated with an OVC or a segment of one or more Subscriber ECs across a Network Operator domain. In a single CEN scenario where the boundaries of the OAM domain for an EVC and an Operator overlap, the monitoring functions for an EVC can be accomplished via an Operator MEG.

As with EVC MEPs, placement of an Operator MEP at a UNI-N is primarily dictated by the need to associate Service Frames with an OVC. A MEP instantiating an Operator MEG is expected to be placed as close as possible to the EETF/EEAF pair instantiating the corresponding Operator EC.

I.2.1.2 OAM Entities at an ENNI

Figure I.4 below depicts a functional representation of an ENNI and the relative placement of OAM entities at an ENNI-N in order to instantiate OAM functions for EVC, Operator and ENNI MEGs.

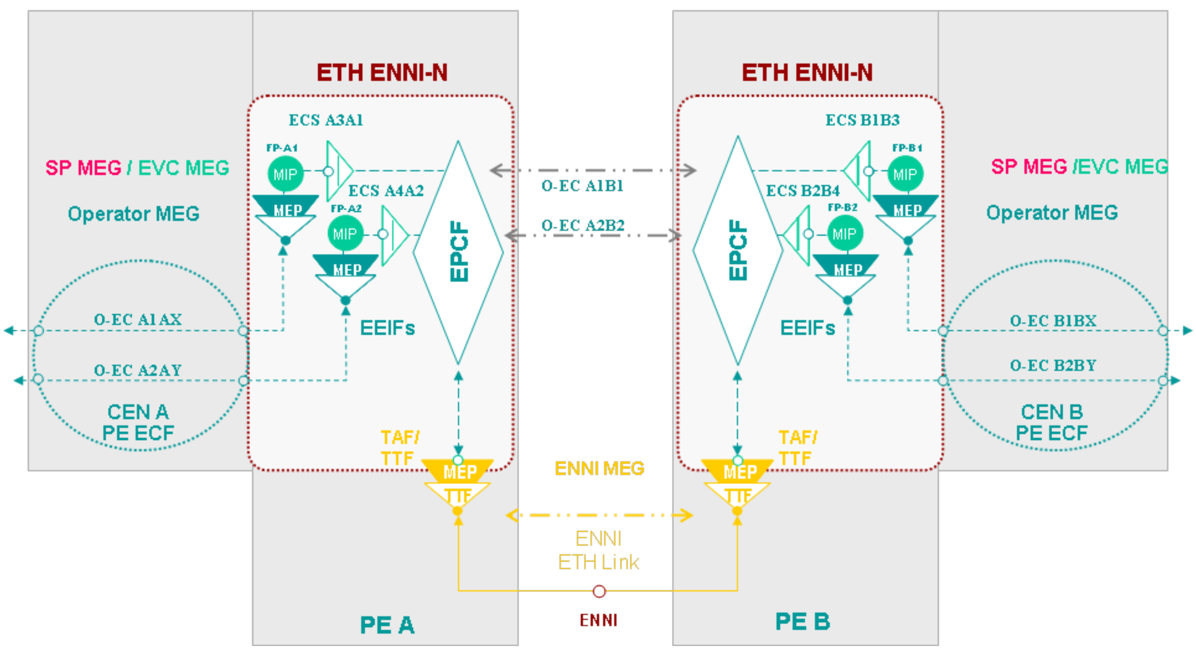

Figure I.29: Functional representation of MEPs & MIPs at an ENNI

[7] Note that an Operator EC may not always be present in a particular Operator CEN. This may be the case, for instance, in small aggregation MENs interconnected via a larger backbone CEN.

I.2.1.2.1 ENNI MEG

The ENNI MEG is intended to cover the OAM requirements for the ENNI ETH Link. Specifically, an ENNI MEG is intended to monitor a link connection connecting the PE ports of two CEN domains. A MEP instantiating an ENNI MEG is expected to be placed as close as possible to the monitored ENNI ETH Link.

I.2.1.2.2 Operator MEG

The Operator MEG is intended to cover the OAM requirements for Operator ECs within a CEN. As an example, an Operator MEG can be used to monitor the Operator EC associated with an OVC or a segment of one or more Subscriber ECs across the Network Operator domain.

Placement of an Operator MEP at an ENNI-N is primarily dictated by the need to associate ENNI Frames with an Operator EC. A MEP instantiating an Operator MEG at a base ENNI-N is expected to be placed as close as possible to the EETF/EEAF pair instantiating the corresponding Operator EC.

I.2.1.2.3 EVC MEG

The EVC MEG is intended to cover the OAM requirements for EVCs from a Network Operator perspective. In certain scenarios a Service Provider may wish to allow other Network Operators to monitor a segment of an EVC at an ENNI. Such a capability can be accomplished via a MIP for the EVC MEG at the target ENNI-N.

Placement of an EVC MIP at an ENNI-N is primarily dictated by the need to associate ENNI Frames with EVCs and the corresponding Operator EC. A MIP associated with an EVC MEG is expected to be placed as close as possible to the EPCF responsible for classification, conditioning and mapping between Link ECs (e.g., S-Tagged frames) at the ENNI-N and the corresponding Operator EC.

Note, however, that all Ethernet networking technologies may not have the capability to support EVC MIPs at an ENNI-N. In particular, MIPs associated with C-VLANs may not be visible at ENNI-Ns, if the NE only handles Ethernet frames at ETH Sublayers other than a C-VLAN based sublayer. Specification of SOAM implementation agreements for EIs is outside the scope of this document.

I.2.1.2.3 SP MEG

The SP MEG is intended to cover the OAM requirements for Tunnel ECs, if present. In certain scenarios a Service Provider may wish to allow other Network Operators to monitor a segment of Tunnel EC at an ENNI. Such a capability can be accomplished via a MIP at the target ENNI-N.

Placement of an SP MIP at an ENNI-N is primarily dictated by the need to associate ENNI Frames with a Tunnel EC. A MIP associated with a SP MEG at a base ENNI-N is expected to be placed as close as possible to the TF/AF pair instantiating the corresponding Link EC (e.g., S-Tagged frames) across the E-NNI. If present, the SP EC MIP can share location with the corresponding EVC MIP (see Figure I.4) assuming both MEGs are instantiated at the same ETH Sublayer. In that case, the SP MEG should use a lower MEL than the EVC MEG.

I.2.2 SOAM Reference Model for the EI Extensions

MEF 30 specifies the Service OAM Fault management Implementation Agreement applicable to EI extensions for the remote UNI and VUNI. Figure I.5, adapted from MEF 30/Figure 4[8], illustrates the OAM framework as applicable to the UTA Service in MEF 28. As noted in MEF 28, when a tunnel based OVC service, such as a UTA OVC, is provisioned to instantiate an Ethernet Service across two or more Network Operators, a number of SOAM MEGs are also expected to be instantiated to enable the fault management and performance monitoring functions associated with the end-points of the OVC. The SOAM MEG associated with such a Tunnel EC is referred to as a Service Provider MEG (SP MEG). A similar SP MEG arises when monitoring O-ECs supporting Hybrid-NID based services.

[8] Note that MEF17/Figure 5 refers to Point-to-point MEG. Thus, the use of MEG vs. ME is equivalent.

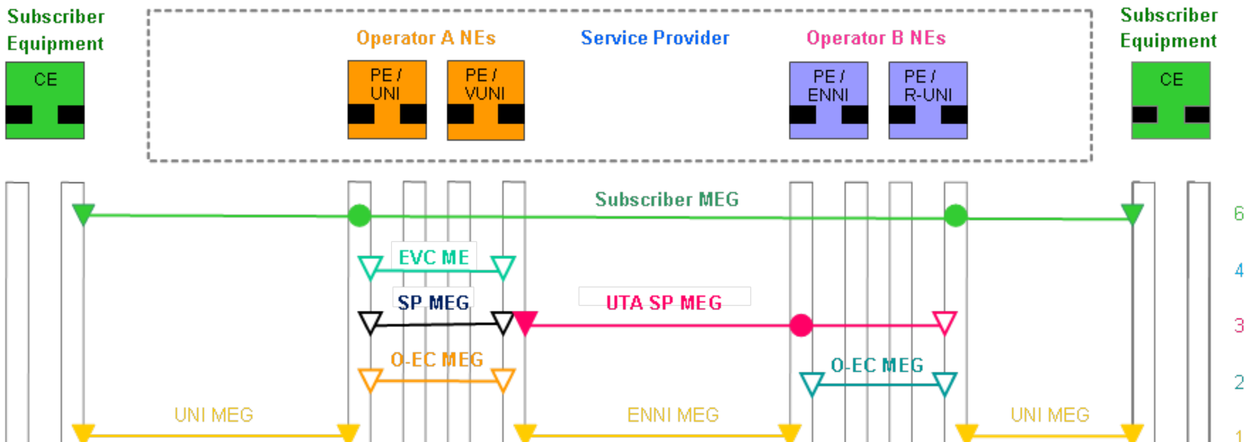

Figure I.30: Example of SOAM Framework applied a UTA Service (derived from MEF 30, Figure 4)

The next sections describe placement expectations for the OAM entities associated with the MEGs at an RUNI-N, VUNI-N and TAP-N.

I.2.2.1 OAM Components at the RUNI-N

Figure I.6 depicts a functional representation of an RUNI-N and the relative placement of OAM entities in support of a UTA OVC. Note that support of a UTA OVC does not require any additional OAM functionality at the associated UNI-C. Yet, a significant distinction between the RUNI-N and the base UNI-N is the presence of MEPs associated with the SP-EC for the UTA EC instead of EVC MEPs as the RUNI-N is not aware of subscriber EVCs.

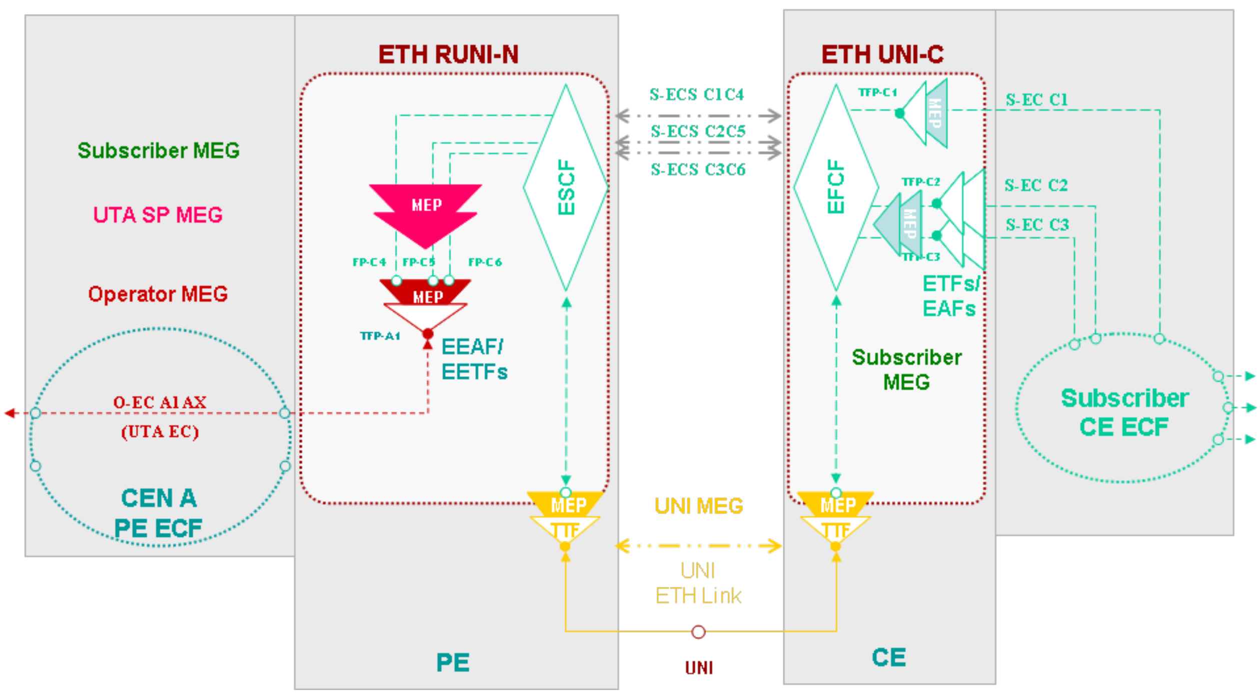

Figure I.31: Functional representation of MEPs & MIPs at an RUNI-N

I.2.2.1.1 Subscriber MEG

The Subscriber MEG is intended to cover the OAM requirements for an EVC from the Subscriber perspective. Specifically, a Subscriber MEG is intended to monitor the Subscriber ECs between a port at a UNI-C and a port on another UNI-C associated with the same EVC.

Unlike the UNI-N, no MIPs associated with the Subscriber MEG(s) are expected at the RUNI-N in support of the UTA OVC as the RUNI-N is not intended to be EVC aware. Instead, any MIPs associated with a Subscriber MEG are expected to be place at the VUNI-N (see Section I.2.2.2.3).

I.2.2.1.2 UNI MEG

The UNI MEG covers the OAM requirements for the UNI ETH Link. Specifically, a UNI MEG is intended to monitor a link connection between the PE port on the intermediate Network Operator domain and the CE port on the Subscriber domain.

I.2.2.1.3 UTA SP MEG

The UTA SP MEG is intended to cover the OAM requirements for the UTA OVC. Specifically, an SP MEG is intended to monitor Service Frames exchanged between the PE port associated with the RUNI-N in the intermediate Network Operator domain and PE port at the ENNI-N and adjunct VUNI-N of the VUNI Provider.

Placement of a UTA SP MEP at the RUNI-N is primarily dictated by the need to associate Service Frames with a UTA OVC. A MEP instantiating a SP MEG is expected to be placed to as close as possible to the ESCF responsible for classification, conditioning and mapping between Subscriber Link ECs (e.g., C-Tagged/Untagged Service Frames) at the UNI and the corresponding Operator EC for the UTA EC.

I.2.2.1.4 Operator MEG

The Operator MEG is intended to cover the OAM requirements for the Operator EC associated with the UTA OVC within the intermediate CEN(s). The placement of an Operator MEP at an RUNI-N is primarily dictated by the need to associate a UTA OVC with an Operator EC. A MEP instantiating an Operator MEG is expected to be placed as close as possible to the EETF/EEAF pair instantiating the corresponding Operator EC for the UTA EC.

I.2.2.2 OAM Components at the ENNI with adjunct VUNI-N

Figure I.7 depicts a functional representation of a VUNI-N and the relative placement of OAM entities at an ENNI-N with an adjunct VUNI-N in support of a UTA OVC.

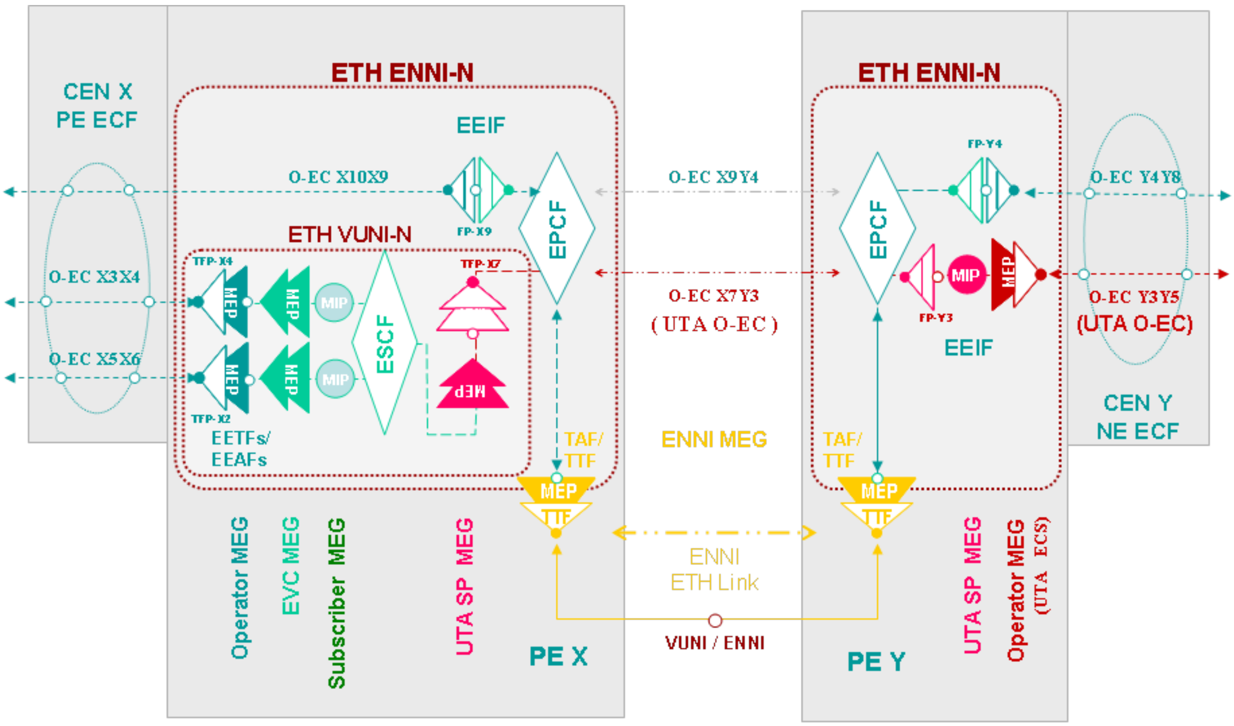

Figure I.32: Functional representation of MEPs & MIPs at an ENNI with an adjunct VUNI

I.2.2.2.1 UTA SP MEG at the VUNI-N

The UTA SP MEG is intended to cover the OAM requirements for the UTA OVC from the VUNI Provider perspective. Placement of a UTA SP MEP at the VUNI-N adjunct to the ENNI-N is primarily dictated by the need to associate ENNI frames with a UTA OVC. A MEP instantiating a UTA SP MEG at the VUNI-N is expected to be placed as close as possible to the EETF/EEAF pair instantiating the Operator EC associated with the UTA EC.

There could be a MIP associated with the UTA SP MEG at any intermediate ENNI-Ns traversed by the UTA SP-EC. If present, it is expected to be placed as close as possible to the EPCF responsible for classification, conditioning and mapping of ENNI frames to an Operator ECs and outside the OAM domain of the corresponding Operator MEG.

I.2.2.2.2 EVC MEG at the VUNI-N

The EVC MEG at the VUNI-N is intended to cover the OAM requirements for EVCs from a Service Operator (VUNI Provider) perspective. Placement of an EVC MEP at a VUNI-N is primarily dictated by the need to associate ENNI Frames with EVCs and its associated Operator ECs. A MEP associated with an EVC MEG is expected to be placed as close as possible to the ESCF responsible for classification, conditioning and mapping of the Subscriber ECs (e.g., C-tagged/Untagged frames) to an Operator EC and outside the OAM domain of the corresponding Operator MEG.

I.2.2.2.3 Subscriber MEG at the VUNI-N

The Subscriber MEG at the VUNI-N is intended to cover the OAM requirements for EVCs from a Subscriber perspective. There could be a MIP associated with the Subscriber MEG at the VUNI-N. If present, it is expected to be placed as close as possible to the ESCF responsible for classification, conditioning and mapping of the Subscriber ECs to the associated Operator EC and outside the OAM domain of the corresponding Operator and EVC MEGs.

I.2.2.2.4 Operator MEG at the VUNI-N

The Operator MEG at the VUNI-N is intended to cover the OAM requirements for Operator ECs instantiated within the VUNI Provider in support of the EVCs associated with the UTA Service. Placement of an Operator MEP at a VUNI-N is primarily dictated by the need to associate ENNI Frames with Operator ECs. A MEP instantiating an Operator MEG is expected to be placed as close as possible to the EETF/EEAF pair responsible for instantiating the Operator EC conveying the EVC.

I.2.2.2.5 Other SP MEGs at VUN-N

As with the case of the UNI, there could be other SP MEGs at the VUNI-N used by the VUNI Provider to cover the OAM requirements for Tunnel ECs within its own domain. If present, these SP MEGs follow the same placing conventions as for SP MEGs at UNIs (see, section I.2.1.1.4).