Technical Specification

MEF 17

Service OAM Requirements & Framework – Phase 1

April 2007

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1. Abstract

OAM (Operations, Administration and Maintenance) can be used to manage network infrastructures and services provided across these network infrastructures. This document provides requirements and framework for Service OAM within MEF compliant Metro Ethernet Networks (MENs). Service OAM requirements represent expectations of Service Providers in managing Ethernet Services within the MENs and Subscribers in managing Ethernet Services across the MENs. Service OAM framework describes the high-level constructs used to model different MEN and Service components that are relevant for OAM. The framework also describes the relationship between Service OAM and the architectural constructs of Ethernet Services (ETH), Transport Service (TRAN) and Application Service (APP) Layers as identified in [MEF 4].

2. Terminology

Term	Definition
APP	Application Layer
CLE	Customer Located Equipment
COS	Class of Service
CPE	Customer Premise Equipment
E-LMI	Ethernet Link Management Interface
EMS	Element Management System
E-NNI	External NNI
EoSONET	Ethernet over SONET
ESCF	Ethernet Subscriber Conditioning Function
ETH	Ethernet Services Layer
EVC	Ethernet Virtual Connection
FDV	Frame Delay Variation
FLR	Frame Loss Ratio
I-NNI	Internal NNI
LANE	ATM LAN Emulation
MAC	Media Access Control
ME	Maintenance Entity
MEG	Maintenance Entity Group
MEN	Metro Ethernet Networks
MEP	MEG End Point
MIP	MEG Intermediate Point
MPLS	Multi-Protocol Label Switching
NDD	Network Demarcation Device
NE	Network Element
NI-NNI	Network Interworking NNI
NMS	Network Management System
NNI	Network-Network Interface
OAM	Operations, Administration and Maintenance
PW	Pseudo Wire

Term	Definition
SI-NNI	Service Interworking NNI
SLA	Service Level Agreement
SLS	Service Level Specification
SNI	Service Node Interface
TRAN	Transport Layer
TrCP	Traffic Conditioning Point
UNI	User-Network Interface
VPLS	Virtual Private LAN Service
VPLS	Virtual Private LAN Service
VPWS	Virtual Private Wire Service
xSTP	Spanning Tree Protocol (multiple variations)

3. Scope

The scope of this document is to provide requirements to be satisfied by the Service OAM mechanisms in MENs and to provide a framework for discussing and implementing those mechanisms. Provisioning aspects of the Ethernet Services and MENs are not considered in this document. Also, this document is limited to specifying requirements and framework for OAM mechanisms among MEN network elements functioning at ETH Layer and does not account for OAM interface between MEN network elements and NMS/EMS systems.

The specific functional areas of Services OAM addressed by this document include:

- Fault Management (including detection, verification, localization and notification)
- Performance Monitoring (including performance parameters measurements)
- Auto-discovery (including discovering service aware NE within provider networks)
- Intra-provider and inter-provider Service OAM

Service OAM mechanisms include support for OAM across a specific Class of Service (CoS) instances when multiple CoS instances are supported within an Ethernet service and need to be managed individually, specifically for the purposes of performance monitoring.

Specific functional areas not addressed by this document include:

- Ethernet Service configuration and provisioning
- TRAN Layer OAM

Detailed specifications of OAM mechanisms and/or protocols are outside the scope of this document.

4. Compliance Levels

The key words "**MUST**", "**MUST NOT**", "**REQUIRED**", "**SHALL**", "**SHALL NOT**", "**SHOULD**", "**SHOULD NOT**", "**RECOMMENDED**", "**MAY**", and "**OPTIONAL**" in this document are to be interpreted as described in RFC 2119. All key words must be in upper case, bold text.

5. Introduction

[MEF 4] introduces relevant interfaces and reference points that apply to Metro Ethernet Networks (MENs), as shown in Figure 1. Subscribers connect to MEN across a User-to-Network Interface (UNI). Network Elements (NEs) inside MEN are interconnected via Internal Network-to-Network Interfaces (NNIs) (I-NNIs-not shown in Figure 1). Two autonomous MENs may interconnect at an External NNI (E-NNI). MENs may also interconnect with other transport networks via Network Interworking NNI (NI-NNI) or with other service networks via Service Interworking NNI (SI-NNI). Figure 5 uses relevant reference points to highlight Service OAM applicability.

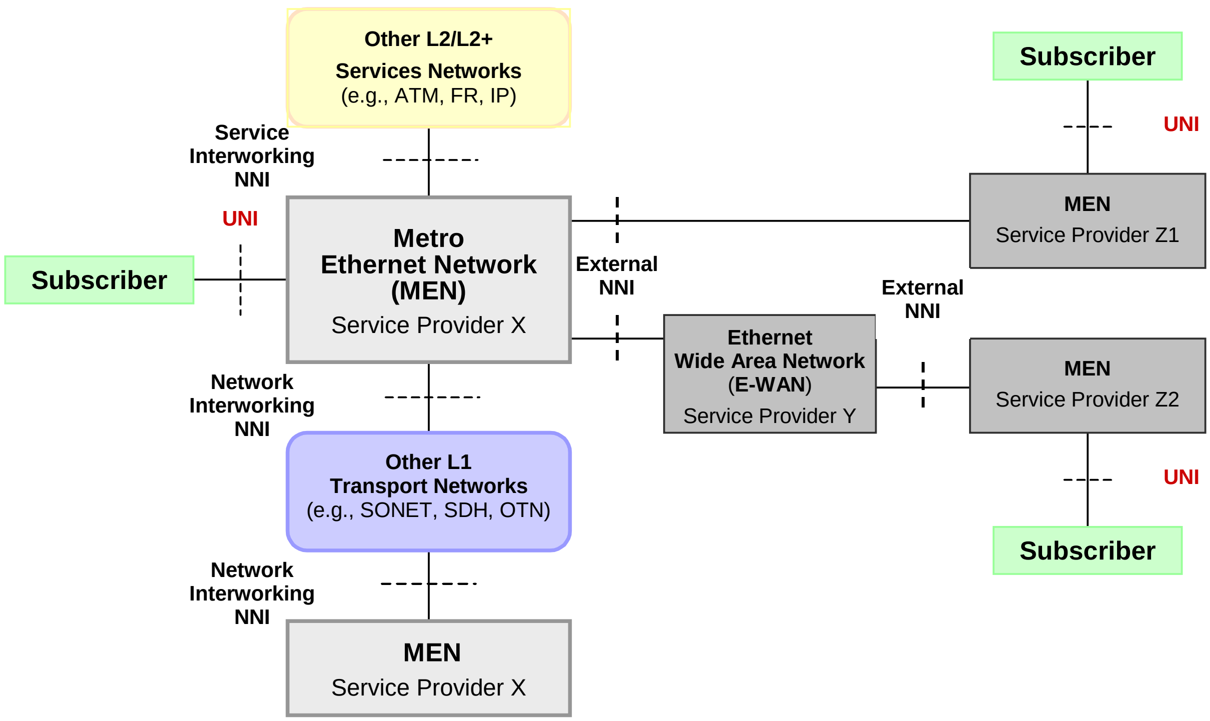

Figure 1: MEN External Interfaces & Associated Reference Points

Figure 2 introduces the MEN layered network model with the data, control and management planes. These planes may be present for all three Layers of this model, namely Transport Service Layer (TRAN Layer), Ethernet Service Layer (ETH Layer) and Application Service Layer (APP Layer). This document focuses on the management plane of the Ethernet Services Layer.

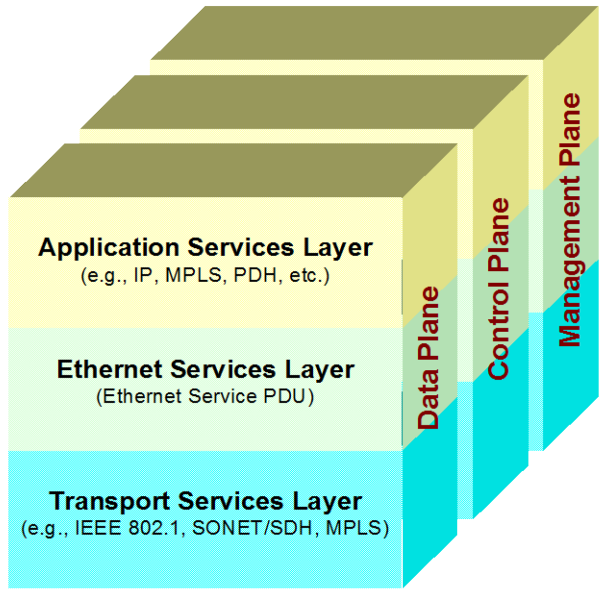

Figure 2: MEN Layer Network Model

Figure 3 highlights a typical arrangement applied by Service Providers to manage their networks and services offered across these networks. The focus of this document is to address the requirements and framework for Service OAM across the NEs. Network/service management using the NMS-EMS management interface is addressed in [MEF 7] and NE management requirements are provided in [MEF 15].

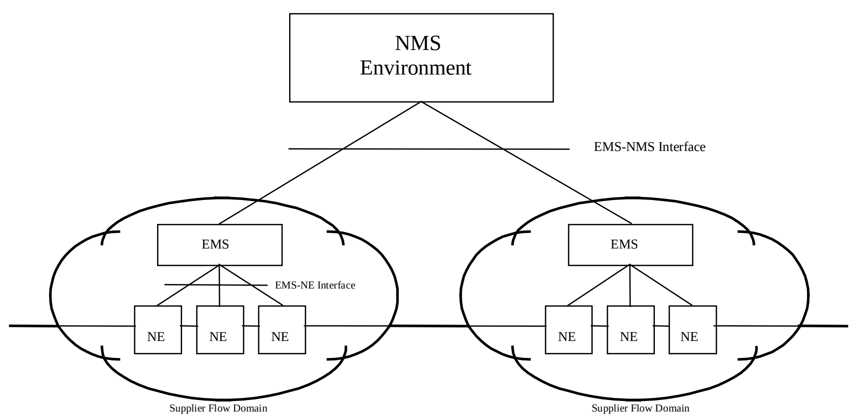

Figure 3: Generic Reference Model for Network/Service Management

6. Ethernet Services Layer

Figure 4 represents the ETH Layer of Figure 2 along with corresponding MEN reference points, and represents both single and multiple MEN Service Providers.

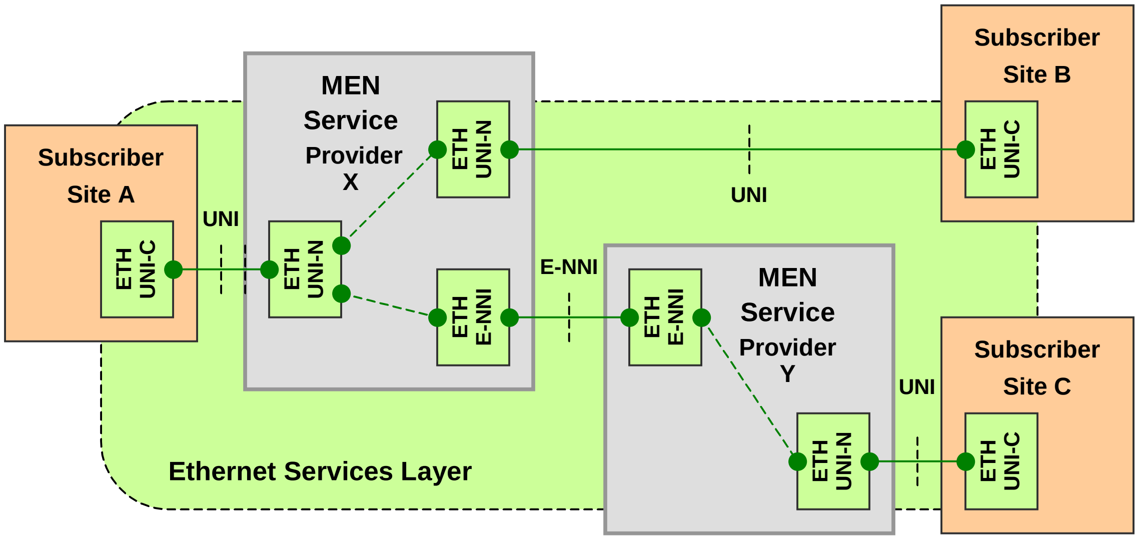

Figure 4: ETH Layer Interfaces and Reference Points

A Multipoint-to-Multipoint Ethernet service is represented in the above figure across Subscriber Sites A, B, and C. A similar representation for a Point-to-Point service can be made using either a single or multiple Service Provider MENs.

From the perspective of the ETH Layer OAM, only those components related to Ethernet service-aware functions are relevant. An EVC is a logical construct in the ETH Layer which is used to enable end-to-end Subscriber service instances across one or more MEN Service Providers [MEF 12]. Section 8 introduces Maintenance Entity Groups (MEGs) across the Subscriber and Service Provider networks, with specific focus on Service Provider MEGs that need to be managed via Services OAM.

7. OAM Domains

An OAM Domain is defined as a network or sub-network, operating at the ETH Layer and belonging to the same administrative entity, within which OAM frames can be exchanged.

Each Service Provider and/or Operator network is typically associated with an administrative boundary. A service may be realized across a single or multiple (sub) network(s). An OAM Domain determines the span of an OAM flow across such administration boundaries. OAM Domains can be hierarchical but must not partially overlap. This hierarchical view of OAM Domains allows the following business relationships and accountability. The OAM Framework as proposed in this document does not address overlapping OAM Domains.

A Subscriber OAM Domain may completely overlap multiple Service Providers' OAM Domains such that Service Providers OAM Domains remain transparent to Subscriber's OAM Domain.

A Service Provider OAM Domain may completely overlap multiple Network Operators' OAM Domains such that Network Operators OAM Domains remain transparent to Service Provider's OAM Domain.

8. OAM Components

8.1 Maintenance Entity (ME)

To determine the application of OAM flows, an OAM Maintenance Entity (ME) is introduced, where a ME represents an OAM entity that requires management.

Figure 5 highlights MEs typically involved in different OAM domains. These MEs correspond purely to the ETH Layer. A ME is essentially an association between two maintenance end points within an OAM Domain; where each maintenance end point corresponds to a provisioned reference point that requires management.

The Subscriber OAM Domain consists of the ME marked "Subscriber ME". The Service Provider OAM Domains consists of the ME marked "EVC ME". If UNI between Subscriber and Service Provider needs to be managed, a "UNI ME" can be realized as shown in the figure. If the Service Provider utilizes facilities of two different Network Operators, each Network Operator OAM Domain could consist of MEs marked as "Operator A ME" and "Operator B ME". Similarly, if the NNI between Network Operators needs to be managed, a "NNI ME" can be realized.

For the purposes of Service OAM, the focus of this framework is on UNI MEs, EVC MEs, and Subscriber MEs that are associated with services. Other MEs shown in Figure 5 are outside the scope of this document.

Note: Service OAM framework and requirements associated with E-NNI MEs, SNI MEs, etc. are expected to be covered in future versions of this document.

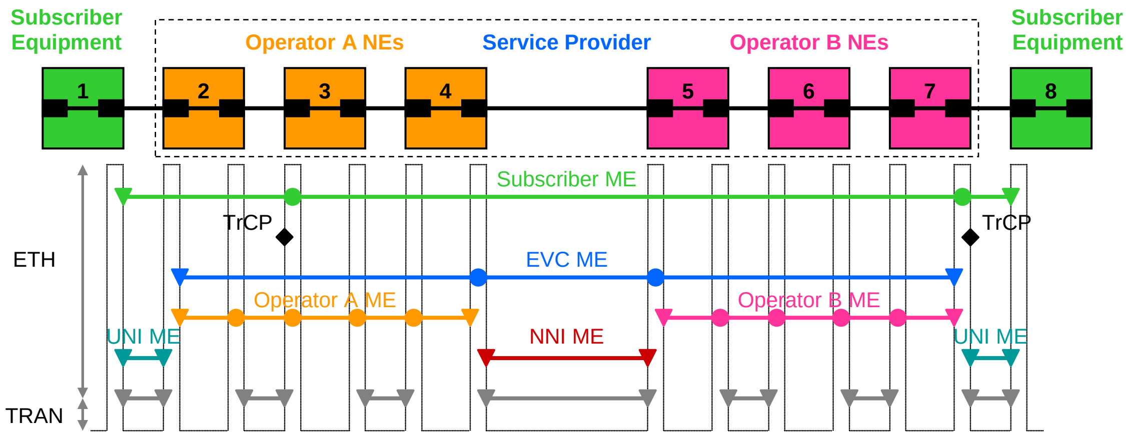

Figure 5: Point-to-point MEs at ETH Layer

8.2 Maintenance Entity Group (MEG)

A ME Group (MEG) consists of the MEs that belong to the same service inside a common OAM domain.

For a Point-to-Point EVC, a MEG contains a single ME. For a Multipoint-to-Multipoint EVC of n UNIs, a MEG contains n*(n-1)/2 MEs.

It is worth noting that though different OAM MEs have been identified, not all may be used in all deployment scenarios.

8.3 MEG End Point (MEP)

A MEG End Point (MEP) is a provisioned OAM reference point which can initiate and terminate proactive OAM frames. A MEP can also initiate and react to diagnostic OAM frames. A MEP is represented by a “triangle” symbol as shown in Figure 5.

A Point-to-Point EVC has two MEPs, one on each end point of the ME. A Multipoint-to-Multipoint EVC of n UNIs has n MEPs, one on each end point.

8.4 MEG Intermediate Point (MIP)

MEG Intermediate Point (MIP) is a provisioned OAM reference point which is capable to react to diagnostic OAM frames initiated by MEPs. A MIP does not initiate proactive or diagnostic OAM frames. A MIP is represented by a “circle” symbol in Figure 5.

The number of MIPs in a Point-to-Point EVC or Multipoint-to-Multipoint EVC is dependent on the specific deployments.

8.5 Traffic Conditioning Point (TrCP)

A Traffic Conditioning Point (TrCP) corresponds to an ESCF (Ethernet Subscriber Conditioning Function) as shown in Figure 5 of [MEF 12]. A TrCP is represented by a diamond symbol in Figure 5. Traffic conditioning may occur at the UNI-C/UNI-N, and/or it may occur at other locations in the network.

Service OAM occurs between the peer MEP instances of a ME. From a network perspective, traffic conditioning performed at the TrCPs may occur before or after a given MEP, and may occur within the same NE as the MEP or in another NE. As such, OAM frames generated by a given MEP may or may not be subject to traffic conditioning.

8.6 MEG Level

MEG Level is used to distinguish between OAM frames belonging to different nested MEs, as shown in Figure 5. MEs belonging to the same MEG share a common MEG Level. Eight MEG Levels have been identified for the purposes of Ethernet OAM [Y.17ethoam] [802.1ag].

When Subscriber, Service Providers, and Network Operators share the MEG Levels space, allocation of MEG Levels can be negotiated among the different roles involved. A default allocation of MEG Levels is such that Service OAM frames for a Subscriber ME use MEG Level 7, 6 or 5; Service OAM frames for an EVC ME use MEG Level 3 or 4 as EVC ME belongs to a Service Provider OAM Domain; and Operator MEs use MEG Levels 2, 1, or 0. The MEG Levels used for UNI ME and NNI ME will default to 0. It may be noted that this default allocation of MEG Level space between Subscribers, Service Providers and Operators could change based on a mutual agreement among them.

Specific MEG Level assignments are outside the scope of this document.

8.7 MEG Class of Service (CoS)

The MEG CoS represents one or more priorities associated with the OAM frames for a given ME. All MEs inside a MEG share a common CoS profile.

Since an EVC can be associated with service frames with different CoS levels, an EVC ME can be associated with OAM frames with multiple priorities.

9. Service OAM Requirements

This section provides requirements for Service OAM.

As stated in Section 8, from a Service perspective, a significant ME of interest is an EVC ME and correspondingly, a significant MEG of interest is an EVC MEG where an EVC MEG consists of one or more EVC MEs.

The following requirements are specifically stated for EVC MEGs and/or EVC MEs, as applicable.

Note: Though requirements are stated specifically for EVC MEGs and/or EVC MEs, these are also generally applicable to Subscriber MEGs and/or Subscriber MEs. Though requirements are stated specifically for EVC MEGs and/or EVC MEs, these are also generally applicable to Subscriber MEGs and/or Subscriber MEs and UNI MEs. Requirements applicable to UNI MEs are for further study.

9.1 Discovery

Discovery allows a Service OAM capable NE to learn sufficient information (e.g. MAC addresses etc.) regarding other Service OAM capable NEs so that OAM frames can be exchanged with those discovered NEs.

In context of EVCs, discovery allows Service OAM capable NEs to learn about other Service OAM capable NEs that support the same EVCs. These NEs are expected to be at the edges of an OAM domain within which the discovery is carried out.

(R1) Service OAM **MUST** offer the capability for a service aware NE to discover other service-aware NEs supporting the same EVC inside a Service Provider OAM Domain.

9.2 Connectivity

A ME can have the following Connectivity Status values:

- *Active*: A ME Connectivity Status of *active* implies that Service OAM frames can be exchanged between the MEPs in both directions.
- *Not Active*: A ME Connectivity Status of *not active* implies that Service OAM frames cannot be exchanged in both directions between the MEPs of the ME.

A Multipoint-to-Multipoint MEG can have the following Connectivity Status values:

- *Active*: A MEG Connectivity Status of *active* implies that each ME in the MEG has a Connectivity Status of active.
- *Not Active*: A MEG Connectivity Status of *not active* implies that each ME in the MEG has a Connectivity Status if not active.
- *Partially Active*: A MEG Connectivity Status of partially active implies that there exist at least one active ME and one not active ME in the MEG.

(R2a) Service OAM **MUST** offer the capability to monitor the Connectivity Status of a ME.

(R2b) Service OAM **MUST** offer the capability to monitor the Connectivity Status of a MEG.

(R2c) Service OAM **SHOULD** offer the capability to detect a change in Connectivity Status within a configurable time interval. This configurable time interval **SHOULD** be more than the network restoration time, which is dependent on the MEN technology.

As an example of **R2c**, if a MEN is based on bridging technology and xSTP is used for network restoration, then the configurable time interval for Connectivity Status monitoring of a ME or a MEG ought to be more than the xSTP restoration time intervals.

Further, when a Connectivity Status becomes *not active* or *partially active*, it may be necessary to verify and localize the fault. This is needed primarily to reduce operating costs by minimising operational repair times and operational resources.

(R2d) Service OAM **MUST** offer the capability to verify the existence of a connectivity fault inside a Service Provider OAM Domain.

(R2e) Service OAM **MUST** offer the capability to localize a connectivity fault inside a Service Provider OAM Domain. Localization is expected to identify the MEP and MIP, or pair of MIPs, in the Service Provider OAM Domain between which the EVC connectivity fault is present.
The determination of EVC status, as defined in [E-LMI], requires determination of the EVC ME/MEG Connectivity Status and UNI ME/MEG Connectivity Status. Specific mechanisms used to correlate the different Connectivity Status values are outside the scope of this document.

(R2f) Service OAM frames for connectivity **SHOULD** be transmitted at the highest priority permissible for the Service frames. This requirement is meant to ensure that Service OAM frames for connectivity are less likely to be discarded in comparison to the Service frames upon congestion.

(R2g) Service OAM **SHOULD** offer the capability to transmit Service OAM frames at any permissible priority.

The MEP Connectivity Status for a MEP in a Multipoint-to-Multipoint MEG can have one the following values:

- *Fully Connected*: A MEP Connectivity Status of *fully connected* implies that all MEs to which the MEP belongs are *active*.
- *Isolated*: A MEG Connectivity Status of *isolated* implies that all MEs to which the MEP belongs are *not active*.
- *Partially Connected*: A MEP Connectivity Status of *partially connected* implies that, among all MEs to which the MEP belongs, at least one is *active* and at least one is *not active*.

(R2h) Service OAM **SHOULD** offer capability to monitor the MEP Connectivity Status in a Multipoint-to-Multipoint MEG.

(R2i) Service OAM **SHOULD** offer capability to detect a change in the MEP Connectivity Status within a configurable time interval. This configurable time interval **SHOULD** be more than the network restoration time interval, which is dependent MEN technology.

9.3 Frame Loss Ratio (FLR) Performance

Frame loss Ratio (FLR) Performance is a measure of number of lost frames inside the MEN and is defined as a percentage in [MEF 10].

FLR Performance is applicable to all Service Frames with the level of Bandwidth Profile conformance determined to be Green, and associated with a particular CoS instance on a Point-to-Point EVC that arrive at the UNI during a time interval *T*, as defined in [MEF 10].

For a Point-to-Point EVC, estimating FLR Performance is dependent on the ability to measure Frame Loss between the MEPs of an EVC ME during a time interval *T*. Such measurements are based on statistics collected at the TrCP points which determine Green, Yellow and Red service frames.

For a Multipoint-to-Multipoint EVC, FLR Performance is for further study.

(R3a) Service OAM **MUST** offer capability to estimate Frame Loss for Service Frames with the level of Bandwidth Profile conformance determined to be Green and associated with a particular CoS instance between the UNIs of a Point-to-Point EVC during a time interval *T* inside a Service Provider OAM Domain. The level of accuracy is for further study.

9.4 Frame Delay Performance

Frame Delay is the time required to transmit a Service Frame from source UNI to destination UNI across the MEN as defined in [MEF 10]. Frame Delay Performance for a particular CoS instance on a Point-to-Point EVC is a measure of the delays experienced by different Service Frames belonging to the same CoS instance.

Frame Delay Performance for a particular CoS instance on a Point-to-Point EVC for a time interval *T* is defined as P-Percentile of the delay for all Service Frames with the level of Bandwidth Profile conformance determined to be Green, successfully delivered between the UNI pairs during a time interval *T*, as defined in [MEF 10].

For a Point-to-Point EVC, estimating Frame Delay Performance is dependent on the ability to measure Frame Delay experienced by Green Service Frames, belonging to a particular CoS instance, between the UNI pairs of a Point-to-Point EVC. Such measurements can be approximated by the Frame Delay experienced by Service OAM Frames belonging to the CoS instance if the Service OAM Frames receive the same treatment as the Green Service Frames between the MEPs of a Point-to-Point EVC ME.

For a Multipoint-to-Multipoint EVC, Frame Delay Performance is for further study.

Frame Delay can be of two types: a) one-way Frame Delay, or b) two-way Frame Delay. One-way Frame Delay is used to characterize various applications and services (e.g. broadcast applications) and its measurement generally requires synchronization of clocks between the two participating NEs. Two-way Frame Delay, in most cases (e.g. voice applications) is considered to be sufficient metric since it is the one that most influences the application quality e.g. length of silence in IP-phone calls.

(R4a) Service OAM **MUST** offer the capability to estimate two-way Frame Delay experienced by Service Frames with the level of Bandwidth Profile conformance determined to be Green and associated with a particular CoS instance between the UNIs of a Point-to-Point EVC during a time interval T inside a Service Provider OAM Domain. The level of accuracy is for further study.

(R4b) Service OAM **SHOULD** offer the capability to estimate one-way Frame Delay experienced by Service Frames with the level of Bandwidth Profile conformance determined to be Green and associated with a particular CoS instance between the UNIs of a Point-to-Point EVC during a time interval T inside a Service Provider OAM Domain. The level of accuracy is for further study.

9.5 Frame Delay Variation (FDV) Performance

Frame Delay Variation (FDV) is the difference in delay of two Service Frames, as defined in [MEF 10]. FDV Performance for a particular CoS instance on a Point-to-Point EVC is a measure of the variation in the delays experienced by different Service Frames belonging to the same CoS instance.

FDV Performance is applicable to all successfully delivered Service Frames with the level of Bandwidth Profile conformance determined to be Green for a particular CoS instance on a Point-to-Point EVC for a time interval *T*, as defined in [MEF 10].

For a Point-to-Point EVC, estimating FDV Performance is dependent on the ability to measure difference between the Frame Delays of a pair of Green Service Frames that belong to a CoS instance and arrive at the ingress UNI exactly Δt time units apart within the time interval *T*. Such measurements can be approximated by the difference between the Frame Delays of a pair of Service OAM frames belonging to the CoS instance between the MEPs of a Point-to-Point EVC ME where the pair of Service OAM frames are inserted exactly Δt time units apart within the time interval *T*, where both Δt and *T* are configurable, and where the Service OAM frames receive the same treatment as Green Service frames.

For a Multipoint-to-Multipoint EVC, FDV Performance is for further study.

FDV can be of two types: a) one-way FDV, and b) two-way FDV.

(R5a) Service OAM **MAY** offer the capability to measure the difference between the two-way Frame Delay estimates of a pair of Service Frames with the level of Bandwidth Profile conformance determined to be Green and associated with a particular CoS instance between the UNIs of a Point-to-Point EVC. The pair of Service OAM frames are inserted exactly Δt time units apart within the time interval *T*, where both Δt and *T* are configurable.

(R5b) Service OAM **MUST** offer the capability to measure the difference between the one-way Frame Delay estimates of a pair of Service Frames with the level of Bandwidth Profile conformance determined to be Green and associated with a particular CoS instance between the UNIs of a Point-to-Point EVC. The pair of Service OAM frames are inserted exactly Δt time units apart within the time interval *T*, where both Δt and *T* are configurable.

9.6 Availability

For further study.

9.7 Service OAM Transparency

Service OAM frames belonging to an OAM Domain originate and terminate within that OAM Domain. Security implies that an OAM Domain must be capable of filtering Service OAM frames. The filtering is such that the Service OAM frames are prevented from leaking outside their OAM Domain. Also, for hierarchical OAM Domains, Service OAM frames from outside an OAM Domain should be either discarded (when such Service OAM frames belong to same or lower-level OAM Domains) or transparently passed (when such Service OAM frames belong to higher-level OAM Domains).

(R7a) In hierarchical OAM Domains, Service OAM **MUST** offer the capability to prevent OAM frames belonging to lower OAM Domain from leaking into higher OAM Domain.

(R7b) In hierarchical OAM Domains, Service OAM **MUST** offer the capability to transparently carry OAM frames belonging to higher OAM Domain across lower OAM Domain.

9.8 Data Plane Execution

(R8a) Service OAM frames **MUST** follow the same path across the MEN as the Service frames in an EVC.

9.9 TRAN Layer Independence

The ETH Layer is independent of the TRAN Layer, as shown in Figure 2. The TRAN Layer may offer its own OAM capabilities; ETH Layer OAM should be independent of underlying TRAN Layer. However, when a fault is detected in the TRAN Layer, it may be useful to communicate such a fault to the ETH Layer. For example, a fault in TRAN Layer should not cause multiple alarm events to be raised and should not result in unnecessary corrective actions to be taken in ETH Layer, when the fault can be restored in the TRAN Layer.

As a result, though the Service OAM should be independent of the TRAN Layer OAM, it should allow interworking with TRAN Layer OAM for the purposes of fault notifications.

(R9a) Service OAM **MUST** offer OAM capabilities without dependency on underlying TRAN Layer technologies and OAM capabilities.

(R9b) Service OAM **SHOULD** allow interworking with TRAN Layer OAM for forwarding TRAN Layer fault conditions to allow alarm suppression at ETH Layer.

9.10 APP Layer Independence

The ETH Layer is independent of the APP Layer, as shown in Figure 2. The APP Layer may offer its own OAM capabilities; but ETH Layer OAM should be independent of APP Layer.

(R10) Service OAM **MUST** offer OAM capabilities without dependency on APP Layer technologies and OAM capabilities.

10. References

[802.1D] IEEE standard for local and metropolitan area networks--Media access control (MAC) Bridges (Incorporates IEEE 802.1t-2001 and IEEE 802.1w), 2004.

[802.3] IEEE Standard 802.3-2002, Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications, 2005.

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

[MEF 7] EMS-NMS Information Model, October 2004.

[MEF 10] Ethernet Service Attributes Phase 1, November 2004.

[MEF 12] Metro Ethernet Network Architecture Framework – Part 2: Ethernet Services Layer, April 2005.

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

[MEF 16] Ethernet Local Management Interface, January 2006.

[Y.1730] Requirements for OAM functions in Ethernet based networks, 2004.

[Y.1731] OAM Functions and Mechanisms for Ethernet based networks, May 2006.

[802.1ag] Connectivity Fault Management, work in progress.

Appendix A: Relationship among different OAM Activities

MEN at ETH Layer is viewed as a multi-hop Ethernet network consisting of a collection of NEs with Ethernet bridge functionality e.g. Ethernet layer 2 control protocol processing, forwarding etc. The connectivity between these NEs may be via IEEE 802.3 compliant Ethernet segments or virtual Ethernet segments, where virtual Ethernet segments are emulated Ethernet Link/LAN technologies e.g. Ethernet Pseudo Wires (PW), Virtual Private LAN Service (VPLS), Ethernet over SONET, ATM LAN Emulation etc.

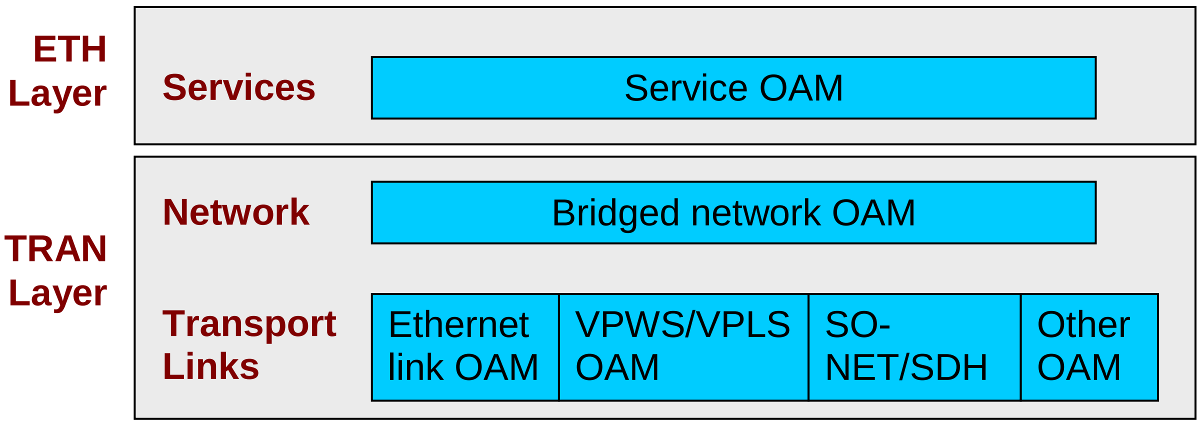

Figure 6: Relationship across different OAM Components

Figure 6 highlights the two MEN Layers (i.e. ETH Layer and TRAN Layer) with the corresponding OAM components belonging to Ethernet services and underlying networks. ETH Layer represents services and is responsible for Service OAM. Ethernet services are carried across single or multi-hop Ethernet networks represented by bridged network under TRAN Layer. The NEs constituting the bridged networks are in turn connecting with transport links e.g. IEEE 802.3 compliant link, Ethernet PW, VPLS, EoSONET, etc.

The Service OAM work in MEF focuses on the ETH Layer, which corresponds to an EVC inside a Service Provider OAM Domain. Besides MEF, ITU-T Q.5/13 and IEEE 802.1 are also working on Ethernet OAM in Y.1731 and 802.1ag draft Recommendations respectively. The work in ITU-T Q.5/13 and IEEE 802.1 is applicable to Subscriber, Service Provider and Network Operator OAM Domains.

ITU-T Q.5/13 and IEEE 802.1 work is not limited to Service OAM as it also covers Network OAM for Ethernet based networks. IEEE 802.1ag focuses on a sub-set of Fault Management for both enterprise and carrier networks. ITU-T Y.1731 accounts for both Fault Management and Performance Monitoring specifically for carrier networks. ITU-T Q.5/13 and IEEE 802.1 Ethernet OAM work is closely aligned to avoid duplication.

Based on the transport link technology used to connect the NEs supporting bridging functionality within Ethernet bridged networks, various link OAM techniques can be applied across the TRAN Layer. E.g. IEEE 802.3ah has defined link level OAM for IEEE 802.3 compliant links. When transport link emulates Ethernet over MPLS/IP as in IETF VPWS and VPLS, IETF's PW-OAM and VPLS-OAM and ITU-T Y.1711 kind mechanisms can be applied to manage those emulated transport links. If SONET/SDH technology is applied, OAM techniques being defined in ITU-T Q.12/15 can be applied.