TECHNICAL REPORT

TR-169

EMS to NMS Interface Requirements for Access Nodes Supporting TR-101

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Notice

Issue History

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Summary

The Broadband Forum's TR-101 describes the requirements in support of DSL to Ethernet aggregation in Access Nodes. TR-141 defines the TR-101-based management interface model between Network Elements (NEs) and Element Management Systems (EMSs). TR-169 takes the next step by defining the requirements for the EMS-Network Management Interface (NMS). TR-169 unifies management-related terminologies by bridging the TR-101 Ethernet management requirements in the Broadband Forum with related efforts and specifications in the ITU-T, Metro Ethernet Forum (MEF), and TeleManagement Forum (TMF). In so doing, this Technical Report produces a set of EMS-NMS interface requirements that are consistent with other international standards.

1. Purpose and Scope

1.1 Purpose

The purpose of this Technical Report is to provide requirements for an interface between an Element Management System (EMS) to a Network Management System (NMS) in support of DSL to Ethernet aggregation in Access Nodes. It does not contain any functional requirements for the management of other Access Node capabilities; these are covered in TR-130 [3]. This Technical Report leverages the ATM aggregation to Ethernet requirements defined in TR-101 [2], the TR-141 [10] Network Element (NE)-EMS information model, the DSL EMS-NMS interface requirements defined in TR-130, and the ITU-T Rec. Q.840.1 [4] EMS-NMS information model requirements and terminology to produce a set of Ethernet EMS-NMS interface requirements that are consistent with other international standards.

This Technical Report bridges the Ethernet functional requirements defined in the Broadband Forum with related requirements and modeling efforts in the ITU-T, MetroEthernet Forum (MEF), and TeleManagement Forum (TMF). This is accomplished through the introduction of a mapping table in Section 6 that is intended to align Broadband Forum Ethernet-related concepts with the terminology used in the ITU-T, while maintaining a view of related terminology used in the TMF[1]. The requirements defined in this Technical Report will provide the foundation for subsequent Access Node EMS-NMS interface information modeling work as well as provide a basis for future protocol-dependent interface requirements.

1.2 Scope

This Technical Report covers the following areas for the Access Node EMS-NMS interface supporting DSL to Ethernet aggregation.

a) Network architecture (Section 4);
b) Network management architecture (Section 5)
c) Terminology mappings between TR-101, ITU Rec. Q840.1, and TMF MTNM 3.5 [6][7][8] (Section 6)
d) EMS-NMS interface requirements (Section 7) including
   (i.) General requirements;

[1] ITU-T Q.840.1 is built on and extends the information model defined in the MEF. The MEF information model describes the interface between an Ethernet EMS and NMS supporting Metro Ethernet Services Phase 1 and Phase 2 networks by providing the profile of management entities based on ITU-T Q.840.1 and extensions where necessary.

(ii.) Configuration management;
(iii.) Fault management; and
(iv.) Performance management;

e) Mapping of TR-169 requirements to TR-101 and TR-141 (Section 8).
f) Optional requirements (Section 9)

2. References and Terminology

2.1 Conventions

In this Technical Report, several words are used to signify the requirements of the specification. These words are often capitalized. More information can be found be in RFC 2119 [1].

MUST	This word, or the terms "REQUIRED" or "SHALL", mean that the definition is an absolute requirement of the specification.
MUST NOT	This phrase, or the phrase "SHALL NOT", mean that the definition is an absolute prohibition of the specification.
SHOULD	This word, or the adjective "RECOMMENDED", means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications must be understood and carefully weighed before choosing a different course.
SHOULD NOT	This phrase, or the phrase "NOT RECOMMENDED" means that there may exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
MAY	This word, or the adjective "OPTIONAL", means that this item is one of an allowed set of alternatives. An implementation that does not include this option MUST be prepared to inter-operate with another implementation that does include the option.

2.2 References

The following references constitute provisions of this Technical Report. At the time of publication, the editions indicated were valid. All references are subject to revision; users of this Technical Report are therefore encouraged to investigate the possibility of applying the most recent edition of the references listed below. A list of the currently valid Broadband Forum Technical Reports is published at www.broadband-forum.org.

[1] RFC 2119	*Key words for use in RFCs to Indicate Requirement Levels*	IETF	1997
[2] TR-101	*Migration to Ethernet-based DSL Aggregation*	Broadband Forum	2006
[3] TR-130	*xDSL EMS to NMS Interface Functional Requirements.*	Broadband Forum	2006
[4] Q.840.1	*Requirements and Analysis for*	ITU-T	2007

	NMS-EMS Management Interface of Ethernet over Transport and Metro Ethernet Network	Recommendation	
[5] MEF 17	*Service OAM Requirements & Framework – Phase 1*	MetroEthernet Forum	2007
[6] TMF 513 (Member Evaluation Version 3.1)	*Multi-Technology Network Management (MTNM) Business Agreement*	TeleManagement Forum	2007
[7] TMF 513 SD1-16	*Supporting Document: Layered Parameters*	TeleManagement Forum	2007
[8] TMF 513 SD1-44	*Supporting Document: Connectionless Technology Management*	TeleManagement Forum	2007
[9] MEF 10.1	*Ethernet Services Attributes Phase 2*	MetroEthernet Forum	2006
[10] TR-141	*Protocol Independent Management Model for Access Nodes Supporting TR-101*	Broadband Forum	2007
[11] Y.1731	*OAM functions and mechanisms for Ethernet based networks*	ITU-T Recommendation	2006
[12] RFC 3635	*Definition of Managed Objects for the Ethernet-like Interface Types*	Internet Engineering Task Force (IETF)	2003
[13] RFC 3636	*Definition of Managed Objects for IEEE 802.3 Medium Attachment Units (MAUs)*	IETF	2003
[14] 802.1ag	*IEEE Standard for Local and metropolitan area networks - Virtual Bridged Local Area Networks Amendment 5: Connectivity Fault Management*	IEEE	2007
[15] 802.1D-2004	*IEEE Standard for Local and metropolitan area networks – Media Access Control (MAC) Bridges*	IEEE	2004
[16] 802.1ad-2005	*2005 IEEE Standard for Local and metropolitan area networks – virtual Bridged Local Area Networks, Amendment 4: Provider Bridges*	IEEE	2006

2.3 Definitions

The following terminology is used throughout this Technical Report.

ATM	Asynchronous Transfer Mode. A connection-oriented high-speed communications protocol in which data is divided into 48 byte "cells" that can be individually switched and routed. Each cell is pre-appended with a 5 byte "header" containing an identifier of the connection of which the data is a part, along with quality of service parameters associated with the connection.
Customer	An entity to which the service provider provides network services.
C-Tag	The innermost VLAN tag as defined in IEEE 802.1ad.
C-VID	The VLAN ID value of some C-Tag.
EMS	Element Management System. This entity is typically provided by a network element supplier and capable of managing multiple network elements of that supplier. An EMS can communicate with one or more NE(s) on an individual or collective basis (e.g., individually to a switch or collectively to a SONET ring). An EMS can have some network management layer capabilities, particularly, when an EMS manages multiple types of NE(s) and/or NE(s) from multiple suppliers.
EVC	Ethernet Virtual Connection. An association of two or more UNIs (i.e., Access Node ports) that limits the exchange of frames to UNIs in the Ethernet Virtual Connection.
FPP	Flow Point Pool, representing an Ethernet UNI on a port
MEG	Maintenance Entity Group. Consists of Maintenance Entities which 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 associating "n" UNIs, a MEG contains n*(n-1)/2 MEs.
MEP	MEG End Point. A MEP is a provisioned OAM reference point capable of initiating and terminating proactive OAM frames.
MIB	Management Information Base. A set of data elements and capabilities made available by a system to enable it to be managed.
MIP	MEG Intermediate Point. A MIP is a provisioned OAM reference point capable of reacting to diagnostic OAM frames initiated by MEPs. A MIP does not initiate proactive and diagnostic OAM frames.
Network	One or more subnetworks connected by network links, providing end-to-end service to one or more customers. Each subnetwork is administered by an EMS and the network is administered by a service provider.
NMS	An entity responsible for end-to-end management of a network composed of network elements from multiple suppliers. Instead of directly managing network elements, it relies upon the capabilities of

	the EMS(s). An NMS can interface with one or more Service Management Systems and can include some service management functionality. An NMS can also include some element management layer capabilities that allow it to manage individual NE(s) or it can contain only network management layer functionality to manage one or more EMS(s).
Port	An access point on an NE to which a link or a customer access link is attached.
Priority Tagged Frame	An Ethernet frame carrying a priority tag.
PVC	An ATM connection established to provide a "permanent" communications channel similar to the way private lines are used in narrowband communications.
QOS	Parameters describing the attributes of a connection such as bandwidth, burstiness of the information on the connection, and priority.
Subnetwork	A collection of one or more NE(s), interconnected by subnetwork links, with connectivity between any pair of NE(s) (i.e., the topology is a connected graph.
S-VID	The VLAN ID value of some S-Tag.
Untagged Frame	An Ethernet frame without any VLAN or priority tagging.
User-Side Bridge Port	This managed entity, defined in TR-141, is the collection of all managed objects that their scope is only a user-side bridge port (on a U-Interface). A UBP is a subclass of the Connectionless Port Termination Point (CPTP) object in MTNM 3.5.
VCI	Virtual Channel Identifier. An integer in each ATM cell header identifying the virtual channel of which the information in the cell is a part.
VLAN ID	Virtual LAN Identifier. The identity of the VLAN on an Ethernet port.
1:1 VLAN	Indicates a one-to-one mapping between user port and VLAN. The uniqueness of the mapping is maintained in the Access Node.
N:1 VLAN	Many-to-one mapping between user ports and VLAN. The user ports may be located in the same or different Access Nodes.
VPI	Virtual Path Identifier. An integer in each ATM cell header identifying the virtual path of which the information in the cell is a part.

2.4 Abbreviations

This Technical Report uses the following abbreviations:

ASP Application Service Provider

BB	Broadband
CBS	Committed Burst Size
CCM	Continuity Check Message
CIR	Committed Information Rate
CoS	Class of Service
CPE	Customer Premises Equipment
CPTP	Connectionless Port Termination Point
EBS	Excess Burst Size
EIR	Excess Information Rate
E-LMI	Ethernet-Link Management Interface
EMS	Element Management System
IETF	Internet Engineering Task Force
IP	Internet Protocol
L2TP	Layer 2 Tunneling Protocol
L2TS	Layer 2 Tunnel Service
LAN	Local Area Network
MAC	Media Access Control
MDF	Metallic Distribution Frame
ME	Maintenance Entity
MEN	Metro Ethernet Network
MP	Maintenance Point
NE	Network Element
NID	Network Interface Device
NMS	Network Management System
NNI	Network-Network Interface
NSP	Network Services Provider
OAM	Operations, Administration, and Maintenance
PADT	PPPoE Active Discovery Terminate
PPP	Point-to-Point Protocol
PPPoE	PPP over Ethernet
PTP	Physical Termination Point
QoS	Quality of Service
SLA	Service Level Agreement
TLS	Transparent LAN Service
TMF	TeleManagement Forum

TR	Technical Report
UNI	User-Network Interface
VLAN	Virtual LAN

3. Technical Report Impact

3.1 Energy Efficiency

TR-169 has no impact on energy efficiency.

3.2 IPv6

TR-169 has no impact on IPv6 support and compatibility.

3.3 Security

There are no relevant security issues relating to TR-169.

4. Network Architecture

The focus of this Technical Report will be on the definition of EMS-NMS interface requirements supporting both the U- and V-interfaces for management of Ethernet in the Access Node. According to TR-101 [2], the U-interface or the user interface can support direct Ethernet framing over DSL. The V-interface supports Ethernet aggregation, where Ethernet is the transport protocol with no ATM present. See Figure 1.

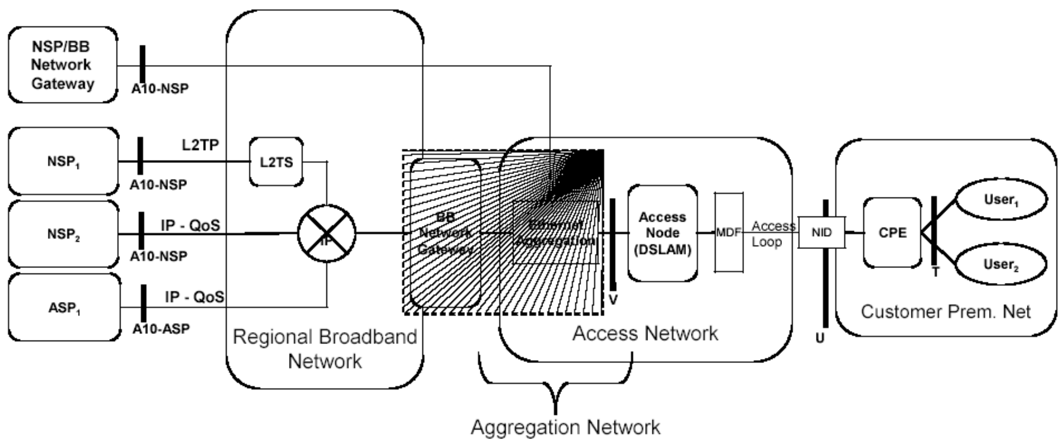

Figure 1 - Network Architectural Reference Model

5. Network Management Architecture

This section describes the network management architecture for managing Ethernet-based aggregation from an EMS-to-NMS perspective. In the network management architecture shown in Figure 2, an NMS provides end-to-end network management functions for a multiple-supplier, multiple-technology network. The NMS environment can consist of one or more NMSs, where a given NMS can support the integrated (i.e., Inter-Domain) management of one or more Layer Network (i.e., technology-specific) Domains using the EMS-NMS interface. This architecture leverages the capabilities of network-supplier EMS products and also supports gateway interfaces to other Operation Support Systems (OSS). NEs typically interface with an EMS as shown in Figure 2. This EMS can be considered supplier-specific. The supplier typically provides documentation on the capabilities of that EMS. The EMS can have either an open interface or a proprietary interface to allow it to manage a subnetwork of one or more NEs (i.e., Access Nodes). If a standards-based versus proprietary interface is used, standard MIB(s) are preferred.[2]

An EMS-NE protocol neutral information model is defined in TR-141 [10] based on the NE requirements in TR-101. The functional capabilities in support of DSL aggregation to Ethernet across the EMS-NMS interface are defined in this Technical Report. Although a corresponding protocol neutral information model that defines the exchange of information between an EMS and an NMS is outside the scope of this Technical Report, such a model should be based on the requirements in this Technical Report.

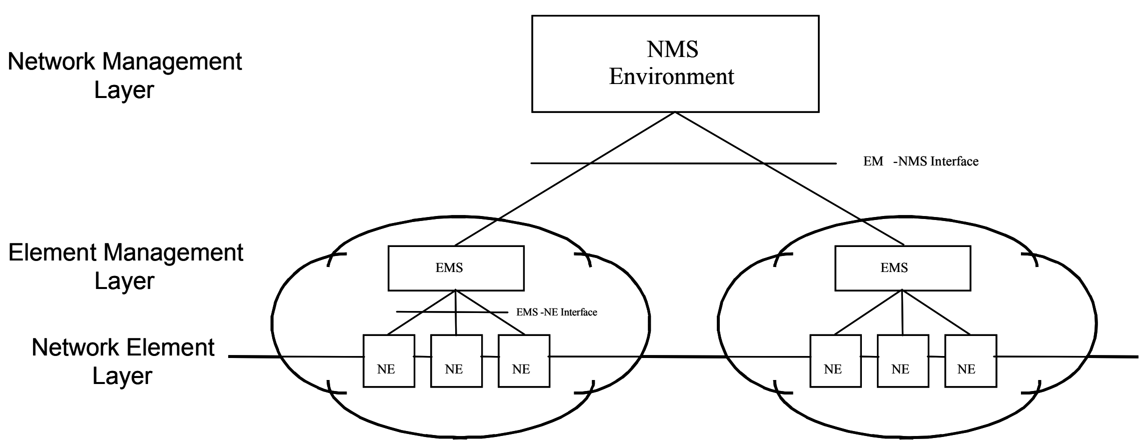

Figure 2 - Network Management Architecture Managing DSL to Ethernet Aggregation

[2] An "open" interface is one which has been published in sufficient detail for other manufacturers to build equipment that can inter-operate. A "standard open" interface is not only published, but has been agreed to in a standards body, such as the ITU-T.

6. Terminology Mappings

TR-101 provides NE level requirements for DSL aggregation to Ethernet. Ethernet service layer functionality is implied within TR-101; however, terminology gaps exist between TR-101, ITU-T Rec. Q.840.1 [4], and MTNM 3.5. As an example, TR-101 does not explicitly reference the term "flows". However, Ethernet flows are certainly implied in the TR-101 requirements on VLANs. ITU-T Rec. Q.840.1 and MTNM 3.5 use "flow domain fragments" to refer to Ethernet Virtual Connections (EVCs) or flows.

In order to describe the EMS-NMS interface requirements in this Technical Report using more ubiquitous terminology, this Technical Report attempts to bridge the terminology gaps. Table 1 - Ethernet Terminology Mappings between TR-101, ITU-T Rec. Q.840.1 and MTNM 3.5 identifies a mapping of Ethernet terminology between TR-101, ITU-T Rec. Q.840.1, and MTNM 3.5.

Table 1 - Ethernet Terminology Mappings between TR-101, ITU-T Rec. Q.840.1 and MTNM 3.5

TR-101 Terminology	ITU-T Q.840.1 Terminology (Object Name in Parentheses, where applicable	TMF MTNM 3.5 Terminology (Object Name in Parentheses, where applicable)	Notes
Network Element	Ethernet Flow Domain (ETH_Flow_Domain)	Flow Domain (FlowDomain)	Atomic flow domain comprised of a single element
UNI[3] (U-Interface), NNI	Ethernet Flow Point Pool (ETH_FPP) Ethernet Flow Point Pool UNI (ETH_FPP_UNI) - ETH_FPP_UNI is a subclass of ETH_FPP - The U-Interface is represented at an Access Node as an ETH_FPP_UNI	Connectionless Port Termination Point (CPTP)	NNI (E-NNI) is not modeled in ITU-T Rec. Q.840.1 MEF is defining an E-NNI specification. On a UNI, the point where frames are mapped to an EVC is represented by a flow point.

[3] A UNI is referred to as a User-Side Bridge Port in TR-141.

TR-101 Terminology	ITU-T Q.840.1 Terminology (Object Name in Parentheses, where applicable	TMF MTNM 3.5 Terminology (Object Name in Parentheses, where applicable)	Notes
Per-Port VLAN	ETH_Flow_Point	CTP	Subnetwork connections (e.g., EVCs) are terminated at Flow Points (FPs) or CTPs.
C-Tag	CE-VLAN Tag	C-Tag	CE-VLAN Tag consists of CE-VLAN ID and CE-VLAN CoS. IEEE uses the term Tag to include both the VLAN Identifier (VID) and Priority Code Point (PCP).
C-VID	CE-VLAN Id	C-VID, CE-VLAN Id	One or more CE-VLAN Ids may map to a given EVC or Ethernet flow.
1:1 VLAN	p2p VLAN	p2p VLAN	
N:1 VLAN	rootedMp VLAN	rootedMp VLAN	
VLAN	Ethernet Flow Domain Fragment_EVC (ETH_FDFr_EVC)	Flow Domain Fragment (FlowDomainFragment)	1. An EVC represents a flow. 2. Multiple VLAN Ids can map to a single EVC (using a S-tag)
Port	Media Access Unit (MAUTransportPort)	Physical Termination Port (PTP)	
S-VID plus priority	S-Tag	S-Tag	
VLAN Membership List	CE-VLAN Id/EVC Map	CE-VLAN Id/EVC Map	ITU-T Rec. Q.840.1 imports terminology from MEF 10.1 [9]

TR-101 Terminology	**ITU-T Q.840.1 Terminology (Object Name in Parentheses, where applicable**	**TMF MTNM 3.5 Terminology (Object Name in Parentheses, where applicable)**	**Notes**
ATM CoS (4)	ATM CoS is not in scope. Ethernet CoS (8 P-bit values)	Both ATM CoS and Ethernet CoS addressed ATM: ServiceCategory (Ethernet CoS: 8 P-bit values)	Precise mapping from ATM CoS to Ethernet P-bits requires further study.
VLAN Transparent Port	1. ETH_FPP_UNI object, set the bundling attribute to "yes"; and 2. ETH_Flow_Point object, set the attribute "ethCeVlanIDMapping" to indicate the individual CE-VLAN Id mappings along with the value "allOthers" for the "transparent" EVC endpoint.	1. CPTP: LayeredParameters: BundlingIndicator set to "yes", and 2. CTP: TrafficMappingTable	
Non-VLAN Transparent Port	1. ETH_FPP_UNI object, set the bundling attribute to "no"; and 2. ETH_Flow_Point object, set the attribute "ethCeVlanIDMapping" to indicate the individual CE-VLAN Id mappings or "untagged".	1. CPTP: LayeredParameters: BundlingIndicator set to "no", and 2. CTP: TrafficMappingTable	

7. EMS-NMS Interface Requirements

This section defines EMS to NMS interface requirements categorized by the following systems management functional areas: Configuration Management, Fault Management, and Performance Management. Accounting Management and Security Management requirements on the EMS-NMS interface are outside the scope of this Technical Report.

For the ETH layer, Fault Management capabilities depend heavily on mechanisms such as Service Operations, Administration, and Maintenance (OAM) and Ethernet Link Management Interface (E-LMI). It is anticipated that the Fault Management and Performance Management functional requirements on the Ethernet EMS-NMS interface will mature in the future as these mechanisms further evolve.

7.1 Configuration Management

This section defines the configuration management capabilities that are relevant for the EMS-NMS interface. These functions include:

- Ethernet Flow Point Pools;
- Access Loop and Bandwidth profiles;
- Ethernet Flow Domain Fragments/EVCs;
- Ethernet Flow Points;
- QoS management;
- ETY management;
- Queue management; and
- Traffic classification.

7.1.1 Ethernet Flow Point Pools

Frames incoming to the Access Node from the CPE are admitted based on frame type and may be tagged or untagged. Frame admission is permitted based on frame type ability on a per FPP basis.

R-01 The acceptable frame types per FPP (i.e., UNI) MUST be configured via the EMS-NMS interface to be one of the following values.

- ‘VLAN tagged’;
- “untagged or priority-tagged”; and
- “admit all” (i.e., accepting VLAN-tagged, untagged and priority-tagged frames).

Note: A priority-tagged frame is an untagged frame that contains priority (CoS) information.

R-02 The EMS-NMS interface MUST support the capability of the NMS to create, retrieve, modify and delete Ethernet Flow Point Pools (FPPs).

R-03 When a FPP is created via the EMS-NMS interface, the type of FPP MUST be indicated. Possible values of the FPP type are:

- UNI
- E-NNI (i.e., Ethernet NNI)
- Unconfigured (i.e., a FPP that is a potential UNI or NNI, but it has not yet been provisioned)

TR-101 defines requirements on IPoE and PPPoE bridged encapsulations that are multiplexed over a single user port, but require different VLAN ID and/or priority assignment. In order to support these encapsulations, the following requirement applies. The remaining criteria in this subsection pertain to Flow Point Pool UNIs. E-NNI criteria are currently under development in the MEF.

R-04 The EMS-NMS interface MUST support the capability to assign an Ethertype filter to a given UNI. At minimum, the following Ethernet filter types, identified in IEEE 802.3, MUST be supported, as identified in TR-101.

- PPPoE (Ethertype =0x8863 and 0x8864)
- IPoE (Ethertype=0x0800)
- ARP (Ethertype=0x0806)

The following filters apply to rootedMp and p2p VLANs.

R-05 The EMS-NMS interface SHOULD allow the configuration of the following filters and applying them to UNIs:

1. Source Media Access Control (MAC) address filter. This filter MAY be used in one of the following ways:
   i. Allowing access from specific devices (i.e. MAC address).
   ii. Denying access from a specific MAC address.
2. Destination MAC address filter. This filter MAY be used in one of the following ways:
   i. Allowing access to specific destinations.
   ii. Denying access to specific destinations.

R-06 The combination of Layer 2 control protocols (see TR-101, Table 1) and the corresponding destination MAC address that are processed at each UNI MUST be assigned a processing decision over the EMS-NMS interface as follows:

- Discard (i.e., Block)
- Peer
- Pass-to-EVC (i.e., Forward)
- Peer & Pass-to-EVC[4]

If pass-to-EVC or Peer & Pass-to-EVC is selected, then the applicable EVC MUST be identified.

The processing behavior of the Layer 2 control protocols MUST be done consistent with TR-101, Table 1.

R-07 Each UNI MUST be assigned a user label to identify the Flow Point Pool over the EMS-NMS interface.

R-08 The user label defined for each UNI via the EMS-NMS interface SHOULD be assigned a value of type String.

R-09 Via the EMS-NMS interface, it MUST be possible to enable the Max Number of Configured Flow Domain Fragments (FDFrs)/EVCs that can be supported by the Flow Point Pool.

R-10 For each Flow Point Pool UNI, there MUST be the ability over the EMS-NMS interface to configure whether service multiplexing is allowed. Service multiplexing allows incoming frames to be mapped to multiple EVCs based on CE VLAN Id. Allowed values of this service multiplexing flag are:

- TRUE (service multiplexing is enabled)
- FALSE (service multiplexing is disabled)

If a given port supports only TLS traffic, the service multiplexing flag for a given Flow Point Pool UNI MUST be set to FALSE since the port is set to a VLAN traffic mapping of “allToOne.”

R-11 The Flow Point Pool UNI MUST be assigned a bundling indicator. To support bundling, multiple CE VLAN IDs may be mapped to a single EVC (i.e., a Flow Domain Fragment) via the EMS-NMS interface. The bundling indicator for a given Flow Point Pool UNI MUST take on one of the following values:

- Yes (i.e., bundling is supported)
- No (i.e., bundling is not supported)
- allToOne (for all TLS traffic across a given Flow Point Pool)

[4] This is a Layer 2 protocol processing service attribute defined in MEF 10.1.

R-12 If the bundling indicator in R-11 is set to "yes" (i.e., an EVC has more than one CE-VLAN ID mapped to it), the EVC MUST support CE-VLAN Id preservation. That is, the EMS-NMS interface MUST allow/ensure that the list of CE-VLAN Ids mapped to the EVC is the same at each UNI in the EVC.

R-13 Via the EMS-NMS interface, a FPP UNI MAY be assigned a bandwidth profile, as defined in Section 7.1.2.

R-14 For a given Flow Point Pool UNI, a CE-VLAN Id assigned to all ingress traffic MAY be set across the EMS-NMS interface. This assignment applies and overrides whether or not a C-VID is set in the Ethernet frame. This parameter can take on an integer ranging from 1 to 4094. R-14 and R-15 cannot be implemented at the same time.

R-15 For a given Flow Point Pool UNI, a CE-VLAN Id MAY be assigned to all untagged traffic across the EMS-NMS interface with the default tagging specified in the ITU Rec. Q.840.1 ingressVLANAssignmentUntagged attribute in the ETH_FPP_UNI object. This parameter can take on an integer ranging from 1 to 4094. R-14 and R-15 cannot be implemented at the same time.

R-16 For a given Flow Point Pool UNI, a VLAN Priority MAY be assigned to all ingress traffic across the EMS-NMS interface. This assignment applies and overrides whether or not a C-VID is set in the Ethernet frame. This parameter can take on an integer ranging from 0 to 7. R-16 and R-17 cannot be implemented at the same time.

R-17 For a given Flow Point Pool UNI, a VLAN Priority MAY be assigned to all untagged traffic across the EMS-NMS interface with the default priority specified in the ITU Rec. Q.840.1 ingressVLANPriorityAssignment Untagged attribute) unless matching an Ethertype filter associated with this port. This parameter can take on an integer ranging from 0 to 7. R-16 and R-17 cannot be implemented at the same time.

R-18 Each Flow Point Pool UNI SHOULD contains a pointer to the Flow Point Pool UNI at the opposite end of the Link supporting the UNI. This pointer MAY be provisioned over the EMS-NMS interface.

R-19 For each user-facing port (i.e., FPP UNI), a capability MUST exist over the EMS-NMS interface to turn off auto-sensing (for sensing protocol encapsulations such as PPP over ATM, as specified in TR-101, R-61).

R-20 The maximum number of source MAC addresses learned from a given FPP UNI MUST be configurable via the EMS-NMS interface.

R-21 The enabling/disabling of the Layer 2 DHCP Relay Agent MUST be configurable on a per-FPP UNI basis via the EMS-NMS interface. The default value is "enabled."

R-22 The ability to configure a list of IP addresses associated with a given VLAN and FPP UNI MUST be supported over the EMS-NMS interface, to be used for users having static IP configuration.

R-23 The maximum number of simultaneous IP multicast groups allowed MUST be configurable per FPP UNI over the EMS-NMS interface.

R-24 The EMS-NMS interface MUST support the setting of a rate limit in packets per seconds of Ethernet OAM messages arriving on the related FPP UNI. A rate limit set equal to zero completely filters Ethernet OAM messages from the FPP UNI.

R-25 The EMS-NMS interface MUST support on a per-FPP UNI basis the ability of the Access Node to enable/disable the insertion of the access loop characteristics via its PPPoE intermediate agent and/or its layer 2 DHCP Relay agent function.

7.1.2 Access Loop and Bandwidth Profiles

Access Node provisioning can be accomplished and made easier through the existence of pre-defined profiles that allow the configuration of common characteristics or features across all or a subset of access loops (i.e., UNIs, EVCs). Examples of profiles include traffic and QOS parameters on Ethernet virtual connections. Relevant Ethernet traffic parameters include the Committed Information Rate (CIR), Committed Burst Size (CBS), Excess Information Rate (EIR), and Excess Burst Size (EBS). A Service Provider will establish a bandwidth profile table and a specific instance of this table will be assigned to each Ethernet FPP.

R-26 The EMS-NMS interface MUST allow profiles to be used in the configuration of common characteristics or features across one or more FPP UNIs and EVCs.

R-27 The EMS-NMS interface MUST support the capability of creating Ethernet bandwidth profiles. An Ethernet bandwidth profile MUST contain the following parameters:

- Committed Information Rate (CIR) specified in bits per second;

- Committed Burst Size (CBS) specified in bytes;
- Excess Information Rate (EIR) specified in bits per second; and
- Excess Burst Size (EBS) specified in bytes.

R-28 For each FPP UNI, an association MUST be established via the EMS-NMS interface between the FPP and the ingress bandwidth profiles that characterize the Flow Point Pool UNI in the ingress direction.

R-29 An association MUST be established via the EMS-NMS interface between an EVC and the ingress bandwidth profiles. An association SHOULD be established via the EMS-NMS interface between an EVC and the egress bandwidth profiles.

R-30 For each FPP that is configured as a UNI, an association SHOULD be established via the EMS-NMS interface between the FPP and the egress bandwidth profiles that characterize the Flow Point Pool UNI in the egress direction.

7.1.3 Ethernet Flow Domain Fragment/EVC

The following requirements apply to an Ethernet Flow Domain Fragment/EVC. EVCs represent the frame flow between the U-interface and the V-interface. On a per EVC basis, a flow point points to a bandwidth profile.

R-31 Each FDFr/EVC MUST be assigned a unique naming identifier value.

R-32 Each VLAN (i.e., EVC) MUST be configured as one of the following types via the EMS-NMS interface:

- Point-to-point (p2p) – referred to as a 1:1 VLAN in TR-101;
- Rooted Multi-point (rootedMp) – referred to as a N:1 VLAN in TR-101.

R-33 The maximum transmission unit (MTU) size parameter for the EVC MUST be configurable via the EMS-NMS interface. The MTU size takes on an integer of value greater than or equal to 1522.

R-34 The EMS-NMS interface MUST provide the capability to set-up a point-to-point EVC across an Ethernet Flow Domain with two endpoints, either one at a user-facing port and another at a network-facing port, or one at a network-facing port and another at a different network-facing port.

R-35 Each rooted, multi-point EVC MUST be associated with more than two Ethernet Flow Points via the EMS-NMS interface.

R-36 The EMS-NMS interface MUST provide the capability to set-up a rooted, multi-point EVC across an Ethernet Flow Domain with more than two endpoints configured as FPP UNIs.

R-37 The EMS-NMS interface MUST provide the capability to tear-down or delete an EVC in an Ethernet Flow Domain.

R-38 Associated with each FDFr/EVC, there MUST exist a VLAN translation table configurable via the EMS-NMS interface that:

- Identifies an S-VID to replace the U-interface C-VID, if the C-Tag needs to be replaced with an S-Tag;
- Identifies both a C-VID and an S-VID, if the U-interface C-VID has to be overwritten and the frame also needs S-Tag attachment.

In either case, the same S-Tag is placed on all frames mapped to an EVC.

R-39 For each CE-VLAN Id in a given port's VLAN membership list, the EMS-NMS interface MUST have the capability to indicate whether to

- Accept (i.e., forward 'as is') the received VLAN priority markings;
- Rewrite the priority using an ingress to egress priority mapping. The priority mapping MUST be configurable (per C-VID in the port's VLAN membership list).

7.1.4 Ethernet Flow Points

An Ethernet Flow Point represents the termination of an EVC on an Ethernet Flow Domain.

R-40 The EMS-NMS interface MUST support the configuration of Ethernet Flow Points, including the assignment of a unique identifier per Ethernet Flow Point.

R-41 Each Ethernet Flow Point MUST be assigned a user label to identify the Flow Point Pool over the EMS-NMS interface.

R-42 The user label defined for each Ethernet Flow Point via the EMS-NMS interface SHOULD be assigned a value of type String. The user label MUST not exceed 63 characters in length.

R-43 For FPP UNIs or NNIs supported on an Access Node, associated Flow Points providing per-EVC VLAN Membership Lists (i.e., VLAN ID mapping) MUST be configurable across the EMS-NMS interface.

R-44 For each VLAN transparent UNI supported on an Access Node, a Flow Point providing the VLAN membership list MUST be configurable via the EMS-NMS interface.

R-45 An S-Tag, which is used to encapsulate incoming traffic, MUST be settable at each UNI Flow Point (where the frame is mapped to an EVC) via the EMS-NMS interface.

R-46 For each CE-VLAN Id in a VLAN membership list, there MUST be a capability over the EMS-NMS interface to indicate whether to accept (i.e. forward 'as is') the received VLAN priority markings or rewrite the priority using an ingress to egress priority mapping.

R-47 The EMS-NMS interface MUST allow the ingress to egress priority mapping to be configurable per CE-VLAN Id in the port's VLAN membership list. This requirement applies to TLS traffic mapped to a TLS EVC and non-TLS (i.e., VLAN tagged) traffic mapping to a non-TLS EVC.

R-48 For N:1 VLANs, the capability to prevent forwarding traffic between Access Node user ports, as described in TR-101/Section 3.2.2, MUST be configurable per S-VID via the EMS-NMS interface.

R-49 Over the EMS-NMS interface, an S-VID assignment MUST be configurable at a Flow Point.

R-50 For any VLAN configured as 1:1 (i.e., p2p), the EMS-NMS interface MUST support the enabling/disabling of MAC address learning on a per Flow Point basis.

R-51 An interworked PPPoE Inactivity Timeout MUST be configurable via the EMS-NMS interface. The parameter is used to help determine when an interworked PPPoE session is considered to be disconnected.

R-52 The NMS MUST have the capability to query via the EMS-NMS interface for the current problem list associated with a given Ethernet Flow Point.

R-53 To support VLAN bundling on a given UNI, the capability to map multiple CE VLAN Ids to a single EVC (via the VLAN Membership List) MUST be supported over the EMS-NMS interface.

R-54 The EMS-NMS interface MUST allow the list of layer 2 control protocols to be defined on a given Flow Point. The list along with frame processing procedures MUST be provided as follows:

- Discard

- Tunnel

R-55 A Flow Point MAY be assigned a bandwidth profile via the EMS-NMS interface.

R-56 A bandwidth profile MAY be assigned on a per CoS basis per Flow Point via the EMS-NMS interface.

R-57 There MUST exist a pointer to the EVC terminating the Flow Point and this pointer value MUST be retrievable via the EMS-NMS interface.

7.1.4.1 IGMP

R-58 The EMS-NMS interface MUST support the handling of user-initiated IGMP messages on a user-facing port and/or a per-VLAN basis. Valid IGMP processing modes are:

- Discard;
- Forward; and
- Process.

R-59 On a per-VLAN basis, the EMS-NMS interface MUST support the capability of assigning transparent snooping or IGMP v3 snooping with proxy reporting. This capability is configurable and applies if the VLAN type is set to rootedMP and the “IGMP processing mode" attribute is set to Process.

R-60 The EMS-NMS interface MUST support the configuration of the IGMP No Match attribute behavior. When there is no match between an IGMP group and a VLAN, this parameter defines whether the message should be forwarded or dropped. Valid values of this IGMP No Match attribute are:

- Discard; and
- Forward.

R-61 For a given VLAN, the EMS-NMS interface MUST support the ability to configure a Discard Upstream Multicast Traffic attribute, which defines whether or not the Access Node should discard multicast traffic in the upstream direction for a given VLAN. Valid values of this Discard Upstream Multicast Traffic attribute are:

- True; and
- False.

If this attribute is set to “True,” the multicast traffic MUST be discarded.

R-62 For a given multicast VLAN, the ability to rate limit IGMP messages received from user-facing ports MUST be configurable via the EMS-NMS interface. This Upstream IGMP Messages Rate Limit parameter defines the rate limit in messages per second for IGMP messages received in the upstream direction. This parameter is applicable if the IGMP processing mode, defined in R-58, is set to "Process."

R-63 IP multicast groups or ranges of multicast groups per multicast VLAN MUST be configurable via the EMS-NMS interface based on:

- Source address matching; and
- Group address matching.

R-64 The IGMP default priority for remarking (with Ethernet priority bits) user-initiated IGMP messages before forwarding them to the network MUST be configurable on a per-VLAN basis.

7.1.4.2 PPPoE

R-65 The EMS-NMS interface SHOULD permit the configuration of a VLAN priority value assigned to PPPoE Active Discovery Terminate (PADT) packets. This will allow the Access Node to mark PPPoE PADT packets with a higher VLAN priority than that used for best-effort PPPoE session packets.

7.1.4.3 IP Security

R-66 The EMS-NMS interface MUST support the ability to enable IP address spoofing control. The default value is "disabled." IP spoofing control MUST be enabled if L2 DHCP Relay Agent Control is enabled.

R-67 The EMS-NMS interface MUST support the capability to configure a list of IP addresses associated with a given VLAN (and FPP UNI). This is applicable for users having static IP configuration.

R-68 The EMS-NMS interface MUST support the capability to control whether downstream IP broadcast and multicast frames are filtered out on a per-VLAN basis.

7.1.5 QoS Management

In an ATM-centric access node, every ATM PVC is assigned a traffic class (i.e. CBR, VBR-RT, VBR-nRT, or UBR) and a traffic profile (e.g. PCR, SCR, MBS etc.). In a typical implementation the above ATM traffic classes are scheduled with strict priority. Using Ethernet, the traffic class can be determined frame-by-frame by examining the VLAN tag priority field, providing 8 different priority values, which can map to a lower number of traffic classes (e.g. 2 to 4). According to IEEE 802.1D-2004, in a typical implementation, the above Ethernet traffic classes are scheduled with strict priority. A fundamental difference from ATM is that multiple Ethernet traffic classes may be multiplexed over a single VLAN (as opposed to a single ATM traffic class per ATM VC). Finally, it is desirable to retain the ATM and IP notions of marking drop precedence of traffic for congestion management in the Access Node.

The following requirements cover QoS implementation and the interworking between the different CoS methodologies.

R-69 On a per-Flow domain basis, a configurable mapping between the 8 possible values of the Ethernet priority field and at least 4 traffic classes for Ethernet frames MUST be supported via the EMS-NMS interface.

R-70 The Access Node SHOULD support at least 6 traffic classes for Ethernet frames, and MUST support a configurable mapping via the EMS-NMS interface to these classes from the 8 possible values of the Ethernet priority field.

R-71 The EMS-NMS interface MUST support the configuration of drop precedence within at least 2 traffic classes and MUST support a configurable mapping to these traffic classes and drop precedence from the 8 possible values of the Ethernet priority field.

R-72 The EMS-NMS interface SHOULD support the enabling/disabling of drop precedence based on the DEI bit value of the 802.1ad header (see Figure 13/TR-101) to these classes and drop precedence from the 8 possible values of the Ethernet priority field. The value “disabled” means that drop precedence is not based on the value of the DEI bit.

7.1.6 ETY Management

In Figure 7/TR-101, the underlying physical layer in the V-interface protocol stack supports “some 802.3 Phy.” In ITU-T Rec. Q.840.1, “some 802.3 Phy” pertains to supporting an ETY (i.e., Ethernet) physical layer. As such, the following Ethernet Media Access Units (MAUs) requirements from ITU-T Rec. Q.840.1 apply at the V-interface.

R-73 The EMS-NMS interface MUST support the ability to associate an ETY, or in the case of link aggregation, multiple ETYs to the FPP (i.e., a FPP UNI) in the client layer.

R-74 An association between the specific physical card and circuit pack containing the MAU MUST be retrievable via the EMS-NMS interface.

7.1.7 Queue Management

TR-101 defines requirements on user-facing queues and network facing queues. TR-141 defines a managed entity called the Queues Block Profile Table that models queues from an NE-EMS interface perspective. Accordingly, a similar set of queue management functions are defined herein for the EMS-NMS interface.

R-75 At least 4 queues per user facing port (i.e., FPP UNI) one per traffic class, MUST be configurable via the EMS-NMS interface.

R-76 At least 6 queues per user facing port (i.e., FPP UNI), one per traffic class, SHOULD be configurable via the EMS-NMS interface.

R-77 Over the EMS-NMS interface, at least 4 queues per network facing port, one per traffic class, MUST be configurable.

R-78 At least 6 queues per network facing port, one per traffic class, SHOULD be settable via the EMS-NMS interface.

R-79 Scheduling of user and network facing queues according to strict priority among at least 4 queues MUST be supported via the EMS-NMS interface.

R-80 The EMS-NMS interface SHOULD support the scheduling of user facing and network facing queues based on their assigned priority and weight. The number of priorities MUST be at least 4; however multiple queues may be assigned to the same priority. A queue weight MUST be assigned only when the same queue priority value is assigned to multiple queues and they are scheduled according to a weighted algorithm. Otherwise, queue weight is not relevant.

R-81 The EMS-NMS interface MUST support the configuration of the maximum size/depth for each user facing and network facing queue.

7.1.8 Traffic Classification

TR-101 discusses the need of the Access Node to mark or re-mark Ethernet priority bits based on certain criteria and the mapping of each VC belonging to a PVC bundle (i.e., an ATM UNI) to valid Ethernet priority values. From the perspective of this Technical Report, this means that Ethernet priority values need to be mapped to VPI/VCI values.

R-82 The EMS-NMS interface MUST support the traffic classification table information, as defined in TR-141, that allows the Access Node to mark or re-mark Ethernet priority bits based on the following classification criteria.

- User-facing port
- Ethertype
- Received Ethernet priority bits
- IP Protocol ID (specifically support classification of IGMP)

R-83 The EMS-NMS interface MUST support configuration of the mapping of Ethernet priority values to VPI/VCI values for each ATM Virtual Connection belonging to a UNI.

7.2 Fault Management

The fault management requirements in TR-130/Section 6.3 are applicable to DSL-to-Ethernet aggregation. This section expands upon the service OAM functionality discussed in TR-130.

7.2.1 Service OAM

MEF 17 [5] and ITU-T Recommendation Y.1731 [11] define Ethernet service OAM functionality and introduce an OAM Maintenance Entity (ME). A ME is an association between two maintenance end points, referred to as peers, within an OAM domain. Figure 3, which also appears in MEF 17, identifies several MEs, including Subscriber MEs, EVC MEs, and UNI MEs.

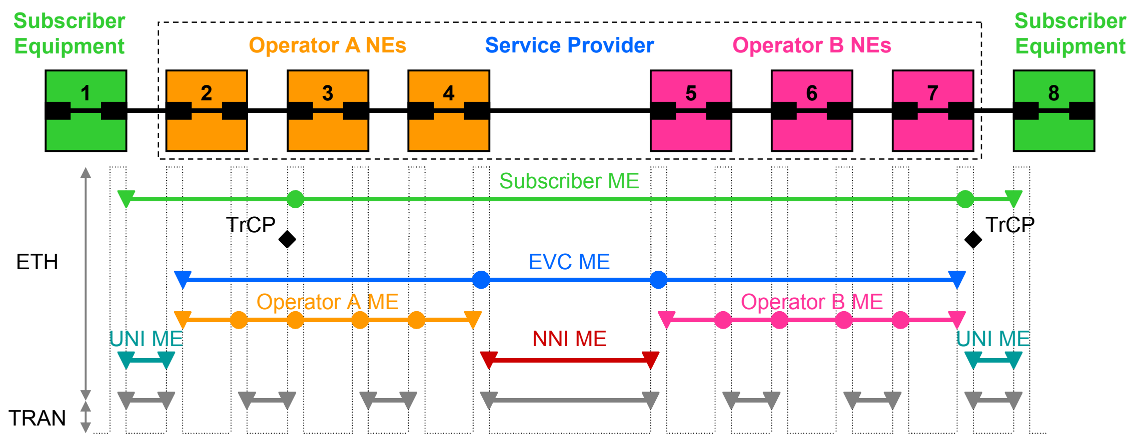

Figure 3 - Service OAM Reference Model

A Maintenance Entity Group End Point (MEP), represented by a triangle symbol in Figure 3, is a provisioned OAM reference point which is capable of initiating and terminating proactive OAM frames. Each MEP has an entity name and a MAC address. A MEP is also capable of initiating and reacting to diagnostic OAM frames. A MEG Intermediate Point (MIP), represented by a circle symbol in Figure 3, is a provisioned OAM reference point which is capable to react to diagnostic OAM frames initiated by MEPs. A MIP does not initiate proactive and diagnostic OAM frames.

R-84 The EMS-NMS interface SHOULD support the configuration of peer maintenance endpoints in the form of a MEP name and a MAC address.

R-85 The EMS-NMS interface MUST support turning off sending of Continuity Check Messages (CCMs) for the MEP(s) on user-facing and network-facing ports, while keeping the associated MEP(s) active.

R-86 The EMS-NMS interface SHOULD allow the configuration of the ITU-T Recommendation Y.1731-defined “Server MEP” function on each user-facing port.

R-87 The EMS-NMS interface MUST allow the initiation of ETH Service OAM loopback tests.

R-88 The EMS-NMS interface SHOULD support the ability of an NMS to initiate a link trace message on an EVC towards its peer MEP(s) and receive an associated line trace reply for the MEP. IEEE 802.1ag [14] describes the data and ITU Recommendation Y.1731 describes the corresponding parameters in the link trace reply.

The MEF has work in progress to define a model (aligned with IEEE) for the management of Ethernet Service OAM. Once the MEF model for management of Service OAM matures, further updates to this Technical Report will be necessary to define the applicable management requirements.

7.3 Performance Management

This section defines performance management requirements associated with the EMS-NMS interface pertaining to per-user facing port/VLAN, Ethernet, and service OAM statistics. These functional requirements are intended to supplement those defined on the xDSL EMS-NMS interface in TR-130.

7.3.1 User-Facing Port/VLAN Statistics

R-89 The total number of currently active hosts SHOULD be collected per-VLAN, per multicast group and made available over the EMS-NMS interface.

R-90 The following performance data SHOULD be collected per-FPP UNI, per multicast VLAN and made available over the EMS-NMS interface.

- Total number of successful joins
- Total number of unsuccessful joins
- Total number of leave messages
- Total number of general queries sent to users
- Total number of specific queries sent to users
- Total number of invalid IGMP messages received

R-91 The following performance data SHOULD be collected per multicast VLAN and made available over the EMS-NMS interface.

- Current number of active groups
- Total number of joins sent to network
- Total number of joins received from users (sum of next two items below)
- Total number of successful joins from users
- Total number of unsuccessful joins from users
- Total number of leave messages sent to network
- Total number of leave messages received from users
- Total number of general queries sent to users
- Total number of general queries received from network
- Total number of specific queries sent to users
- Total number of specific queries received from network
- Total number of invalid IGMP messages received

8. Mapping of Requirements to TR-101 and TR-141

8.1 Requirements Mapping Table

Table 2 provides a mapping of the EMS-NMS requirements defined in this Technical Report with TR-101 requirements and the managed objects defined in TR-141.

Table 2 - Mapping of TR-169 Requirements to TR-101 Requirements and TR-141 Managed Objects

TR-101 Requirement Number	TR-141 Managed Object Name	TR-169 Requirement Number	Comments
R-01	None	None	
R-02	None	None	
R-03	None	None	
R-04	None	None	
R-05	None	None	
R-06	None	None	
R-07	None	None	
R-08	ETHERTYPE 802.1ad	R-38	
R-09	Accepted Frame Type(s)	R-01	
R-10	TLS Function	R-02, R-03, R-11	
R-11	VLAN Membership List	R-03, R-46	
R-12	(TLS) S-VID	R-38 and R-45	
R-13	None	None	
R-14	1. Default Priority 2. Ingress to Egress Priority Mapping Table 3. Ingress to Egress Priority Mapping – Profile Index	R-39 and R-47	
R-15	None	None	
R-16	1. VLAN Membership List 2. VLAN Membership List (VML) – Index	R-44	

TR-101 Requirement Number	TR-141 Managed Object Name	TR-169 Requirement Number	Comments
R-17	1. VLAN Membership List 2. VLAN Membership List (VML) – Index 3. Ingress to Egress Priority Mapping Table 4. Default Priority	R-39	
R-18	None	None	
R-19	Non-Tagged Frames Handling	R-44 and R-45	
R-20	Ingress to Egress Priority Mapping Table	R-46	
R-21	S-VID S-Priority	R-45 and R-49	
R-22	C-VID C-Priority	R-15 and R-17	
R-23	None	None	
R-24	None	None	
R-25	None	None	
R-26	Filters List Index (Ethertype) Filter Table	R-04	
R-27	(Ethertype) Filter Actions	R-14, R-15, R-16, and R-17	
R-28	None	None	
R-29	VLAN Membership List – Index	R-43	
R-30	1. VLAN Membership List – Index 2. VLAN Membership List (VML) – Index	R-38 and R-39	
R-31	1. VLAN Membership List – Index 2. VLAN Membership List (VML) – Index 3. Ingress to Egress Priority Mapping Table 4. Default Priority	R-38 and R-39	
R-32	None	None	

TR-101 Requirement Number	TR-141 Managed Object Name	TR-169 Requirement Number	Comments
R-33	Forwarding Paradigm	R-32, R-34, R-35, R-36, and R-37	
R-34	Applicable	R-73	
R-35	Applicable	R-73	
R-36	None	None	
R-37	Applicable	R-34	
R-38	None	None	
R-39	None	None	
R-40	User to User Traffic Control	R-48	
R-41	None	None	
R-42	None	None	
R-43	None	None	
R-44	Address Learning Control	R-50	
R-45	1. Priority to Traffic Class Mapping 2. Priority to Traffic Class Mapping Profile Index	R-69	
R-46	1. Priority to Traffic Class Mapping Table 2. Priority to Traffic Class Mapping Profile Index	R-70	
R-47	Priority to Traffic Class Mapping Table	R-71	
R-48	Priority to Traffic Class Mapping Table	R-72	
R-49	Number of Queues	R-75	
R-50	Number of Queues	R-76	
R-51	1. Queues Block Profiles Table 2. Queues Setup Profile Index	R-79	
R-52	1. Queues Block Profiles Table 2. Queues Setup Profile Index	R-80	
R-53	Number of Queues	R-77	
R-54	Number of Queues	R-78	

TR-101 Requirement Number	TR-141 Managed Object Name	TR-169 Requirement Number	Comments
R-55	1. Queues Block Profile Table 2. Queues Setup Profile Index	R-79	
R-56	1. Queues Block Profile Table 2. Queues Setup Profile Index	R-80	
R-57	Queues Block Profiles Table	R-03, R-81	
R-58	1. Traffic Classification Table 2. Traffic Classification Profile Index	R-82	
R-59	1. PVC Bundle ID 2. PVC Bundle	R-83	
R-60	None	None	
R-61	None	None	
R-62	Auto Sense Control	R-19	
R-63	None	None	
R-64	None	None	
R-65	None	None	
R-66	None	None	
R-67	None	None	
R-68	None	None	
R-69	None	None	
R-70	None	None	
R-71	None	None	
R-72	None	None	
R-73	None	None	
R-74	None	None	
R-75	None	None	
R-76	Interworked PPPoE Inactivity Timeout	R-51	
R-77	PADT VLAN Priority	R-65	
R-78	None	None	
R-79	Not applicable	Not applicable	
R-80	Not applicable	Not applicable	
R-81	Not applicable	Not applicable	
R-82	Not applicable	Not applicable	

TR-101 Requirement Number	TR-141 Managed Object Name	TR-169 Requirement Number	Comments
R-83	Not applicable	Not applicable	
R-84	None	None	
R-85	None	None	
R-86	Not applicable	Not applicable	
R-87	None	None	
R-88	Downstream Broadcast/Multicast filtering	R-56, R-57, R-68	
R-89	None	None	
R-90	None	None	
R-91	None	None	
R-92	Maximum learned addresses	R-20	
R-93	Maximum learned addresses	R-20	
R-94	1. MAC Addresses Filter 2. Filters List Index	R-05	
R-95	1. EAP Control 2. Slow Control Protocol	R-05, R-06, and R-54	
R-96	L2 DHCP Relay Agent Control	R-21	
R-97	L2 DHCP Relay Agent Control	R-21	
R-98	None	None	
R-99	None	None	
R-100	None	None	
R-101	None	None	
R-102	None	None	
R-103	None	None	
R-104	None	None	
R-105	None	None	
R-106	None	None	
R-107	None	None	
R-108	IP Addressing Spoofing Prevention Control	R-66	
R-109	Static Hosts Table	R-22 and R-67	
R-110	Not applicable	Not applicable	
R-111	Not applicable	Not applicable	

TR-101 Requirement Number	TR-141 Managed Object Name	TR-169 Requirement Number	Comments
R-112	Agent Circuit Id	R-07	
R-113	Agent Remote Id	R-07, R-08, and R-10	
R-114	None	None	
R-115	None	None	
R-116	Not applicable	Not applicable	
R-117	Not applicable	Not applicable	
R-118	None	None	
R-119	Agent Circuit ID	R-07	
R-120	Agent Remote ID	R-07 and R-08	
R-121	None	None	
R-122	Agent Circuit ID	R-40, R-41, and R-42	
R-123	1. Agent Circuit ID 2. Circuit ID Syntax Type	R-40, R-41, and R-42	Maps to Flow Point Pool Id and EVC Id
R-124	1. Circuit ID Syntax Type 2. Access Node Id	R-40	Maps to Flow Point Id
R-125	Access Node Id	TR-130, Section 6.2.1	
R-126	1. Circuit Id Syntax Type 2. Circuit Id Syntax	R-31, R-40, R-41, and R-42	Maps to EVC Id
R-127	Loop Characteristics Insertion Control	R-25	
R-128	Not applicable	Not applicable	
R-129	None	None	
R-130	None	None	
R-131	None	None	
R-132	None	None	
R-133	Not applicable	Not applicable	
R-134	Not applicable	Not applicable	
R-135	Not applicable	Not applicable	
R-136 – R-139	Not applicable	Not applicable	
R-140	Not applicable	Not applicable	
R-141 – R-190	Not applicable	Not applicable	
R-191	Not applicable	Not applicable	
R-192	Not applicable	Not applicable	
R-193	Not applicable	Not applicable	
R-194	Not applicable	Not applicable	
R-195	Not applicable	Not applicable	
R-196	Not applicable	Not applicable	
R-197	Not applicable	Not applicable	

TR-101 Requirement Number	TR-141 Managed Object Name	TR-169 Requirement Number	Comments
R-198	Not applicable	Not applicable	
R-199	Not applicable	Not applicable	
R-200	Not applicable	Not applicable	
R-201	Not applicable	Not applicable	
R-202	IGMP Processing Mode	R-58	
R-203	None	None	
R-204	IGMP No-Match Behavior	R-60	
R-205	None	None	
R-206	Discard Upstream Multicast Traffic	R-61	
R-207	None	None	
R-208	Upstream IGMP Messages Rate Limit	R-62	
R-209	IGMPv3 Transparent Snooping	R-58	
R-210	None	None	
R-211	None	None	
R-212	None	None	
R-213	None	None	
R-214	None	None	
R-215	IGMP Default Priority	R-64	
R-216	None	None	
R-217	Multicast VLAN Statistics Tables	R-89, R-90, and R-91	
R-218	NtoOne VLAN Type	R-55 and R-56	
R-219	Multicast Group Description Table	R-63	
R-220	Maximum Number of Simultaneous Multicast Groups	R-23	
R-221	IGMP Processing Mode	R-58	
R-222	None	None	
R-223 – R-237	Not applicable	Not applicable	
R-238	TBD	TBD	
R-239	TBD	TBD	
R-240	TBD	TBD	
R-241	None	None	
R-242	Not applicable	Not applicable	

TR-101 Requirement Number	TR-141 Managed Object Name	TR-169 Requirement Number	Comments
R-243	Not applicable	Not applicable	
R-244	Not applicable	Not applicable	
R-245	Not applicable	Not applicable	
R-246	Not applicable	Not applicable	
R-247	IGMP Snooping Mode	R-59	
R-248	IGMP Snooping Mode	R-59	
R-249	None	None	
R-250	None	None	
R-251 – R-263	Not applicable	Not applicable	
R-264	None	None	
R-265	None	None	
R-266	None	None	
R-267	Upstream Ethernet OAM Message Rate Limit	R-24	
R-268	Upstream Ethernet OAM Message Rate Limit	R-24	
R-269	None	None	
R-270	None	None	
R-271	None	None	
R-272	None	None	
R-273	Applicable	R-87	
R-274	None	None	
R-275	None	None	
R-276	Applicable	R-88	
R-277	None	None	
R-278	None	None	
R-279	Peer MEP Table	R-84	
R-280	Applicable	Applicable to R-85	
R-281	Applicable	R-85	
R-282	None	None	
R-283	“Server MEP” Function Control	R-86	
R-284	None	None	
R-285	None	None	
R-286	Applicable	R-87	
R-287	None	None	
R-288	Applicable	R-88	
R-289	None	None	
R-290	Peer MEP Table	R-84	

TR-101 Requirement Number	TR-141 Managed Object Name	TR-169 Requirement Number	Comments
R-291	Applicable	Applicable to R-85	
R-292	Applicable	R-85	
R-293	None	None	
R-294	None	None	
R-295	Applicable	Applicable	
R-296	Applicable	Applicable	
R-297	Applicable	Applicable	
R-298	None	None	
R-299	None	None	
R-300	None	None	
R-301 – R-339	Not applicable	Not applicable	
R-340	Not Applicable	Not applicable	
R-341	None	None	
R-342	Not Applicable	Not applicable	
R-343	Access Loop Configuration Profile	R-26	
R-344	None	None	
R-345	None	None	
R-346	None	None	
R-347	Not applicable	Not applicable	
R-348	Not applicable	Not applicable	
R-349	Not applicable	Not applicable	
R-350	Not applicable	Not applicable	
R-351	Not applicable	Not applicable	
R-352	Not applicable	Not applicable	
No explicit TR-101 requirement; but MTU size must be managed for Ethernet.	No explicit TR-141 managed object; but MTU size must be managed.	R-33	MTU size is defined in RFC 3635 [12].

9. Optional Requirements

This section defines a set of EMS-NMS functional requirements that support useful Ethernet network management capabilities that are not explicitly referenced from TR-101 and TR-141.

9.1 Configuration Management

9.1.1 Ethernet Bandwidth Profiles

Section 7.1.2 discusses the content of Ethernet bandwidth profiles. It is also useful to support within bandwidth profiles a coupling flag admission option for yellow colored frames (CF), and the color mode (CM) indicating whether the color-aware or color-blind mode is employed. In color aware mode, frames are marked by the traffic policing mechanism as green or yellow (and red, but these are dropped).

R-92 The EMS-NMS interface MAY support the configuration of a Color Mode boolean variable associated with an Ethernet bandwidth profile. The value TRUE indicates that "color-aware mode" is in place. FALSE means "color-blind" mode.

R-93 The EMS-NMS interface MAY support the capability within an Ethernet bandwidth profile of allowing yellow frames to be admitted if unused bandwidth is available. The following Boolean values of this coupling flag parameter are allowed.

- 0, meaning that the volume of yellow service frames admitted into the network cannot exceed the EIR;
- 1, meaning that the volume of yellow service frames admitted into the network cannot exceed CIR + EIR

In either case, the yellow service frame burst size is bounded by EBS.

9.1.2 ETY Auto-Negotiation

MAU capabilities may be set through auto-negotiation. An attribute indicating whether or not auto-negotiation is supported on the MAU is useful.

R-94 For each ETY, the NMS MAY configure whether auto-negotiation is supported via the EMS-NMS interface.

9.1.3 Service Class Profiles

Presently, the explicit mapping of P-bit values to service profiles has not been defined in the ITU or MEF. ITU Rec. Q.840.1 provides the ability to map p-bits into service classes. ITU Rec. Q.840.1 provides an example of a Gold service class profile. Other examples of service profiles can be Silver, Bronze, et al. One or more P-bit values can be mapped to a given service profile at the discretion of the service provider.

R-95 The EMS-NMS interface MAY support the capability of creating an Ethernet service profile table. The Ethernet service profile table enables service class instances to be created based on VLAN priority.

R-96 The EMS-NMS interface MAY support the capability to assign a Service Class Profile on a per-EVC basis. In the absence of a Service Class Profile per EVC, then all VLAN traffic will be processed in the same manner (i.e., at the same class of service with no traffic having more priority than other traffic on the EVC). This is accomplished in ITU-T Rec. Q.840.1 using the ETHCoSPerformanceMapping attribute.

9.2 Performance Management

9.2.1 Ethernet Statistics

The following requirements define pertinent Ethernet performance management parameters that are relevant to DSL-to-Ethernet aggregation.

R-97 The following egress performance management traffic measurements MAY be available over the EMS-NMS interface on a per Flow Point Pool UNI entity, per CoS per UNI entity, per EVC entity, and per CoS per EVC entity, given that each entity enforces traffic management in the egress direction.

- Egress Green Frames
  - Number of green frames received by the egress UNI from the MEN.
- Egress Yellow Frames
  - Number of yellow frames received by the egress UNI from the MEN.
- Egress Green Octets
  - Number of green octets received by the egress UNI from the MEN.
- Egress Yellow Octets
  - Number of yellow octets received by the egress UNI from the MEN.

R-98 The following congestion discards performance managements MAY be available via the EMS-NMS interface on a per congestible resource on each Flow Point Pool UNI entity, per CoS per UNI entity, per EVC entity, and per CoS per EVC entity in both the ingress and egress directions.

- Green Frame Discards
  - Number of green frames discarded due to congestion.
- Green Octets Discarded
  - Number of green octets discarded due to congestion.

R-99 The following congestion discards performance managements MAY be collected on a per-congestible resource on each Flow Point Pool UNI entity, per CoS per UNI entity, per EVC entity, and per CoS per EVC entity in both the ingress and egress direction.

- Yellow Frame Discards
  - Number of yellow frames discarded due to congestion.
- Yellow Octets Discarded
  - Number of yellow octets discarded due to congestion.

R-100 The following Ethernet performance data MAY be collected on a per CoS basis and made available over the EMS-NMS interface.

- Ethernet Stats Packets 65 to 127 Octets (etherStatsPkts65to127Octets)
- Ethernet Stats Packets 128 to 255 Octets (etherStatsPkts128to255Octets)
- Ethernet Stats Packets 256 to 511 Octets (etherStatsPkts256to511Octets)
- Ethernet Stats Packets 512 to 1023 Octets (etherStatsPkts512to1023Octets)
- Ethernet Stats Packets 1024 to 1518 Octets (etherStatsPkts1024to1518Octets)

R-101 The following Ethernet abnormality measurements MAY be available via the EMS-NMS interface at each Flow Point Pool UNI.

- Undersized Frames
  - Number of frames expressed as an integer, where the frame size was smaller than 64 octets, received at the MetroEthernet Network (MEN) from the UNI.
- Oversized Frames
  - Number of oversized frames (frames greater than 1522 octets) received at the MEN from the UNI. This count is expressed as an integer.
- Fragmented Frames
  - Number of fragmented frames received at the MEN from the UNI. This count is expressed as an integer.
- FCS and Alignment Errors

  - Number of CRC and alignment errored frames received at the MEN from the UNI. This count is expressed as an integer.
- Invalid CE-VLAN ID
  - Number of frames received with an invalid CE-VLAN ID. This counted is expressed as an integer.

R-102 The following traffic measurements MAY be available over the EMS-NMS interface at each Flow Point Pool UNI.

- Octets Transmitted OK
  - Number of octets that the MEN sent to the UNI. This count is expressed as an integer.
- Unicast Frames Transmitted OK
  - Number of Unicast Frames that the MEN sent to the UNI. This count is expressed as an integer.
- Multicast Frames Transmitted OK
  - Number of Multicast frames that the MEN sent to the UNI. This count is expressed as an integer.
- Broadcast Frames Transmitted OK
  - Number of Broadcast Frames that the MEN sent to the UNI. This count is expressed as an integer.
- Octets Received OK
  - Number of octets (not including IPG) that the UNI sent to the MEN. This count is expressed as an integer.
- Unicast Frames Received OK
  - Number of Unicast Frames that the UNI sent to the MEN. This count is expressed as an integer.
- Multicast Frames Received OK
  - Number of Multicast frames that the UNI sent to the MEF. This count is expressed as an integer.
- Broadcast Frames Received OK
  - Number of Broadcast Frames that the UNI sent to the MEF. This count is expressed as an integer.

R-103 The following ingress performance management traffic measurements MAY be available over the EMS-NMS interface on a per Flow Point Pool UNI entity, per CoS per UNI entity, per EVC entity, and per CoS per EVC entity, given that each entity enforces traffic management in the ingress direction.

- Ingress Green Frames
  - Number of green frames sent by the ingress UNI to the MEN.
- Ingress Yellow Frames
  - Number of yellow frames sent by the ingress UNI to the MEN.

- Ingress Red Frames
  - Number of red (discarded) frames at the ingress UNI.
- Ingress Green Octets
  - Number of green octets sent by the ingress UNI to the MEN.
- Ingress Yellow Octets
  - Number of yellow octets sent by the ingress UNI to the MEN.
- Ingress Red Octets
  - Number of red (discarded) octets at the ingress UNI.

R-104 The following Medium Attachment Unit (MAU) termination performance managements, defined in RFC 3636 [13], MAY be available over the EMS-NMS interface for each transport layer port that represents the underlying transport termination of the Ethernet MAU.

- Interface MAU Media Available State Exits
  - Number of times the MAU leaves the available state
- Interface MAU Jabbering State Exits
  - Number of times the MAU enters the jabbering state
- Interface MAU False Carriers
  - Number of false carrier events during idle

9.2.2 Service OAM

The following Ethernet Service OAM performance data requirements are applicable. As the model for management of Service OAM matures in the MEF, further updates to this section may occur to define the applicable OAM performance data.

R-105 The following Ethernet Service OAM performance data MAY be collected on each MEG (i.e., EVC) and available on a read-only basis via the EMS-NMS interface.

- Ratio of frames Lost per CoS
- Average round trip Frame Delay per CoS
- Average one way Frame Delay per CoS
- Average round trip Frame Delay Variation per CoS
- Average one way Frame Delay Variation per CoS
- Availability Performance

R-106 The following Ethernet Service OAM performance data MAY be collected on a per Maintenance Point (MP).

- Count of incoming frames received at the MP
- Count of incoming frames discarded at the MP
- Count of outgoing frames sent from the MP

- Count of outgoing frames discarded at the MP
- Timer for loss of continuity at the MP
- Total count of Mismerge, Unexpected MEP, Unexpected MEG Level, Unexpected Period Sequence Errors, and Invalid TTL errors
- Count of OAM Mismerge errors
- Count of OAM Unexpected MEP errors
- Count of OAM Unexpected MEG errors
- Count of OAM Unexpected Period errors
- Count of OAM Sequence errors
- Count of Invalid TTL errors

