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Gap Analysis for Layer and Technology Independent OAM Management in the
                      Multi-Layer Environment
                   draft-txh-lime-gap-analysis-04

Abstract

   This draft analyses the existing management plane OAM related works
   in different SDOs, against the key objectives of Layer Independent
   OAM Management (LIME), to find the gap between them. The results can
   be used as the guidance for further work. This gap analysis is not
   targeted at L0-L2 transport OAM in ITU-T, either technology specific
   or generic across those technologies. Rather, it is intended to
   leverage knowledge from that domain for the benefit of developing
   generic layer independent OAM management for L3-L7 (and L2.5 MPLS
   OAM).

Status of This Memo

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1. Introduction

   Operations, Administration, and Maintenance (OAM) mechanisms are
   critical building blocks in network operations that are used for
   service assurance, fulfillment, or service diagnosis,
   troubleshooting, and repair. The current practice is maintenance and
   troubleshooting are achieved per technology and per layer. The
   operation process can be very cumbersome. At present, within the
   L0-L2 technology domains, considerable effort has been expended in
   ITU-T to establish a coherent approach to OAM, including generic
   layer independent principles.

   Due to this fact, [I-D.edprop-opsawg-multi-layer-oam-ps] discusses a
   valuable direction in management plane by establishing a coherent
   approach to OAM information from L2.5-L7 using a centralized

management entity and have a unified and consistent OAM view of
multi-layer networks. Operators can rely on consolidated OAM
management to correlate different layer OAM information (e.g., fault,
defects and network failure), and quickly identify the faulty element
with its layer information in the network path. Note that current
LIME work focuses on layer-independent and technology-independent
configuration, reporting and presentation for OAM mechanisms in the
context of IP, MPLS, BFD, pseudowires, and Transparent
Interconnection of Lots of Links (TRILL) technology developed by
IETF. The second important objective of LIME is to achieve a layer
and technology independent OAM view of a network and allow management
applications present to the user an abstract view of this network and
its supporting layers that is strictly topological, free of any
technology specific information. This means an abstract and generic
OAM management model in the management plane should be utilized (with
extensions as appropriate to L2.5-L7), from which OAM specific views
can be established, and technology-specific OAM data models can be
developed by mapping from the information model view. A generic OAM
management model can provide a consistent configuration, reporting,
and presentation for the OAM mechanisms. It also can mitigate the
problem related to specific OAM technology dependency.

This draft analyses the existing management plane OAM related work in
several SDOs, against the key objectives of LIME, to find the gap
between them. The results can be used as the guidance for further
work.

2. Conventions used in this document

   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 RFC2119 [RFC2119].

2.1. Terminology

   DM Data Model

   EMS Element Management System

   IM Information Model

   NMS   Network Management System

   MP Maintenance Point [802.1Q]

   MEG   Maintenance Entity Group [G.8013] [RFC6371]

   MEP   MEG End Point [G.8013] [RFC6371]

   MIP   MEG Intermediate Point [G.8013] [RFC6371]

   ME Maintenance Entity [G.8013] [RFC6371]

   MD Maintenance Domain [802.1Q]

   MPLS   Multiprotocol Label Switching

   NE Network Element

   OAM   Operations, Administration, and Maintenance [RFC6291]

   LIME   Layer Independent OAM Management [I-D.edprop-opsawg-multi-layer-oam-ps]

   SFC   Service Function Chaining

   SFF   Service Function Forwarder

   SDO   Standard Developing Organization

3. Existing OAM Related Works

3.1. Survey of ITU-T Work from L0-L2

3.1.1. Generic L0-L2

   [G.800] and [G.805] specify the unified and generic functional
   architecture of transport networks. [G.806] specifies the generic
   processing of transport equipment functions, including handling of
   OAM, defect correlation, and alarm suppression, etc. [G.7710]
   specifies the generic management requirements for configuration,
   fault, and performance (i.e. the C, F, P of FCAPS). [G.7711] is on-
   going work in ITU-T to specify the generic management information
   model for L0-L2 transport networks.

3.1.2. Technology Specific L0-L2

   [G.803], [G.872], [G.8010] and [G.8110.1] specify the functional
   architecture respectively for SDH, OTN, Ethernet, MPLS-TP transport
   networks. [G.783], [G.798], [G.8021] and [G.8121] specify
   respectively the processing of transport equipment functions for
   SDH, OTN, Ethernet, MPLS-TP, including handling of OAM, detect
   correlation, and alarm suppression, etc.
   [G.784], [G.874], [G.8051] and [G.8151] specify respectively the
   the management requirements for configuration, fault, and performance
   (i.e. the C, F, P of FCAPS). [G.774], [G.874.1], [G.8052] and
   [G.8152] specify respectively the management information model for
   SDH, OTN, Ethernet, MPLS-TP transport networks.

3.2. Management Information Models

   ITU-T's Recommendation [G.8052] and [G.8152] provide the management
   protocol-neutral information models for managing network elements in
   the Ethernet transport network and MPLS-TP transport network as
   defined in Recommendations [G.8010] and [G.8110.1] respectively. The
   management information models are derived from the "functional
   models", which describe the data plane behavior and processing.
   Management information models manage the "atomic functions" defined
   in the data plane in transport networks. They contain the object
   classes for the Ethernet and MPLS-TP NE management. This includes
   the Termination Point (TP), Maintenance Entity Group (MEG) End Point
   (MEP), MEG Intermediate Point (MIP), Traffic Conditioning & Shaping
   (TCS), Loss Measurement (LM), Delay Measurement (DM), and the general
   Performance Monitoring (PM), Current Data (CD) and History Data (HD).
   [G.8052] has been published. [G.8152] is still in progress. There
   is already some degree of consolidation among the /L0 (OTN)
   [G.874.1], (SDH) [G.774]/, /L1 (OTN) [G.874.1], (SDH) [G.774]/ and

/L2 (Ethernet) [G.8052], (MPLS-TP) [G.8152]/ information models
specified by these ITU-T recommendations. In fact, they have a
common basis for information model and are not technology-specific
models any more.

[MEF-7.1] specifies the EMS-NMS interface profile identifying the
managed objects (i.e. logical UML objects) needed to support Metro
Ethernet services. This specification provides the profile of
management entities based on ITU-T [Q.840.1], and also provides a
mapping to the TMF's MTNM 3.5 Ethernet model. Specifically this
document adds management support for Service OAM. The Ethernet
Service OAM object definitions include common OAM objects (e.g.,
EthMe, EthMeg, EthMep, etc.), Fault Management Objects (e.g.,
Continuity Check, Loopback, etc.), Performance Monitoring Objects
(e.g., Loss Measurement, Delay Measurement, etc.).

3.3. IEEE CFM MIB

The IEEE8021-CFM-MIB MIB Module and IEEE8021-CFM-V2-MIB MIB module
are CFM MIB modules for managing IEEE CFM in [802.1Q]. The former
document defines all the MIB objects that used to read, create,
modify, and delete OAM related information (i.e., CFM Stack Table, MD
Table, MA Table, MEP Table, LinkTrace Reply Table, MEP DB Table,
Notifications Table, etc). The latter document defines CFM V2 module
for managing IEEE CFM. It contains objects that replace those
deprecated in the IEEE8021-CFM-MIB module (i.e., CFM Stack Table, CFM
Vlan Table, CFM Default MD Level Table, etc).

3.4. MEF SOAM FM and PM MIB

[MEF-31] defines the MIB modules for MEF Service OAM Fault Management
(FM). This document includes two MIBs necessary to support the MEF
SOAM FM functionality: the MEF-SOAM-TC-MIB that includes the Textual
Conventions (TC) for the SOAM MIB family and the MEF-SOAM-FM-MIB that
includes extensions to Connectivity Fault Management (CFM) as
developed in [IEEE 802.1Q], including MIBs found in [IEEE 802.1Q] and
[IEEE 802.1ap], and enhanced by ITU-T [Y.1731] to support the SOAM FM
functions as presented in the [MEF-30] specification. It includes
the SOAM FM MIB objects such as mefSoamNet, mefSoamMeg, mefSoamMep,
mefSoamCc, mefSoamAis, mefSoamLb, etc.

[MEF-36] specifies the Performance Monitoring (PM) MIB necessary to
manage SOAM implementations that satisfy the Service OAM requirements
and framework specified by [MEF-17], the Service OAM Performance
Monitoring requirements as specified by [MEF-35], and the Service OAM
management objects as specified by [MEF-7.1] which are applicable to
Performance Monitoring functions. Two non-MEF documents serve as the
baseline documents for this work: ITU-T [G.8013] and IEEE [802.1Q].
The SOAM PM MIB is divided into a number of different object

groupings: the PM MIB MEP Objects, PM MIB Loss Measurement Objects,
PM MIB Delay Measurement Objects, and SOAM PM Notifications.

3.5. IETF Technology-specific MIB Series

IETF specifies a series MIB module for various technologies, which
includes: [RFC7331] for BFD MIB, [RFC4560] for PING MIB, [MPLS-TP OAM
ID MIB] for MPLS-TP MIB, etc.

All these documents are technology-specific and limited to L1, L2,
L3. The OAM MIB definition above L3 (i.e., SFC service layer) is
still missing in IETF.

3.6. IEEE CFM YANG

[P802.1Qcx] specifies Unified Modeling Language (UML)-based
information model and a YANG data model that allows configuration
and status reporting for bridges and bridge components for
Connectivity Fault Management (CFM) as specified in [802.1Q].

3.7. MEF CFM and SOAM YANG Data Model

SOAM CFM YANG module [MEF-38] is an important work that defines the
managed objects necessary to support SOAM CFM functionality by using
the IETF YANG Module Language [RFC6020]. This YANG module contains
the management data definitions for the management of Ethernet
Services OAM for Connectivity Fault Management.

[MEF-39] provides the YANG module that supports the Ethernet Service
OAM (SOAM) Performance Monitoring functions. This YANG module
contains the management data definitions for the management of
Ethernet Services OAM for Performance Monitoring and extends the
Connectivity Fault Management (CFM) YANG modules.

[MEF-38] and [MEF-39] will be updated as [MEF-38.1] and [MEF-39.1].

3.8. YANG Model for OAM Management and Technology-specific extensions

[I-D.ietf-lime-yang-oam-model] is an IETF work that creates a YANG
unified data models for connection oriented OAM protocols. It defines
a YANG [RFC6020] data model for Layer independent OAM Management
implementations that can be applied to various network technologies.

[I-D.ietf-trill-yang-oam] extends the Generic YANG model defined in
[I-D.ietf-lime-yang-oam-model] for OAM with TRILL technology.

[I-D.ietf-bfd-yang] defines YANG data model for BFD without
augmenting the Generic YANG model for connection-less OAM defined in
[I-D. ietf-lime-yang-connectionless].

3.9. Discussion

   Until now, all the OAM models and operations in the management plane
   for L3-L7 are technology dependent and limited to one specific layer.
   One point which should be noticed is that the information models
   specified for transport networks (L0/L1/L2, [G.874.1], [G.8052],
   [G.8152]) by the ITU-T have received some degree of consolidation,
   and are not technology dependent. [I-D. lam-lime-summary-l0-l2-
   layer-independent] provides the summary on this point.

   [I-D.ietf-bfd-yang] indicates the concern how it can augment to the
   Generic YANG model defined in [I-D. ietf-lime-yang-connectionless].

   It is noted that the YANG Data model for OAM Performance Management
   has not been developed and some drafts for them are expired.

4. Security Considerations

   TBD.

5. IANA Considerations

   This drafts includes no request to IANA.

6. Acknowledgements

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   their valuable comments and thoughtful inputs to this draft regarding
   ITU-T OAM works in L0-L2.

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