Gap Analysis for Layer and Technology Independent OAM Management in the
                      Multi-Layer Environment
                 draft-txh-opsawg-lime-gap-analysis-00

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.

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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.

   Due to this fact, [LIME-PS] discusses a valuable direction in
   management plane by consolidating OAM information from each layer
   using centralized management entity and have a unified and consistent
   OAM view of multi-layer network. 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. The second
   important objective of LIME is to achieve a layer and technology
   independent OAM view of network and allow management application
   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 management plane should be developed firstly,
   and then any technology-specific OAM data model can be developed by
   extending and inheriting from it. 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. [LIME-UC] lists the key use case
for LIME application.

This draft analyses the existing management plane OAM related works
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 [G.8052]

IM Information Model

NMS Network Management System [G.8052]

MP Maintenance Point [802.1Q]

MEP Maintenance Entity Group End Point [Y.1731] [RFC6371]

MIP Maintenance Entity Group Intermediate Point [Y.1731] [RFC6371]

MEG Maintenance Entity Group [Y.1731] [RFC6371]

ME Maintenance Entity [Y.1731] [RFC6371]

MD Maintenance Domain [802.1Q]

MPLS Multiprotocol Label Switching

NE Network Element

NVO3 Network Virtualization Overlays

OAM Operations, Administration, and Maintenance [RFC6291]

LIME Layer Independent OAM Management [LIME-PS]

SF Service Function Chaining

SFF Service Function Forwarder
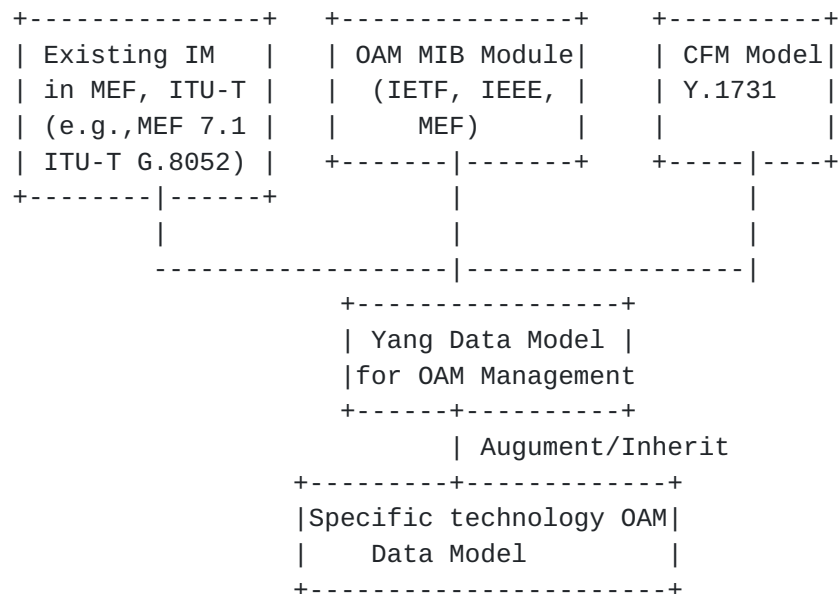
SDO Standard Developing Organization

3. Existing OAM Related Works

Two objectives of LIME are:

o Consolidated OAM Management

o Layer and technology independent OAM Management

To achieve these two objectives and accelerate Yang data model
development, we can use Existing Information model in ITU-T and MEF,
OAM MIB Module and CFM model as basis and directly develop Yang Data
model.

```
     +---------------+   +---------------+    +----------+
     | Existing IM   |   | OAM MIB Module|    | CFM Model|
     | in MEF, ITU-T |   |  (IETF, IEEE, |    | Y.1731   |
     | (e.g.,MEF 7.1 |   |      MEF)     |    |          |
     | ITU-T G.8052) |   +-------|-------+    +-----|----+
     +--------|------+           |                  |
              |                  |                  |
           ------------------|-----------------|
                  +-----------------+
                  | Yang Data Model |
                  |for OAM Management
                  +------+----------+
                         | Augument/Inherit
                +---------+------------+
                |Specific technology OAM|
                |    Data Model         |
                +-----------------------+
```

                    Yang Data Model Development

   Following are the detailed surveys for the existing management plane
   OAM works.

3.1. 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.
   They contain the object classes for the Ethernet and MPLS-TP NE
   management. It includes the Termination Points (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.

   [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, EthMip, EthMp, EthMd, EthMepPeerInfo), Fault
   Management Objects (e.g., Continuity Check, Loopback, Link Trace,
   Signal Functions), Performance Monitoring Objects (e.g., Abstract

Performance Monitoring Objects, Loss Measurement, Delay Measurement,
Function Sets).

The above OAM information models provide the baseline for the further
definitions of OAM MIB modules and OAM YANG model. But they are
still technology-specific definitions, not abstract and generic
enough.

3.2. 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).

These CFM MIB modules defined for Ethernet network are the input for
analyzing what the generic OAM data model should be and have.

3.3. 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 [Y.1731] 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.

These documents' MIB definitions are also in the Ethernet layer and
are the input for the LIME works.

3.4. 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 layer
1/2/3. The OAM MIB definition above layer 3 (i.e., SFC service
layer) is still missing in IETF. Further study is needed to abstract
a unified and general OAM data model for any network layers from them
and other SDOs' OAM works.

3.5. 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.

These MEF OAM YANG works are important reference for the LIME works.

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

[I-D.tissa-netmod-oam] is an IETF work that creates a YANG unified
data model for OAM that is based on IEEE CFM model. This model may
be used also for IP OAM functionality. This effort is focused on the
management plane of OAM and should be complemented by an accompanying
data-plane and/or control-plane work. It may require also some
extensions to support wider variety of functions and technologies.

[I-D.tissa-nvo3-yang-oam] extends the Generic YANG model defined in
[I-D.tissa-netmod-oam] for OAM with NVO3 technology specifics and
presents Yang Module for NVO3 OAM.

3.7. Discussion

   Until now, all the OAM data models and operations in the management
   plane are technology dependent and limited to one specific layer.

3.7.1. Consolidation in the Management Plane

   Consolidation means here the management functions are capable of
   receiving and reacting to related information from every transport
   segment at every layer in the network. The reacting to related
   information from every layer can include:

   o Synthesize the OAM information from every layer;

   o Exchange and correlation between the OAM information from every
      layer;

   o Orchestrating and coordinating the OAM operations among every
      layer based on the above information for an end to end service.

   However, there is little consolidation of OAM in management plane nor
   well-documented inter-layer OAM operations within current MIB
   definition works by IEEE, MEF or IETF, and YANG model definition work
   by MEF. This also results in an end to end and service-level OAM
   view of network is hardly generated in the management plane.

   In addition to consolidation, a layer and technology independent OAM
   view of network is also important for multi-layer OAM. The challenge
   to get this view is to abstract in a way that retains in the
   management plane as much useful information as possible while
   filtering the data that is not needed to be leaked to layers in the
   data plane. An important part of this effort is a clear
   understanding of what information is actually needed. Current
   existing OAM works in various SDOs do not consider this issue now.

3.7.2. A Generic and Reusable OAM Data Model

   Another aspect is about the OAM data model specification. The
   existing traditional implementations of data models in management
   plane, such as MIB, YANG, are all technology-specific. They specify
   the MIB module or YANG model for specific technology respectively.
   There are many overlapping contents and repeated works during specify
   data model for any technologies. The same condition happens each
   time when a new technology needs to specify its own data model in
   management plane.

   So, a generic and reusable OAM data model is essential and valuable
   for this kind of work. And to the extent that management operations

are being redesigned in terms of YANG modules [RFC6020] over NETCONF
[RFC6241], the opportunity appears to use the concept of layer and
technology independent abstraction to extract the reusable parts,
simplifying the work on the remainder.

4. Security Considerations

TBD.

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