Network Working Group
Internet-Draft
Intended status: Informational
Expires: January 1, 2015

D. King
Old Dog Consulting
M. Boucadair
France Telecom
S. Aldrin
Huawei USA
G. Mirsky
Ericsson
Q. Wu
Huawei

June 30, 2014

# Use Cases for Transport Independent Multiple Layer OAM
## draft-king-opsawg-time-multi-layer-oam-use-case-00

Abstract

This document identifies and discusses use-cases for transport independent OAM that need to interface multi-layer or multi-domain transport networks to cover heterogeneous networking technologies. As providers face multi-layer networks and diverse transport technologies, generic and integrated OAM is desirable for simplifying network operations and maintenance.

Table of Contents



## 1. Introduction

This document discusses use-cases for transport independent OAM that need to interface multi-layer or multi-domain transport networks to to cover heterogeneous networking technologies. As providers (e.g., network providers, data center providers, etc.) face multi-layer networks and diverse transport technology, generic and integrated OAM is desirable for keeping network complexity down and simplifying OAM.

This document is a part of the TIME effort, called Transport Independent OAM in Multi-Layer Environment. The goal of TIME is as follows

- o Understand and discuss situations where an OAM protocol can be tuned and optimized for a specific data plane.
- o OAM consolidation in the data plane:
  - * Exchange OAM information at the service layer atop of layer 3.
  - * Deployed over various encapsulating protocols, and in various medium types
- o OAM consolidation in the management plane:

* Abstract OAM information common to different layers.

* Expose OAM information via unified interface to management entities, independently of the layer they belong to.

* Discuss how information gathered from various layers can be correlated for the sake of network operations optimization purposes.

* Propose means to help during service diagnosis; these means may rely on filtering information to be leaked to other layers so that time recovery can be optimized. A typical example would be efficient root cause analysis that is fed with input from various layers.

* Propose means that would help to optimize a network as a whole instead of the monolithic approach that is specific to a given layer. For example, investigate means that would help in computing diverse and completely disjoint paths, not only at layer 3 but also at the physical layer.

These objectives are not frozen; further discussion is required to target key issues and scope the work to be conducted within IETF accordingly.

The problem statement and architecture is discussed in [TIME-PS].

## 2. Multi-Layer OAM use cases illustration

### 2.1. Multi-Level OAM Consolidated in the Data Plane and Management Plane

```
                Domain A                  Domain B
                ----------                  ----------
              //-MPLS/IP   -\\            //-MPLS/IP   -\\
            //               \\         //               \\
           /                   \       /                   \
         ||                     ||   ||                     ||
         |                        |   |                       |
 +---+  +-----+      +-----+    +-----+ +-----+     +-----+     +-----+  +---+
 |CE |--| PE |------|  P +----| PE |-+ PE +---- | P  |-----| PE |--|CE |
 +-+-+  +--+-+      +--+-+    +-+--+ +--+-+     +--+-+     +-+--+  +-+-+
   |     | |          |        | |   | |          |         | |     |
   |     |||          |        |||   |||          |         |||     |
   |       |          |        |       |          |         |       |
   |       |\\        |      //|       |\\        |       //|       |
   |       |  \\-      |   -//  |       |  \\-     |    -//  |       |
   |       |     ------+---     |       |     -----+----     |       |
 L1        |           |Ethernet OAM(CC,CV,etc.)    |         |       |
   o-------D-----------+--------+-------+----------+---------D-------o
   |       |           |        |       |          |         |       |
 L2|       |           |IP OAM(Ping, Tracerroute, etc.)         |       |
   o-------o-----------D--------o-------o----------D---------o-------o
   |       |           |        |       |          |         |       |
 L3|      Transport Independent OAM(Integrated Ethernet with IP OAM  |
   o-------o-----------D--------o-------o----------D---------o-------o
   |       |           |        |       |          |         |       |
   |       |           |        |       |          |         |       |

                  o  Maintenance Endpoint(MEP)
                  D  Maintenance Intermediary point (MIP)
```

Figure 1 illustrates a multi-layer network in which IP traffic between two customer edges is transported over an IP/MPLS provider

Figure 1 illustrates a multi-layer network in which IP traffic between two customer edges is transported over an IP/MPLS provider network and multiple layers OAMs are used. Ethernet OAM is used at the customer level for monitoring the end-to-end connection between the two customer edges, while IP OAM is used at the provider level for monitoring the connection between any two provider edges in each network. In addition to Ethernet OAM, transport independent OAM is also used for monitor end to end connection between the two customer edges at the abstract level.

With transport independent OAM in the data plane, a user who wishes to issue a IP Ping Command or use connectivity verification command can do so in the same manner regardless of the underlying protocol or transport technology. Consider a scenario where both Ethernet OAM and IP OAM can be decomposed into a set of various OAM functions and

an Ethernet OAM can be integrated with IP OAM in one protocol. When one OAM function is invoked, it will be invoked in the same way as the other OAM function regardless of the underlying protocol.

Alternatively, when Ethernet OAM and IP OAM can be consolidated through uniformed interface at the management plane, A user who wishes to issue a IP Ping command or a IP Traceroute or initiate a session monitoring can also do so in the same manner regardless of the underlying protocol or technology.

Consider a scenario where an IP ping to PE B from CE A failed. Between CE A and PE B there are IEEE 802.1 bridges a,b and c. Let's assume a,b and c are using [8021Q] CFM. Upon detecting IP layer ping failure, the user may wish to "go down" to the Ethernet layer and issue the corresponding fault verification (LBM) and fault isolation (LTM) tools, using the same API.

### 2.2. OAM at Top of Layer 3

```
                               +--------+
                               |Unified |
   +---------------------------+OSS/NMS +---------------------------+
   |                           +--------+                           |
   |             Domain A                    Domain B           |
   |            ----------                    ----------            |
   |          //  MPLS/IP  -\\             //- MPLS/IP  -\\         |
  +----+    //                \\         //                \\       |
  |SF- | SN1          SN2      SN3     SN4       SN5        SN6   +-+--+
  |    |+++--+      +----|    +--+++ +++--+     +----+     +--+++-|SF- |
  |Ingr||SF1 |      |    |    |SF4|| ||   |     |SF7 |     |   || |Egr |
  |    ++    +------|    +-----+    +-+    +-----|    +-----|    +-+    |
  |ess ||SF2 |      | SF3|    |SF5 | |SF6 |     |SF8 |     |SF9 | |ess |
  +-+-+|+--+-+      +--+-+    +-+--+ +--+-+     +--+-+     +-+--+ |+-+-+
   |     | |           |        | |   | |          |         | |     |
   |     |||           |        |||   |||          |         |||     |
   |       |           |        |       |          |         |       |
   |       |\\         |      //|       |\\        |       //|       |
   |       |  \\-      |   -//  |       |  \\-     |    -//  |       |
   |       |     ------+---     |       |     -----+----     |       |
   L1      |           |Ethernet OAM(CC,CV, etc.)    |         |       |
   o-------D-----------+--------+-------+----------+---------D-------o
   |       |           |        |       |          |         |       |
   L2      |           |IP OAM(Ping, Tracerroute, etc.)         |       |
   o-------o-----------D--------o-------o----------D---------o-------o
   |       |           |        |       |          |         |       |
   L3     Transport Independent OAM(Integrated Ethernet with IP OAM  |
   o-------o-----------D--------o-------o----------D---------o-------o
   |       |           |        |       |          |         |       |
   |       |           |        |       |          |         |       |

                  o  Maintenance Endpoint(MEP)
                  D  Maintenance Intermediary point (MIP)

   Layer7-  SF1  --------------------- SF6  ------- SF7--------------
   Layer6------------------------F4 ---------------------------------
   Layer5------------ SF3-------SF5------------------------ SF9----
   Layer4---SF2 ---------------------------------- SF8--------------
```

In Service Function Chain, the service packets are steered through a set of Service Function Nodes distributed in the network. Overlay technologies (or tunneling techniques in general) can be used to stitch these Service Function Nodes in order to form end to end path.

When the service packet enters into the network, OAM information needs to be imposed by ingress node of the network into the packet(e.g., packet header extension or TLV extension in the overlay header) and pass through the network in the same path as the service

traffic and processed by a set of Service Functions that are hosted in Service Function Nodes and located in different layers at the top of layer 3.

When any Service Function Nodes or any service segment between two service nodes fails to deliver user traffic, there is a need to provide a tool that would enable users to detect such failures, and a mechanism to isolate faults.

In case of several SFs co-located in the same Service Function Node, the packet is processed by all SFs in the Service Function Node, Once the packet is successfully handled by one SF, the packet is forwarded to the next SF that is in the same Service Function Node.

When the packet leave the network, the OAM information needs to stripped out from the packet.

To provide unified view of OAM information common to different layers, different domains, different operators, these OAM information needs to gathered from various layer using different encapsulation and tunneling techniques and abstracted and provided to the management application via the unified management interface.

As indicated in [I-D.boucadair-sfc-requirments], the following OAM functions are to be supported:

- o Support means to verify the completion of the forwarding actions until the SFC Border Node is reached (see Section 3.4.1 of [RFC5706]).

- o Support means to ensure coherent classification rules are installed in and enforced by all the Classifiers of the SFC domain.

- o Support means to correlate classification policies with observed forwarding actions.

- o Support in-band liveliness and functionality checking mechanisms for the instantiated Service Function Chains and the Service Functions that belong to these chains.

Other service diagnosis and troubleshooting requirements are discussed in [I-D.boucadair-sfc-requirments].

## 2.3. Overlay OAM

```
                Domain A                     Domain B
                ----------                    ----------
              //-MPLS/IP   -\\             //-MPLS/IP   -\\
            //                \\         //                \\
           /                    \       /                    \
         ||                      ||   ||                      ||
         |                        |   |                        |
 +---+  +----+      +----+    +----+ +----+     +----+     +----+  +---+
 |CE |--| PE +------|  P +----| PE +-+ PE +-----+ P  +-----+ PE +--|CE |
 +-+-+  +--+-+      +--+-+    +-+--+ +--+-+     +--+-+     +-+--+  +-+-+
   |     | |           |        | |   | |          |         | |     |
   |     |||           |        |||   |||          |         |||     |
   |       |           |        |       |          |         |       |
   |       |\\         |      //|       |\\        |       //|       |
   |       |  \\-      |   -//  |       |  \\-     |    -//  |       |
   |       |     ------+---     |       |     -----+----     |       |
 L1        |           |Ethernet OAM(CC,CV,etc)    |         |       |
   o-------D-----------+--------+-------+----------+---------D-------o
   |       |           |        |       |          |         |       |
   |    L2 |           |IP OAM(Ping, Tracerroute, etc.)         |
           o-----------D--------o-------o----------D---------o-
           |           |        |       |          |         |

                 o  Maintenance Endpoint(MEP)
                 D  Maintenance Intermediary point (MIP)
```

Overlay network is referred to a network that is built on top of another underlying network and provides various services to tenant system. With the growth of network virtualization technology, the needs for inter-connection between various overlay technologies/ networks (e.g., VXLAN or NVGRE) in the Wide Area Network (WAN) become important since it can provide end to end connectivity.

When a packet traverses a set of overlay networks in the data path, each overlay network will comprise an overlay segment used to connect overlay nodes in the same network and these overlay segment are stitched together to form end to end data path.

When any Overlay Segment fails to deliver user traffic, there is a need to provide a tool that would enable users to detect such failures, and a mechanism to isolate faults. It may also be desirable to test the data path before mapping user traffic to the Overlay Segment.

## 3. Requirements

This section provides high-level requirements to fulfill transport independent OAM in Multi-layer Environment to support various use cases discussed in the previous sections.

- o The interfaces between the management entity and each Managed device in the transport network domain SHOULD support standards-based abstraction with a common information/data model.

- o The management entity should be able to create a single unified view of OAM information that is common to various layers, various domain and various operators.

- o The following capability should be supported:

  * Support customized service diagnostic.

  * Support diagnose the availability of a End to End path.

  * Support diagnose the availability of a segment Path that is subpath of end to end path.

  * Support verification on the correct value of Path ID between any two pair of overlay nodes or any two pair of service nodes.

  * Support verifying Overlay Control Plane and Data Plane consistency at either two overlay nodes or two service nodes.

  * Support local diagnostic procedures specific to each Service Node.

  * Support in-band liveliness and functionality checking mechanisms for the overlay node or service node.

  * Support Trace on the underlying network.

## 4. IANA Considerations

This memo includes no request to IANA.

## 5. Security Considerations

TBD.

## 6. Normative References

[I.D-quinn-sfc-problem-statement]
Quinn, P., "Network Service Chaining Problem Statement", ID draft-quinn-nsc-problem-statement-03, August 2013.

[TIME-PS] Wu, Q., "Problem Statement and Architecture for Transport-Independent Multiple Layer OAM", ID draft-ww-opsawg-multi-layer-oam-01, June 2014.

Authors' Addresses

Daniel King
Old Dog Consulting
UK

Email: daniel@olddog.co.uk

Mohamed Boucadair
France Telecom
Rennes 35000
France

Email: mohamed.boucadair@orange.com

Sam Aldrin
Huawei Technologies USA
2330 Central Expressway
NSanta Clara, CA 95051
USA

Email: aldrin.ietf@gmail.com

Greg Mirsky
Ericsson

Email: gregory.mirsky@ericsson.com

Qin Wu
Huawei
101 Software Avenue, Yuhua District
Nanjing, Jiangsu 210012
China

Email: bill.wu@huawei.com