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                        Overlay OAM Requirements
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Abstract

   This document describes a list of functional requirements for
   Operations Administration and Maintenance (OAM) in various Overlay
   and Service networks like Service Function Chaining (SFC), Bit Index
   Explicit Replication (BIER), Network Virtualization over Layer 3
   (NVO3).

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1. Introduction

We have witnessed and participated in design of new paradigms in the
networking that are aimed to address network virtualization, service
function chaining, and multicast services. New paradigms require new
architectural concepts, principles and components. [RFC7365] defines
a framework for Data Center Network Virtualization over Layer 3
(NVO3). [RFC7665] describes the architecture for creating and
maintaining Service Function Chains (SFCs) in a network.
[I-D.ietf-bier-architecture] defines a stateless multicast
architecture for optimal multicast packet forwarding using "Bit Index
Explicit Replication" (BIER). These frameworks are defined in a

flexible manner that they are transport agnostic and may be deployed
on various underlay networks such as IPv4, IPv6 and MPLS.

The above mentioned new architectural concepts and principles have
been combined into new network layers with distinct encapsulation
headers. For example, [I-D.ietf-sfc-nsh] defines an encapsulation
header as Network Service Header (NSH) to realize Service Function
Path. While [RFC7348] (VxLAN) and [RFC7637] (NVGRE) are different
encapsulation header proposed for NVO3, [I-D.ietf-nvo3-vxlan-gpe]
extends VxLAN further to be used for Service Function Chain (SFC).
Similarly, [I-D.ietf-bier-mpls-encapsulation] defines the BIER
encapsulation header over MPLS network and
[I-D.xu-bier-encapsulation] describes the BIER encapsulation header
over IP network.

Introduction of the new Overlay networks, sets forth new Operations,
Administration and Maintenance (OAM) requirements that can be
addressed by enhancing the existing toolset or developing new
protocols. For example, [I-D.ietf-sfc-oam-framework] defines the
framework for SFC OAM, [I-D.nordmark-nvo3-transcending-traceroute]
proposes a way to perform traceroute in NVO3 networks and
[I-D.kumarzheng-bier-ping] proposes on-demand connectivity
verification and fault isolation procedure (Ping and Trace) on BIER
network.

The goal of this document is to identify and list the OAM
requirements commonly applicable to new Overlay networks which can
further be used to analyze the existing OAM tools. The identified
gaps can be addressed, either through enhancing existing OAM tools
and if necessary, constructing new OAM tools, that can be used as a
common unified OAM toolset to support and perform various OAM
functions including proactive and on-demand path monitoring and
service validation on the new Overlay network.

2. Requirements notation

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].

3. Terminology

ECMP: Equal Cost Multipath

SFC: Service Function Chaining

BIER: Bit Index Explicit Replication

NVO3: Network Virtualization over L3

OAM: Operations, Administration and Maintenance

MPLS: Multiprotocol Label Switching

VxLAN: Virtual Extensible Local Area Network

NVGRE: Network Virtualization Using Generic Routing Encapsulation

Centralized Controller: An external standalone or virtual entity with topology awareness and with an ability to interact with network devices for OAM functionality.

Overlay nodes: Network nodes participating in the Overlay network.

Underlay Network or Underlay Layer: The network that provides connectivity between the Overlay nodes. MPLS network providing LSP connectivity between BIER nodes is an example for underlay layer.

Overlay Network or Overlay Layer: A network layer that is built on top another network layer. VxLAN-GPE over IP network is an example for Overlay layer.

[4](). Detailed Requirement List

This section lists the OAM requirement for different Overlay networks. The below listed requirement MUST be supported with any underlay transport network:

REQ#1: The listed requirements MUST be supported with any type of transport layer over which the overlay network can be realized.

REQ#2: It MUST be possible to initialize Overlay OAM between any node towards any node(s) in the overlay network.

REQ#3: It SHOULD be possible to initialize an Overlay OAM from a centralized controller.

REQ#4: Overlay OAM MUST support proactive and on-demand OAM monitoring and measurement methods.

REQ#5: Overlay OAM MUST support unidirectional OAM methods for continuity check, connectivity verification and performance measurement.

   REQ#6: Overlay OAM packets SHOULD be fate sharing with data traffic,
           i.e. in-band with the monitored traffic, i.e. follow exactly
           the same overlay and transport path as data plane traffic,
           in forward direction, i.e. from ingress toward egress end
           point(s) of the OAM test.

   REQ#7: Overlay OAM MUST support bi-directional OAM methods. Such
           OAM methods MAY combine in-band monitoring or measurement in
           forward direction and out-of-band notification in the
           reverse direction, i.e. from egress to ingress end point of
           the OAM test.

   REQ#8: Overlay OAM MUST support Path Maximum Transmission Unit (MTU)
           Discovery from the overlay layer over any transport layer.

4.1. Fault Management

4.1.1. Pro-active Fault Management

   Availability, not as performance metric, is understood as ability to
   reach the node, i.e. the fact that path between ingress and egress
   does exist. Such OAM mechanism also referred as Continuity Check.

   REQ#9: Overlay OAM MUST support pro-active monitoring of any virtual
           node availability in the given overlay network.

   REQ#10: Overlay OAM MUST support Remote Defect Indication (RDI)
           notification by egress to the ingress, i.e. source of
           continuity checking.

   REQ#11: Overlay OAM MUST support connectivity verification.
           Definition of mis-connectivity defect entry and exit
           criteria are outside the scope of this document.

4.1.2. On-demand Fault Management

   REQ#12: Overlay OAM MUST support fault localization of Loss of
           Continuity check at Overlay layer.

   REQ#13: Overlay OAM MAY support fault localization of Loss of
           Continuity check at transport layer.

   REQ#14: Overlay OAM MUST support tracing path in overlay network
           through the overlay nodes.

   REQ#15: Overlay OAM MAY support tracing path in underlay network
           connecting overlay border nodes.

   REQ#16: Overlay OAM MAY support verification of the mapping between
           its data plane state and client layer services.

   REQ#17: Overlay OAM MUST have the ability to discover and exercise
           equal cost multipath (ECMP) paths in its underlay network.

   REQ#18: Overlay OAM MUST be able to trigger on-demand FM with
           responses being directed towards initiator of such proxy
           request.

4.2. Performance Management

   Section 3.4 and Section 3.5 of [RFC7799] defines the definition for
   Active and Passive mode of Performance Measurement (PM) methods.
   This section lists the requirements for both active and passive PM
   methods. Passive PM is a measurement method that should not modify
   the actual data packet processing behavior on underlay and overlay
   network. Accordingly, it should be supported by the Overlay nodes.

   REQ#19: Overlay OAM MUST support active one-way packet delay
            measurement.

   REQ#20: Overlay OAM MUST support passive one-way packet delay
            measurement.

   REQ#21: Overlay OAM MUST support active two-way packet delay
            measurement.

   REQ#22: Overlay OAM MUST support packet delay variation measurement.

   REQ#23: Overlay OAM MUST support active end to end packet loss
            measurement.

   REQ#24: Overlay OAM MUST support passive end to end packet loss
            measurement.

   REQ#25: Overlay OAM SHOULD support active per-segment packet delay
            measurement.

   REQ#26: Overlay OAM SHOULD support passive per-segment packet delay
            measurement.

   REQ#27: Overlay OAM SHOULD support active per-segment packet loss
            measurement.

   REQ#28: Overlay OAM SHOULD support passive per-segment packet loss
            measurement.

   REQ#29: Overlay OAM MUST support delivered packet throughput
            measurement.

4.3. Alarm Indication Suppression

   REQ#30: Overlay OAM MUST support defect notification mechanism, like
            Alarm Indication Signal.

   REQ#31: Any virtual node in the given overlay network MAY originate a
            defect notification addressed to any node in that network.

4.4. Overlay Network Resiliency

   REQ#32: Overlay OAM MUST support methods to enable survivability of
            an overlay network. These recovery methods MAY use
            protection switching and restoration.

5. IANA Considerations

   This document does not propose any IANA consideration.

6. Security Considerations

   This document list the OAM requirement for various Overlay
   encapsulations and may have security implications. For example, if
   proactive FM is required, the security implication is that a passive
   eavesdropper can know when the session is down. Or, proactive FM may
   be used either to launch DoS or to highjack session and impact state,
   e.g. cause protection switchover. These security implications are
   natural results of the requirements, and do not depend on the
   particular implementation. Whether existing security mechanisms of
   existing protocols proposed to be re-used in OAM for overlay networks
   are adequate or require enhancements is for further study. New OAM
   protocols for overlay networks must consider their security mechanism
   to on per-solution basis.

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