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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).

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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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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