MEF 86

Presto Service OAM Interface Profile Specification

September 2019

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1 List of Contributing Members

The following members of the MEF participated in the development of this document and have requested to be included in this list.

CenturyLink

Infinera

Nokia

PCCW Global

NEC Corporation

Spirent Communications

Verizon

Table 1-Contributing Members

2 Abstract

This Interface Profile Specification specifies Presto Management Interface for SOAM (Service Operations, Administration and Maintenance) in support of performance and fault management of MEF Network Resource Provisioning [19] (NRP) activated resources.

The Presto interface is defined in the MEF 55 [17] Lifecycle Service Operations (LSO) Architecture and Framework as the provisioning interface between the Service Orchestration Functionality (SOF) and Infrastructure Control and Management (ICM).

The Presto SOAM defines the edge and intermediate SOAM component activation, SOAM frame invocation and corresponding collection and reporting of SOAM information. The Presto SOAM is responsible for the activation of MEGs (Maintenance Entity Groups), MEPs and MIPs.

In addition, these components are associated with ordered pairs with lifecycle activation. These ordered pairs depending on the use case associated with a PM or FM Session. Finally, the collection and reporting of SOAM results is a responsibility of Presto SOAM.

3 Terminology and Abbreviations

This section defines the terms used in this document. In many cases, the normative definitions to terms are found in other documents. In these cases, the third column is used to provide the reference that is controlling, in other MEF or external documents.

In addition, terms defined in MEF 10.3 [10] and MEF 55.1 [17] are included in this document by reference and are not repeated in the table below.

Term	Definition	Reference
Access	Connectivity Service supporting connecting one or more UNIs to one or more ENNIs within context of single ICM.	MEF 60 [19]
Alarm Indication Signal (AIS)	The Ethernet alarm indication signal function (ETH-AIS) is used to suppress alarms following detection of defect conditions at the server (sub) layer.	ITU-T G.8013/Y.1731 [7]
Carrier Ethernet Network (CEN)	A network from a Service Provider or network operator supporting the MEF service and architecture models.	MEF 12.2 [11]
Client Signal Fail (CSF)	The Ethernet client signal fail function (ETH-CSF) is used by a MEP to propagate to a peer MEP the detection of a failure or defect event in an Ethernet client signal when the client itself does not support appropriate fault or defect detection or propagation mechanisms such as ETH-CC or ETH-AIS.	ITU-T G.8013/Y.1731 [7]
Connection	Represents an enabled (provisioned) potential for forwarding (including all circuit and packet forms) between two or more NodeEdgePoints of a Node.	ONF TR-527 [23]
ConnectionEndPoint	Represents the ingress/egress port aspects that access the forwarding function provided by the Connection.	ONF TR-527 [23]
ConnectivityService (CS)	Represents an “intent-like” request for connectivity between two or more ConnectivityServiceEndPoints. As such, ConnectivityService is a container for connectivity request details and is distinct from the Connection that realizes the request.	ONF TR-527 [23]

Term	Definition	Reference
ConnectivityServiceEndPoint (CSEP)	Represents the ingress/egress port aspects that access the forwarding function provided by the ConnectivityService. The ConnectionServiceEndPoint has a client-server relationship with the ServiceInterfacePoint.	ONF TR-527 [23]
Context (API Context)	Defines the scope of control, interaction and naming that a particular TAPI provider or client application has with respect to the information exchanged over the interface.	ONF TR-527 [23]
Continuity Check (CC)	The Ethernet continuity check function (ETH-CC) is used for Proactive OAM. It is used to detect loss of continuity (LOC) between any pair of MEPs in a MEG.	IEEE 802.1Q [2] ITU-T G.8013/Y.1731 [7]
Continuity Check Message (CCM)	SOAM PDU used to verify connectivity.	IEEE 802.1Q [2] ITU-T G.8013/Y.1731 [7]
Create, Read, Update, Delete (CRUD)	The ability to Create an object or attribute, Read the object or attribute, Update or modify the object or attribute, and Delete the object or attribute	This document
Delay Measurement Message (DMM)	SOAM PDU used to measure frame delay	ITU-T G,8013/Y.1731 [7]
Delay Measurement Response (DMR)	SOAM PDU used to measure frame delay	ITU-T G,8013/Y.1731 [7]
Ethernet- Local Area Network (E-LAN)	An Ethernet Service Type that is based on a Multipoint-to-Multipoint EVC.	MEF 6.2 [9]
Edge	Connectivity Service supporting connecting one or more UNIs with two or more INNIs in context of a single ICM.	This document
End-to-End	Connectivity Service supporting connecting two or more UNIs within context of a single ICM.	This document
External Network Network Interface (ENNI)	A reference point representing the boundary between two Operator CENs that are operated as separate administrative domains	MEF 4 [8]
Fault Management (FM)	Fault Management	IEEE 802.1Q [2] ITU-T G.8013/Y.1731 [7]

Term	Definition	Reference
Frame Loss Ratio (FLR)	The ratio of the number of ingress frames minus the number of egress frames divided by the number of ingress frames	MEF 10.3 [10]
I-Access	Interface Profile with specification classes for INNI and ENNI in an ICM Domain.	MEF 60 [19]
Information Model	Models managed objects at a conceptual level, independent of any specific implementations or protocols used to transport the data. The MEF uses UML Class Diagrams to model Information Models.	IETF RFC 3444 [5]
Internal Network-to-Network Interface (INNI)	A reference point representing the boundary between two Infrastructure Control and Management domains that partition an administrative domain.	MEF 4 [8]
I-Transit	Interface Profile with specification classes for two or more INNIs in an ICM Domain.	MEF 60[19]
Layer-Protocol	Protocol layer attribute. E.g., OCH, ODU, ETH, MPLS.	ONF TR-527 [23]
Link	An abstract representation of the effective adjacency between two or more associated Nodes in a Topology. It is terminated by NodeEdgePoints of the associated Nodes.	ONF TR-527 [23]
Link Aggregation Group (LAG)	Link Aggregation Group	IEEE 802.1AX [1]
Link Trace (LT)	The Ethernet link trace function (ETH-LT) is an on-demand OAM function that can be used for the following two purposes: • Adjacent relation retrieval • Fault localization	IEEE 802.1Q [2] ITU-T G.8013/Y.1731 [7]
Link Trace Message (LTM)	A SOAM PDU used for the link trace function	IEEE 802.1Q [2] ITU-T G.8013/Y.1731 [7]
Link Trace Response (LTR)	A SOAM PDU used for the link trace function	IEEE 802.1Q [2] ITU-T G.8013/Y.1731 [7]
Lock (LCK)	The Ethernet locked signal function (ETH-LCK) is used to communicate the administrative locking of a server (sub) layer MEP and consequential interruption of data traffic forwarding towards the MEP expecting this traffic.	ITU-T G.8013/Y.1731 [7]

Term	Definition	Reference
Loopback (LB)	The Ethernet loopback function (ETH-LB) is used to verify connectivity of a MEP with a MIP or peer MEP(s).	IEEE 802.1Q [2] ITU-T G.8013/Y.1731 [7]
Loopback Message (LBM)	A SOAM PDU used for the loopback function.	IEEE 802.1Q [2] ITU-T G.8013/Y.1731 [7]
Loopback Response (LBR)	A SOAM PDU used for the loopback function	IEEE 802.1Q [2] ITU-T G.8013/Y.1731 [7]
Loss Measurement Message (LMM)	A SOAM PDU used for loss measurement.	ITU-T G.8013/Y.1731 [7]
Loss Measurement Response (LMR)	A SOAM PDU used for loss measurement	ITU-T G.8013/Y.1731 [7]
Maintenance Entity (ME)	Maintenance Entity	ITU-T G.8013/Y.1731 [7]
Maintenance Entity Group (MEG)	A set of MEs that exist in the same administrative boundary, with the same MEG Level and MEG ID.	IEEE 802.1Q [2] ITU-T G.8013/Y.1731 [7]
MEP	Maintenance Association End Point (IEEE 802.1Q-2014 [2]), or equivalently MEG End Point (ITU-T G.8013/Y.1731 [1] or MEF 17 [12]). An actively managed SOAM entity associated with a specific service instance that can generate and receive SOAM PDUs and track any responses. It is an end point of a single MEG, and is an end point of a separate Maintenance Entity for each of the other MEPs in the same MEG.	IEEE 802.1Q [2] ITU-T G.8013/Y.1731 [7] MEF 17 [12]
MIP	Maintenance Domain Intermediate Point (IEEE 802.1Q-2014 [2]) or equivalently a MEG Intermediate Point (ITU-T G.8013/Y.1731 [7] or MEF 17 [12]. An intermediate point in a MEG that is capable of reacting to some SOAM PDUs but does not initiate SOAM PDUs.	IEEE 802.1Q [2] ITU-T G.8013/Y.1731 [7] MEF 17 [12]

Term	Definition	Reference
Measurement Interval (MI)	Measurement Interval	MEF 35.1 [15]
Media Access Control (MAC)	Media Access Control	IEEE 802.3 [3]
Network Resource	Resource in the control of an ICM Domain and described via objects in MEF NRM. The relevant resources are SIPs, CSEPs and ConnectivityService extensions from ONF TAPI.	MEF 60 [19]
Node	Abstract representation of the forwarding-capabilities of a particular set of Network Resources.	ONF TR-527 [23]
NodeEdgePoint (NEP)	Represents the inward network-facing aspects of the edge-port functions that access the forwarding capabilities provided by the Node.	ONF TR-527 [23]
Network Resource Model (NRM)	MEF Network Resource Model	MEF 59 [18]
Network Resource Provisioning (NRP)	NRP is an API service at the Presto reference point for resource activation requests from SOF to ICM.	MEF 60 [19]
OamContext	Represents the collection of OamService, Meg, OamJob and OamProfile for a single OAM association.	This document
OamJob	Represents the performance or fault management configuration attributes that will be measured. The OamJob is associated with an OamProfile and OamServicePoints.	This document
OamProfile	Represents the configuration object for setting performance thresholds and bin'd data.	This document
OamService	Represents a service associated with one or more end points that supports performance and fault management capabilities for proactive and on demand functionality. It has an association with an OamProfile and one or more OamServicePoints.	This document
OamServicePoint	Represents a network vertex that can support an OamService function. Each OamServicePoint is associated with a ConnectivityServiceEndPoint.	This document
One-way Delay Message (1DM)	A SOAM PDU used to measure delay	ITU-T G.8013/Y.1731 [7]
One-way Synthetic Loss Message (1SL)	A SOAM PDU used to measure loss	ITU-T G.8013/Y.1731 [7]

Term	Definition	Reference
ONF Core	Common Information Model which is divided into a number of pieces and is centered on a core fragment that is independent of specific data plane technology. The model includes pieces that provide data plane technology (forwarding technology) specific structures and properties.	ONF TR-512 [21]
Open Networking Foundation Transport API (ONF TAPI)	The TAPI abstracts a common set of control plane functions, such as Network Topology, Connectivity Requests, Path Computation, Notifications and Network Virtualization to a set of Service interfaces.	ONF TR-527 [23]
Operator Virtual Connection (OVC)	An association of OVC End Points	MEF 26.2 [13]
O-Transit	Connectivity Service supporting connecting two or more ENNIs in context of a single ICM.	This document
Performance Management (PM)	Performance Management	ITU-T G.8013/Y.1731 [7]
Presto Network Resource Provisioning (NRP)	Presto NRP is an API service at the Presto reference point for resource activation requests from SOF to ICM.	MEF 60 [19]
Presto Service Operations Administration and Maintenance (SOAM)	Presto SOAM is an API service at the Presto reference point for performance and fault monitoring requests from SOF to ICM.	This document
Protocol Data Unit (PDU)	Protocol Data Unit	This document
Remote Defect Indicator (RDI)	The Ethernet remote defect indication function (ETH-RDI) can be used by a MEP to communicate to its peer MEPs that a defect condition has been encountered.	IEEE 802.1Q [2] ITU-T G.8013/Y.1731 [7]
ServiceInterfacePoint (SIP)	Represents the outward customer-facing aspects of the edge-port functions that access the forwarding capabilities provided by the Node. A ConnectivityServiceEndPoint terminates on a ServiceInterfacePoint. NOTE: A SIP relates to a UNI, ENNI or INNI.	This document.
Synthetic Loss Message (SLM)	A SOAM PDU used for loss measurement	ITU-T G.8013/Y.1731 [7]
Synthetic Loss Response (SLR)	A SOAM PDU used for loss measurement	ITU-T G.8013/Y.1731 [7]

Term	Definition	Reference
Service Provider (SP)	Service Provider	MEF 26.2 [13]
Services Operations Administration and Maintenance (SOAM)	Service Operation Administration and Maintenance functions include: • Fault Management (including detection, verification, localization and notification) • Performance Monitoring (including performance parameters measurements) • Auto-discovery (including discovering service aware NE within provider networks) • Intra-provider and inter-provider Service OAM	MEF 17 [12]
Test (TST)	The Ethernet test signal function (ETH-Test) is used to perform one-way on-demand in-service or out-of-service diagnostics tests.	ITU-T G.8013/Y.1731 [7]
Threshold Crossing Alert (TCA)	Threshold Crossing Alert	MEF 35.1 [15]
Topology	An abstract representation of the topological-aspects of a particular set of network resources. It is described in terms of the underlying topological network of Nodes and Links that enable the forwarding capabilities of that particular set of network resources.	ONF TR-527 [23]
Unified Modeling Language (UML)	The Unified Modeling Language (UML) is a unified model for object-oriented analysis and design	OMG [20]
Universally Unique ID (uuID)	An ID that is unique across a network or set of networks.	This document
Use Case	In the UML, a Use Case represents one particular type of a system's behavior based on stimuli from an external source (i.e., an actor). A system may have several Use Cases that define all its behavior.	OMG [20]
Virtual LAN (VLAN)	Virtual LAN	IEEE 802.1Q [2]
VLAN ID (VID)	Virtual LAN ID	IEEE 802.1Q [2]

Table 2-Terminology and Abbreviations

4 Compliance Levels

The key words "**MUST**", "**MUST NOT**", "**REQUIRED**", "**SHALL**", "**SHALL NOT**", "**SHOULD**", "**SHOULD NOT**", "**RECOMMENDED**", "**NOT RECOMMENDED**", "**MAY**", and "**OPTIONAL**" in this document are to be interpreted as described in BCP 14 (RFC 2119 [4],

RFC 8174 [6]) when, and only when, they appear in all capitals, as shown here. All key words must be in bold text.

Items that are **REQUIRED** (contain the words **MUST** or **MUST NOT**) are labeled as **[Rx]** for required. Items that are **RECOMMENDED** (contain the words **SHOULD** or **SHOULD NOT**) are labeled as **[Dx]** for desirable. Items that are **OPTIONAL** (contain the words **MAY** or **OPTIONAL**) are labeled as **[Ox]** for optional**.**

A paragraph preceded by **[CRa]<** specifies a conditional mandatory requirement that **MUST** be followed if the condition(s) following the "<" have been met. For example, "**[CR1]<**[D38]" indicates that Conditional Mandatory Requirement 1 must be followed if Desirable Requirement 38 has been met. A paragraph preceded by **[CDb]<** specifies a Conditional Desirable Requirement that **SHOULD** be followed if the condition(s) following the "<" have been met. A paragraph preceded by **[COc]<** specifies a Conditional Optional Requirement that **MAY** be followed if the condition(s) following the "<" have been met.

5 Introduction

The Interface Profile Specification defines the requirements, use cases, realized classes, SOAM interfaces and associated operations/parameters, state machines, and sequence diagrams that describe the dynamic behavior of the Presto SOAM interface.

Presto SOAM focuses on performance and fault management control, measurement and collection processes across Presto interface by the SOF client to the ICM server. The Interface Profile Specification is intended to provide input into developing data schemas (e.g., YANG modules) for Presto SOAM interface.

The scope of this specification is a protocol neutral description of the information, i.e., the attributes (or properties) of the network resource objects to support the activation of MEGs, MEPs, MIPs and OAM Service (order pairs) and corresponding collection and reporting of performance information. Service and facility monitoring are all described within this document including, EVC, OVC, ENNI, INNI and UNI.

The Appendix provides a general overview of the Service OAM objects, concepts and relationships used throughout this document.

6 Presto SOAM and NRM OAM

The Presto SOAM implementation will directly leverage the NRM OAM (Network Resource Management Information Model: Operations, Administration and Maintenance) [24]. Use cases are defined for the following areas:

- OAM Profile Provisioning
    - TCA Provisioning
- OAM Service Provisioning
    - OAM Service Point Provisioning
- OAM Job Provisioning
- OAM Job Collection
- SOAM Notifications and Thresholds

The MEF NRM OAM imports and leverages the ONF TAPI OAM model. In the example in Figure 1 there is a ConnectivityService instance, which is ended by two ConnectivityServiceEndPoints, which are augmented by MEF specific attributes, as defined in CarrierEthConnectivityEndPointResource class.

Each ConnectivityServiceEndPoint is *monitored* by an EthOamMepServicePoint, which represents the "service view" (in ONF terminology) of the Ethernet MEP. The EthOamMepServicePoint is augmented by MEF specific attributes, as defined in CarrierEthOamSrvMepResource class. Note that TAPI OAM technology independent classes, like Meg and Mep, are augmented by TAPI Ethernet specific classes, resp. EthMegSpec and EthMepSpec.

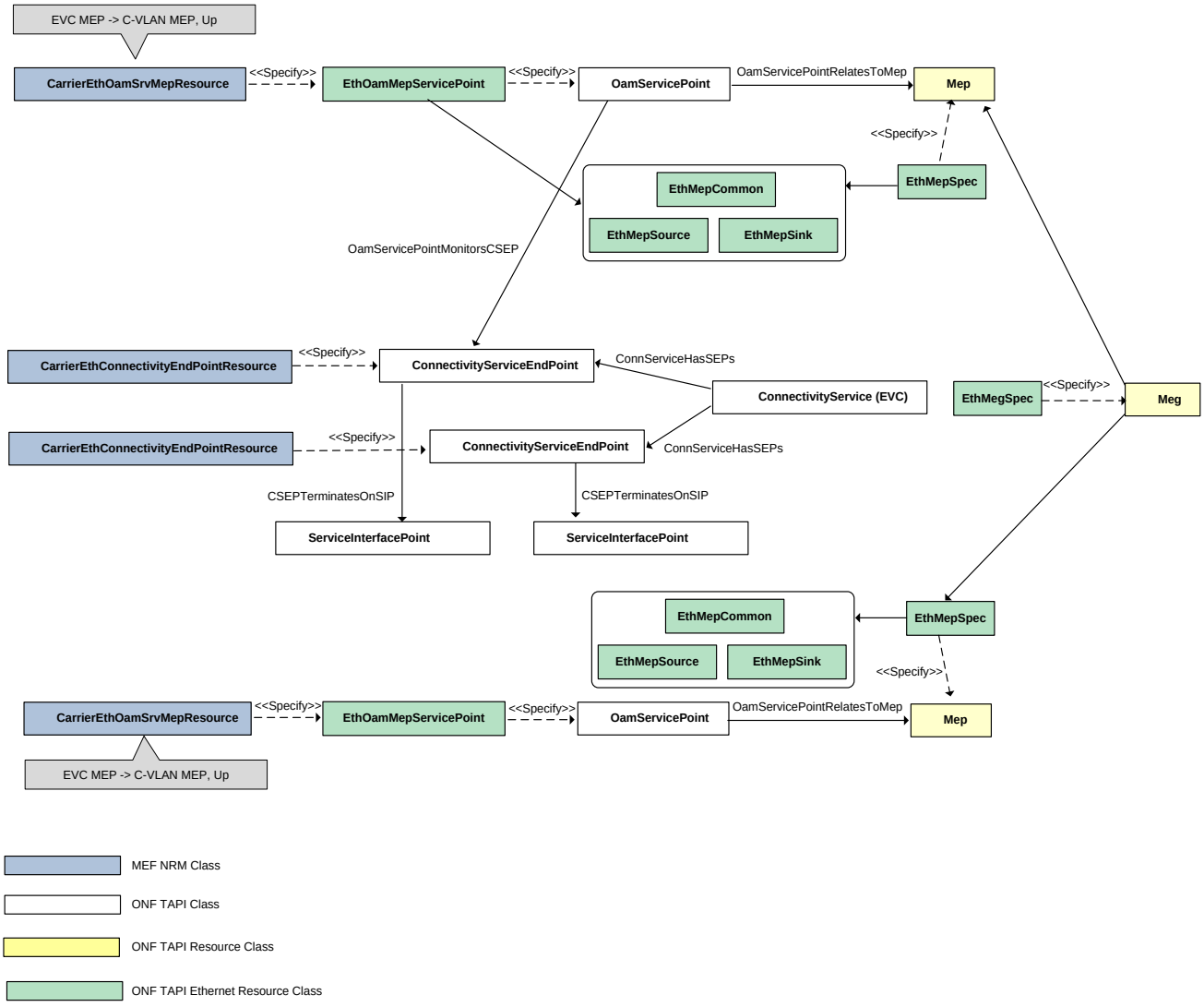


Figure 1-Relationships with ONF TAPI OAM: Two MEPs monitoring an EVC

TAPI is augmented by MEF specific attributes, regarding OAM Job and Performance Metrics. Note that TAPI OAM technology independent classes, like OamJob, CurrentData and HistoryData, are augmented by TAPI Ethernet specific classes, respectively, EthProActiveSingle/DualEndedMeasurementJob EthProActiveLmPerformanceData.

MEF specific attributes, as defined by CarrierEthOamJobProActDualEndSyntLossResource, CarrierEthOamJobProActSingleEndSyntLossResource and CarrierEthOamMet-rics1EndSynthLossResource, augment TAPI Ethernet specific classes.

6.1 Single-Ended Measurements

Single-Ended or 1-way measurements requires the ICM responsible for the Controller OamServicePoint (i.e., MEP) to activate the OAM Job which initiates the SOAM frames. The ICM is also responsible for the OAM Job Collection from the Controller OamServicePoint. The Controller OamServicePoint is responsible for transmission of the SOAM frames and process the data analytics when receiving SOAM frames from the Remote OamServicePoint.

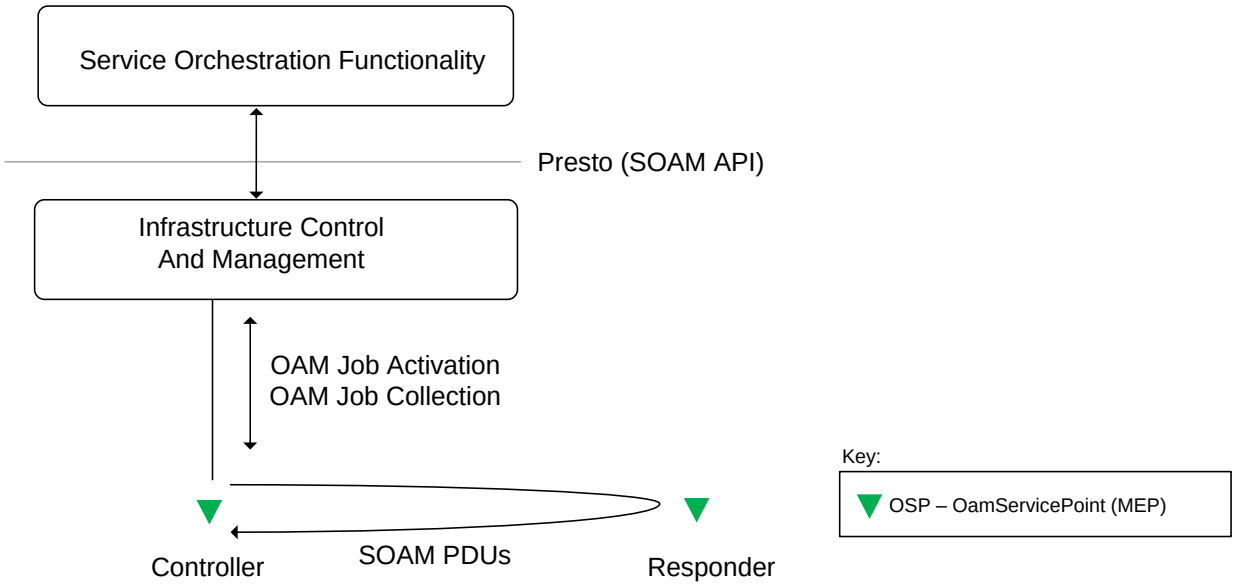


Figure 2-Single-Ended Measurement

6.2 Dual-Ended Measurements

Dual-Ended or 2-way measurements requires the ICM(s) responsible for the both OamService-Point (i.e., MEP) to activate the OAM Job which initiates the SOAM frames. The ICM(s) are also responsible for the OAM Job Collection from the respective Remote OamServicePoint.

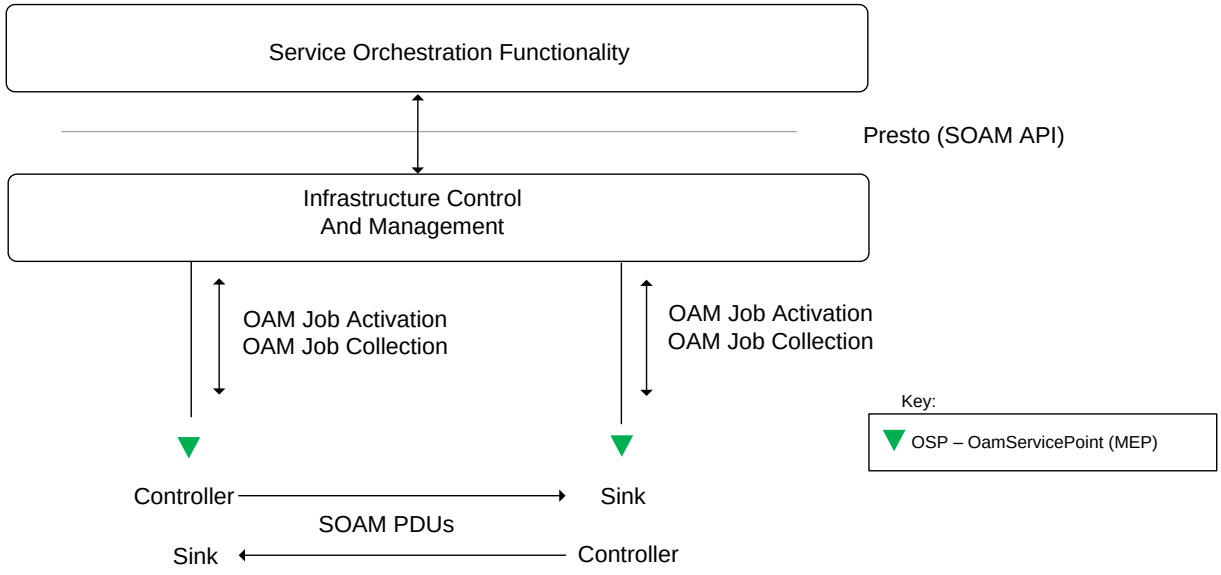


Figure 3-Dual-Ended Measurements

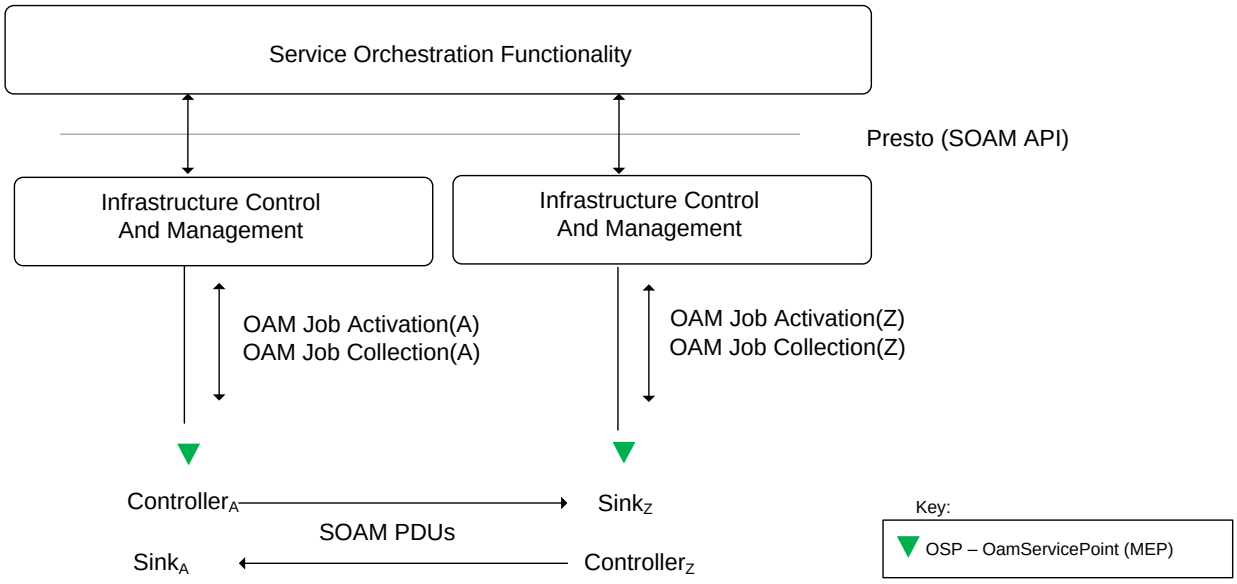


Figure 4-Dual-Ended Measurements with 2 ICMs

6.3 MEF 35.1 to Presto SOAM Mappings

The Presto SOAM functionality supports Legato specified performance management based on MEF 35.1. There are four PM solutions that must be supported by Presto SOAM. MEF 35.1 defines a set of Performance Management solutions in support of both SLA and On-Demand measurements. The tables below provide a mapping of the MEF 35.1 SOAM configurations and collections to Presto SOAM supporting objects.

PM Solution	PM Function(s)	ITU-T PDU	EthOamJob-Type	Presto SOAM Resource(s)
PM-1	- Single-Ended Delay - Single-Ended Synthetic Loss	DMM/DMR SLM/SLR	ETH_DM ETH_SLM	- CarrierEthOamJobProActSingleEndDelayResource - CarrierEthOamJobProActSingleEndSyntLossResource
PM-2	Dual-Ended Delay	1DM	ETH_1DM	CarrierEthOamJobProActDualEndDelayResource
PM-3	Single-Ended Service Loss	LMM/LMR	ETH_LM_LMM	CarrierEthOamJobProActSingleEndLossResource
PM-4	Dual-Ended Synthetic Loss	1SL	ETH_1SLM	CarrierEthOamJobProActDualEndSyntLossResource

Table 3-PM Solutions Configurations to Presto SOAM Resources Mappings

PM Solution	PM Data Set	Presto SOAM Resource(s)
PM-1	- Mandatory Single-Ended Delay Data Set - Mandatory Single-Ended Delay Data Set with Clock Synchronization - Availability State Transition Event Data - Mandatory Single-Ended Synthetic Loss Data Set - Optional Single-Ended Synthetic Loss Data Set	- CarrierEthOamMetrics1EndDelayResource - CarrierEthOamMetricsFdSyncResource - CarrierEthOamMetrics1EndSynthLossResource - CarrierEthOamMetricsAvailFlrResource
PM-2	- Mandatory Dual-Ended Delay Data Set - Mandatory Dual-Ended Delay Data Set with Clock Synchronization	- CarrierEthOamMetrics2EndDelayResource - CarrierEthOamMetrics2FdSynchResource
PM-3	Mandatory Single-Ended Service Loss Data Set	- CarrierEthOamMetrics1EndLossResource
PM-4	- Availability State Transition Event Data - Mandatory Dual-Ended Synthetic Loss Data Set - Optional Dual-Ended Synthetic Loss Data Set	- CarrierEthOamMetricsAvail2FlrResource - CarrierEthOamMetrics2EndSynthLossResource

Table 4-PM Solution Collections to Presto SOAM Resources Mappings

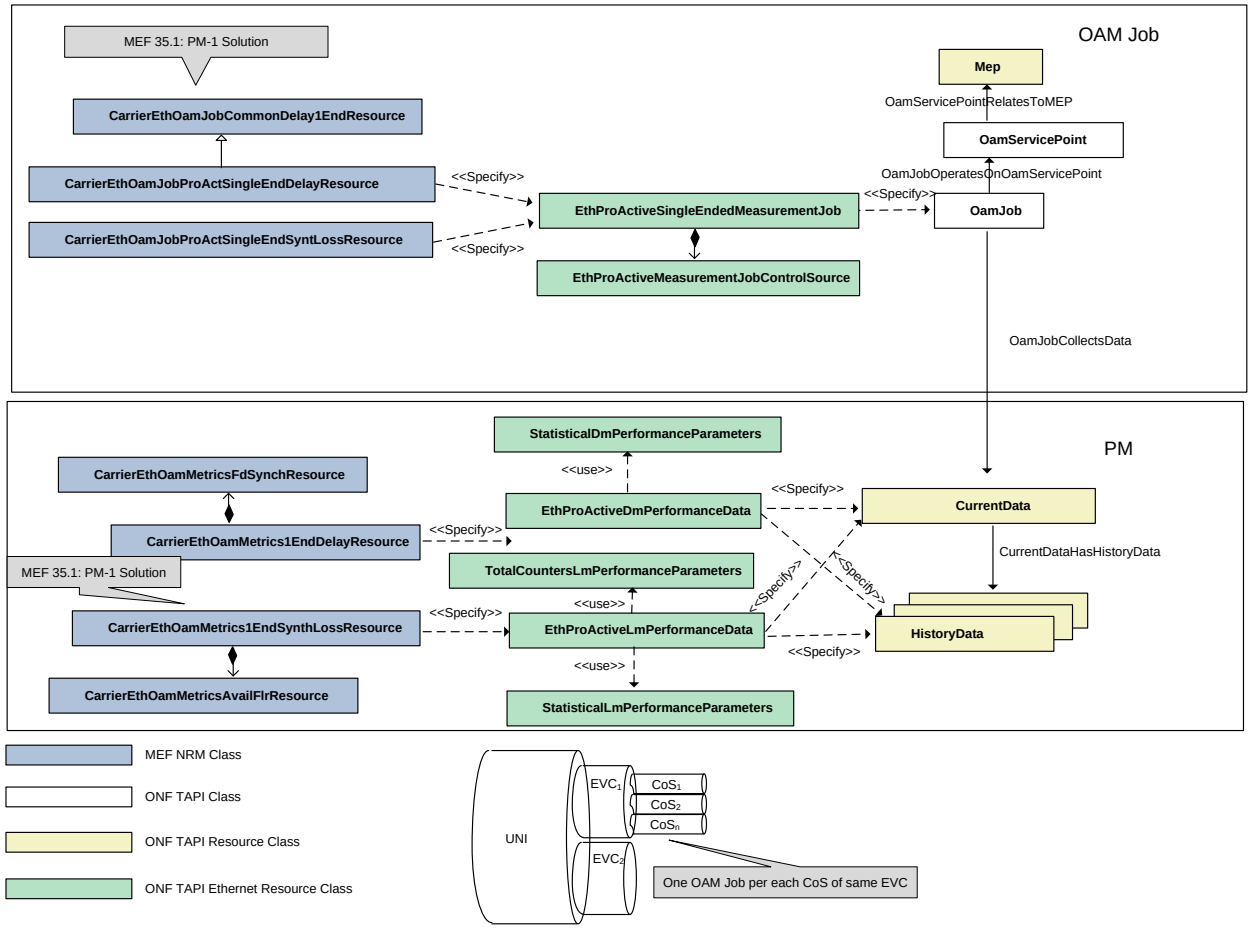


Figure 5-Relationships with MEF 35.1 PM-1 and Presto SOAM

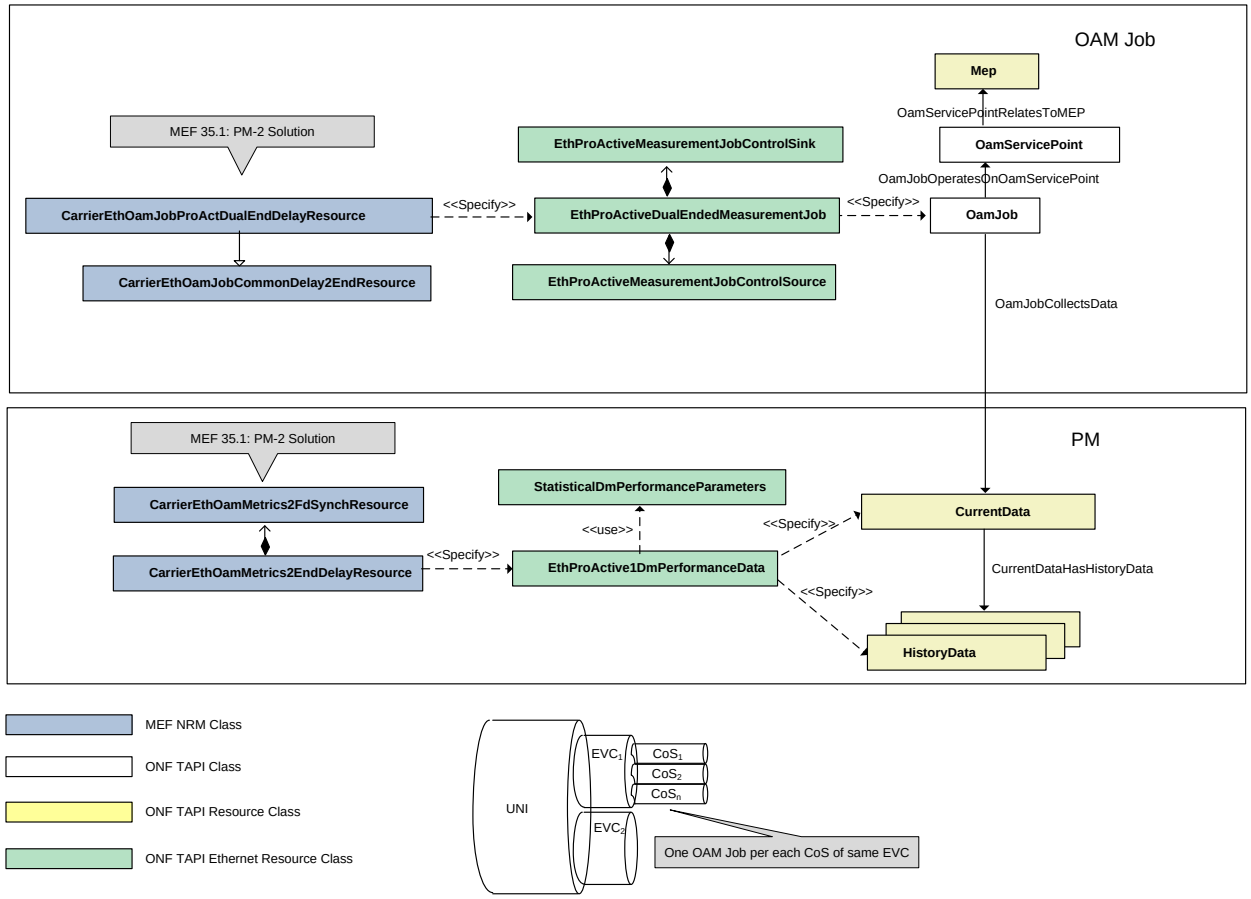


Figure 6-Relationships with MEF 35.1 PM-2 and Presto SOAM

NOTE: Dual-ended measurements, the PM Parameters include also EthProActive1LmSourcePerformanceData and EthProActive1DmSourcePerformanceData. This allows clear separation between PM Params collected from “source” and from “sink” MEPs, specifically when they are in different ICMs.

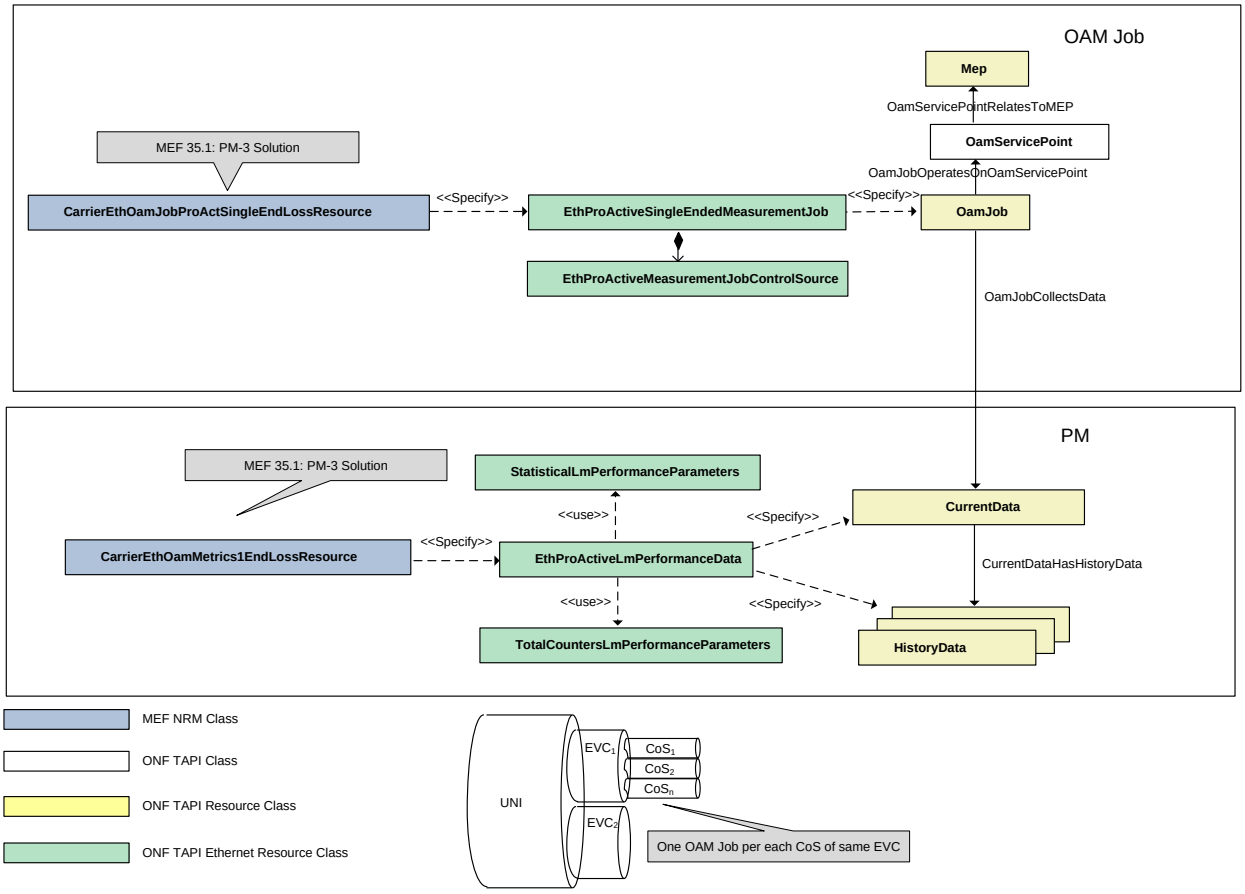


Figure 7-Relationships with MEF 35.1 PM-3 and Presto SOAM

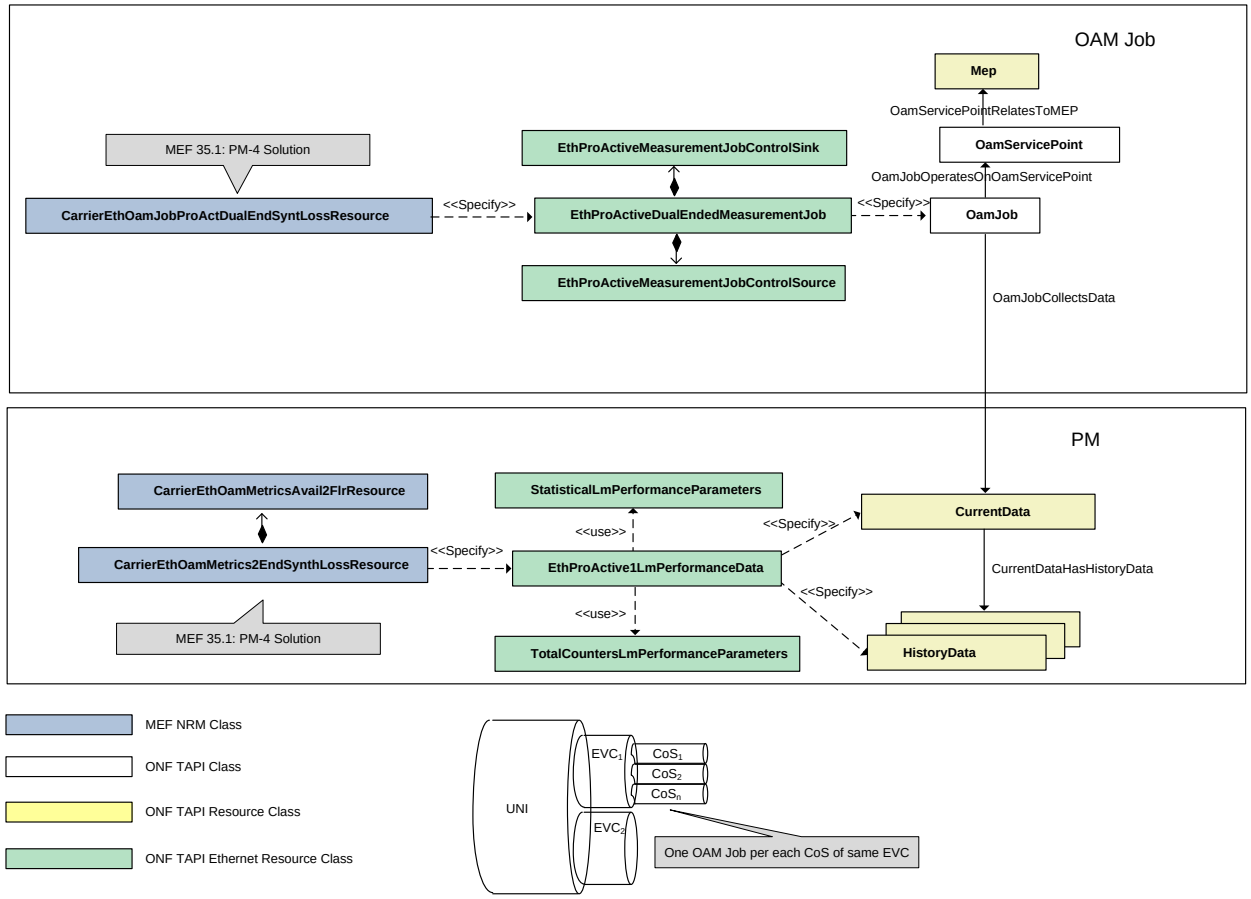


Figure 8-Relationships with MEF 35.1 PM-4 and Presto SOAM

NOTE: Dual-ended measurements, the PM Parameters include also EthProActive1LmSourcePerformanceData and EthProActive1DmSourcePerformanceData. This allows clear separation between PM Params collected from “source” and from “sink” MEPs, specifically when they are in different ICMs.

The Presto SOAM implementation provides the necessary functionality to support MEF service SLAs. The Presto SOAM aligns and extends MEF NRM OAM and ONF TAPI OAM. The base functional components of TAPI OAM are OamService, OamServicePoint and OamJob. A client (i.e., SOF) will receive a MEF Legato Service Activation request.

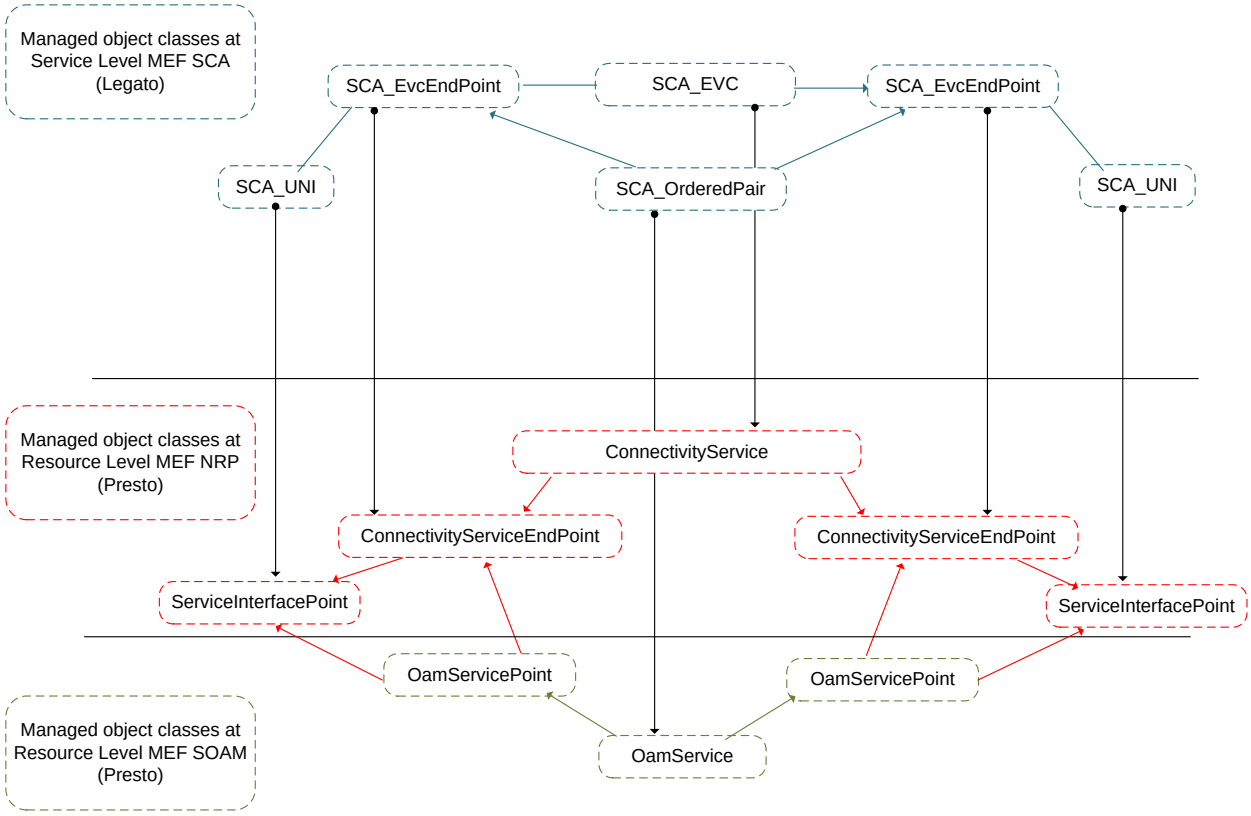


Figure 9-Legato to Presto OAM Provisioning Map for SCA EVC

The Presto OamService is associated with one or more OamServicePoints. It is leveraged for both performance and fault management OAM functions. In the case of supporting MEF SLAs (EVC and OVC) each ordered pair is a point-to-point OamService with two OamServicePoints. In the case of Presto SOAM with the Controller MEP and Responder MEP under two ICMs, two SOAM OamService calls are invoked, one to each ICM. In the case of a fault management function (i.e., CCM) the OamService is associated with a single OamServicePoint.

7 Overview

Figure 1 illustrates the MEF Lifecycle Service Orchestration Reference Architecture (MEF LSO RA) with the Presto interface highlighted. Presto is the Management Interface Reference Point between the Service Orchestration Functionality (SOF) and the Infrastructure Control and Management (ICM) needed to allow management and operations interactions supporting LSO connectivity services.

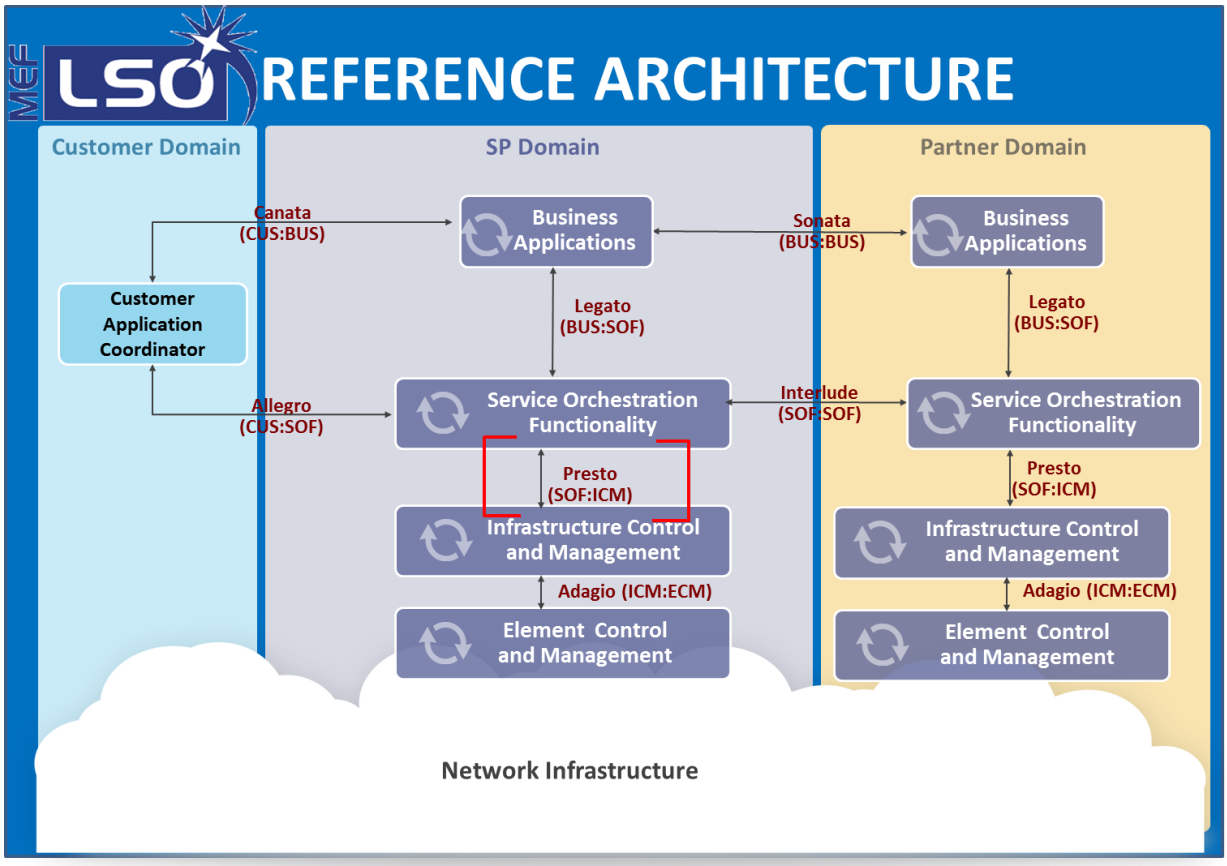


Figure 10-LSO Reference Architecture

7.1 Presto SOAM Reference Scenarios

The following section provides a Presto reference with respect to the LSO architecture. Specifically, the various one or more ICM Domain scenarios are illustrated and discussed. The information given provides context for the use case definitions in this document. These are provided to assist the reader in understanding from a modeling perspective what points are being addressed within this document and the reference points that are not being addressed. The reference scenarios presented below are specified for Presto SOAM performance management, fault management, etc.

7.1.1 End-to-End Scenario

This scenario is when a MEF EVC Service is supported over one ICM domain in a SP Carrier Ethernet Network (CEN). In this case, the Presto SOAM request for an *OamService* is across one Presto interface. The corresponding OamServicePoint (OSPs) are all the Layer Protocol CarrierEthOamSrvMepResource type.

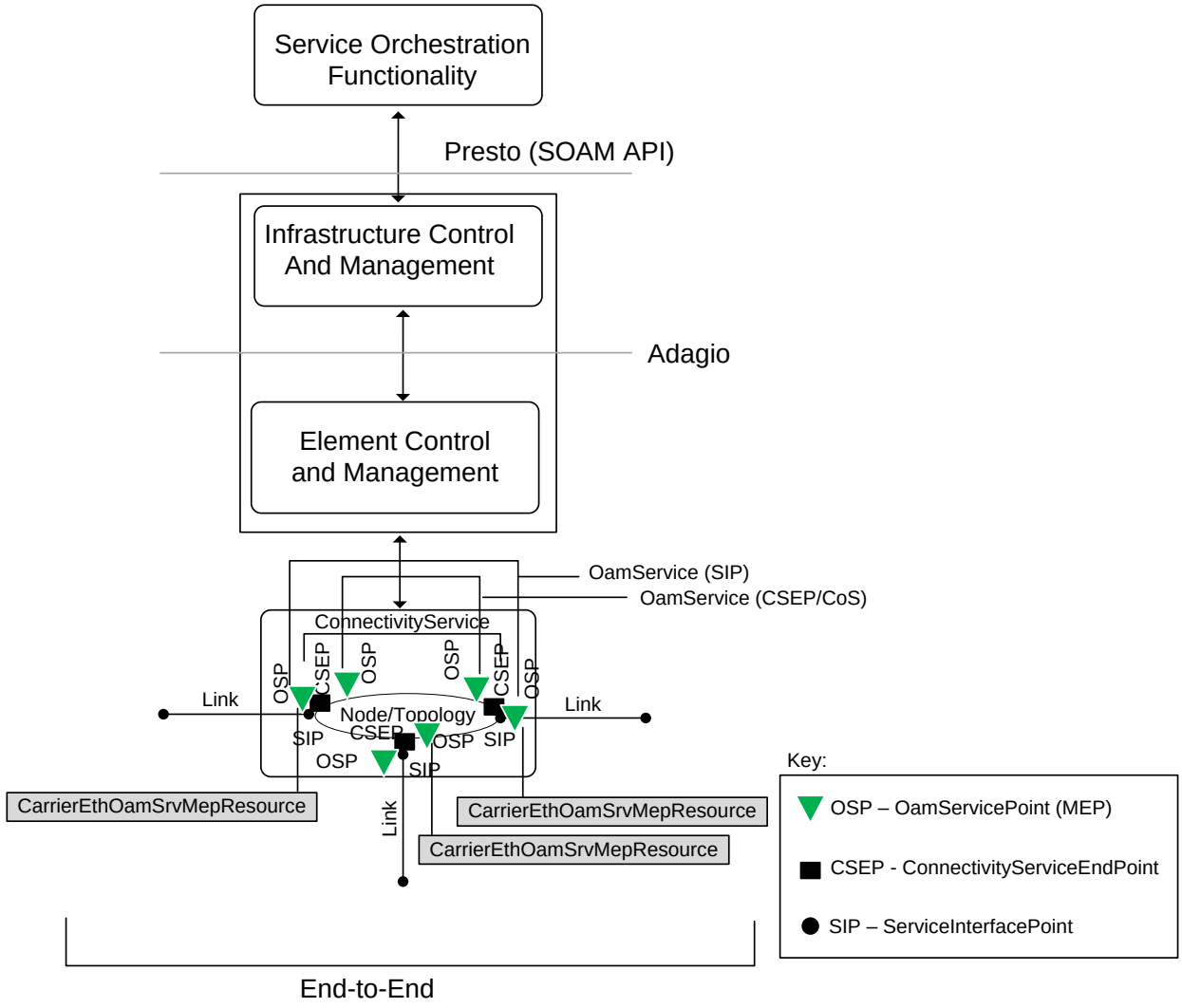


Figure 11-End-to-End Scenario

7.1.2 Edge and I-Transit

The Edge and I-Transit scenario occurs when an MEF EVC is supported over two or more ICM domains in a SP CEN. In these cases, the Presto SOAM requests for OamServices are across each of the Presto interfaces to respective ICMs.

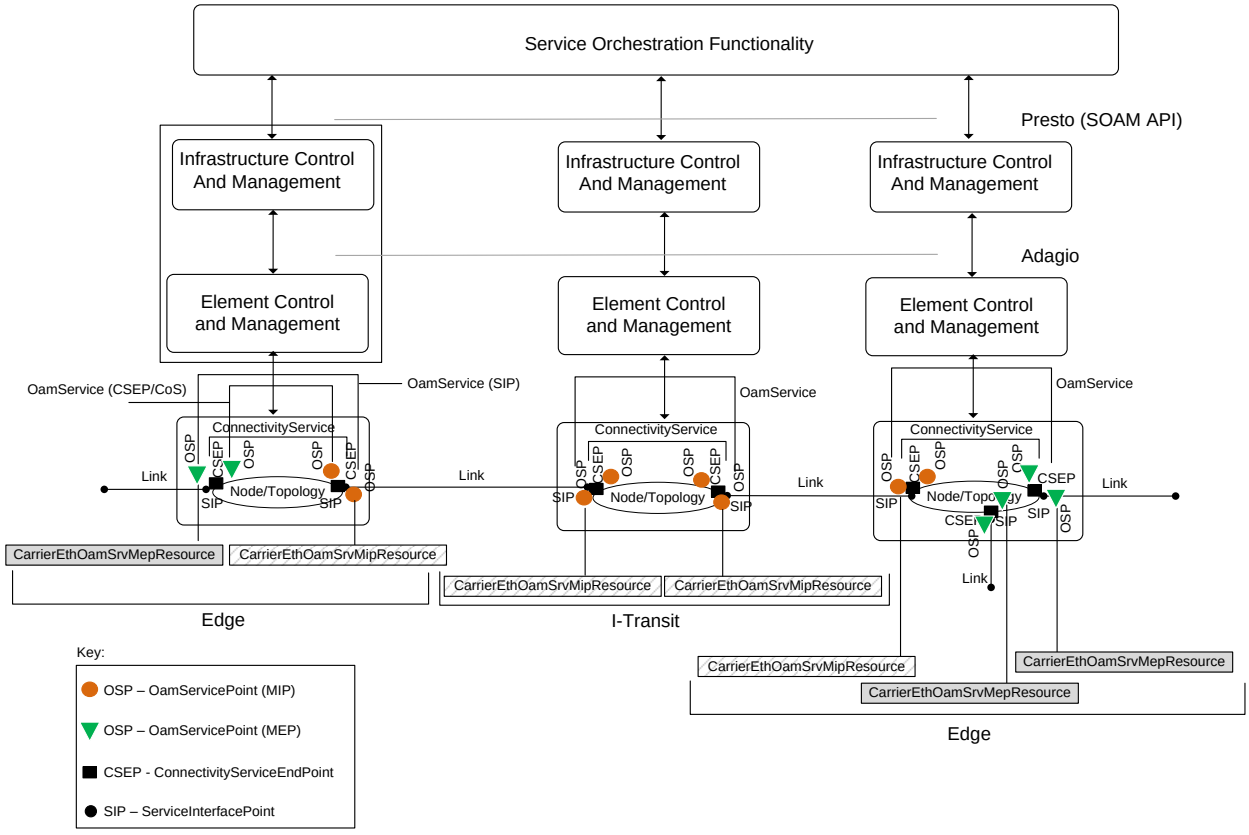


Figure 12-Edge and I-Transit Scenario(s)

NOTE: The example configuration above is illustrating a logical SOF. The actual implementation of SOF could include one or more SOF components with inter-SOF communications to one or more ICM components.

7.1.3 Access

This scenario is when a MEF OVC Service is supported over one ICM domain in a SP CEN. In this case, the SOAM request for an *OamService* is across one Presto interface. This scenario supports an OVC Service as defined in MEF 51.

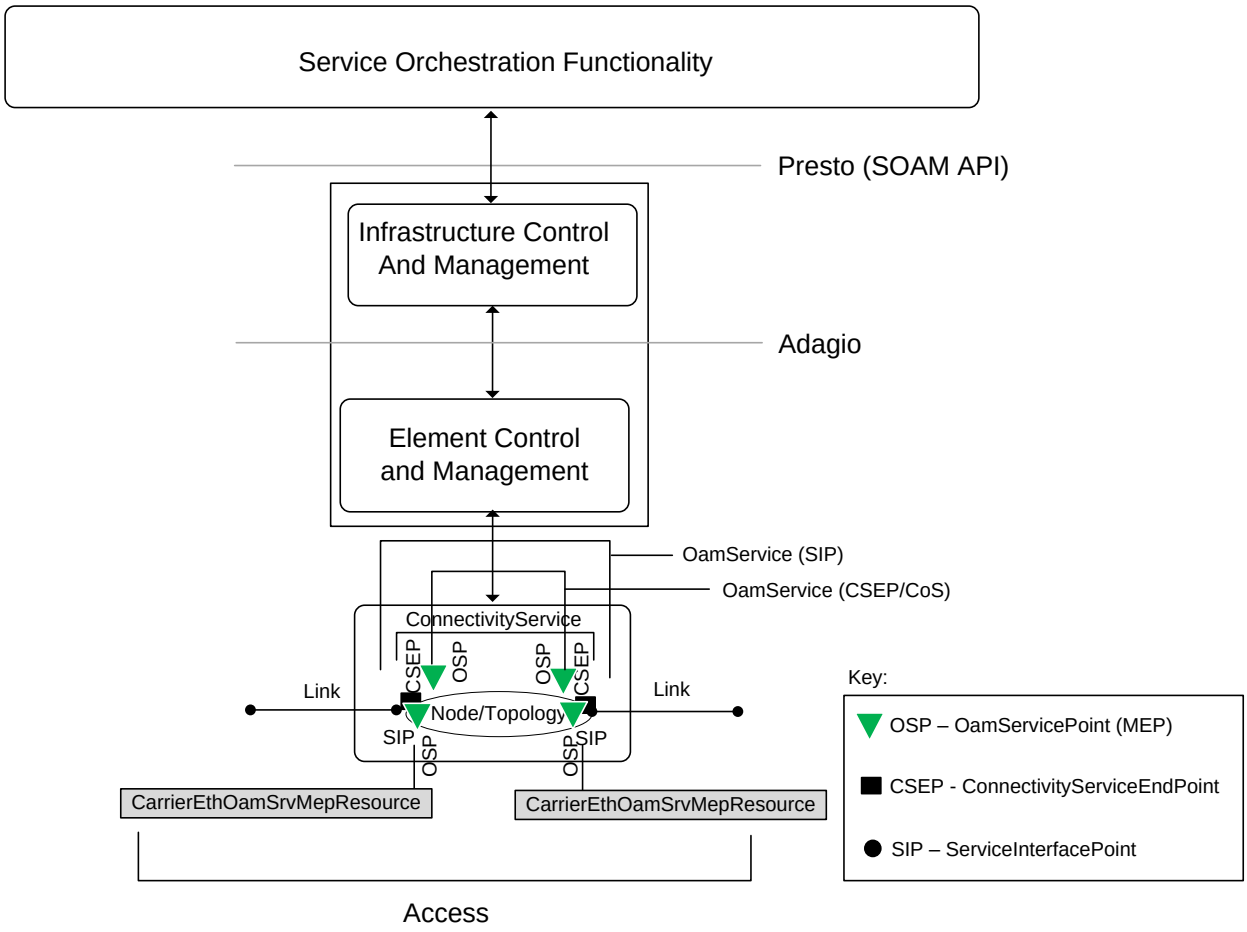


Figure 13-Access

7.1.4 I-Access

The I-Access scenario is when a Presto SOAM request is for support of a MEF OVC Service and the Presto SOAM resources are CarrierEthOamSrvMepResource to support MEPs and MIPs.

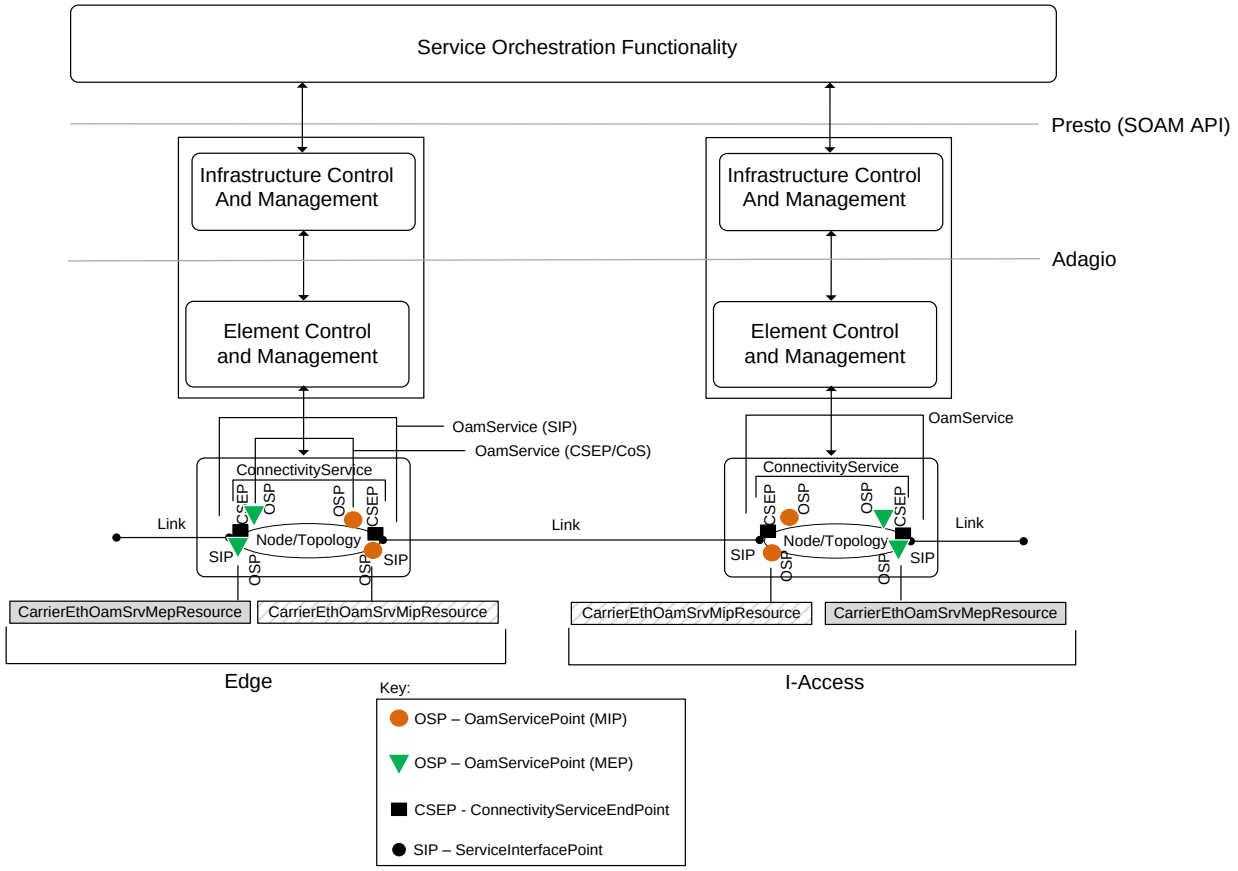


Figure 14-I-Access

NOTE: The example configuration above is illustrating a logical SOF. The actual implementation of SOF could include one or more SOF components with inter-SOF communications to one or more ICM components.

7.1.5 O-Transit

The O-Transit scenario is when a Presto SOAM request is for support of a MEF OVC Service and the Presto SOAM resources are CarrierEthOamSrvMepResources to support MEPs.

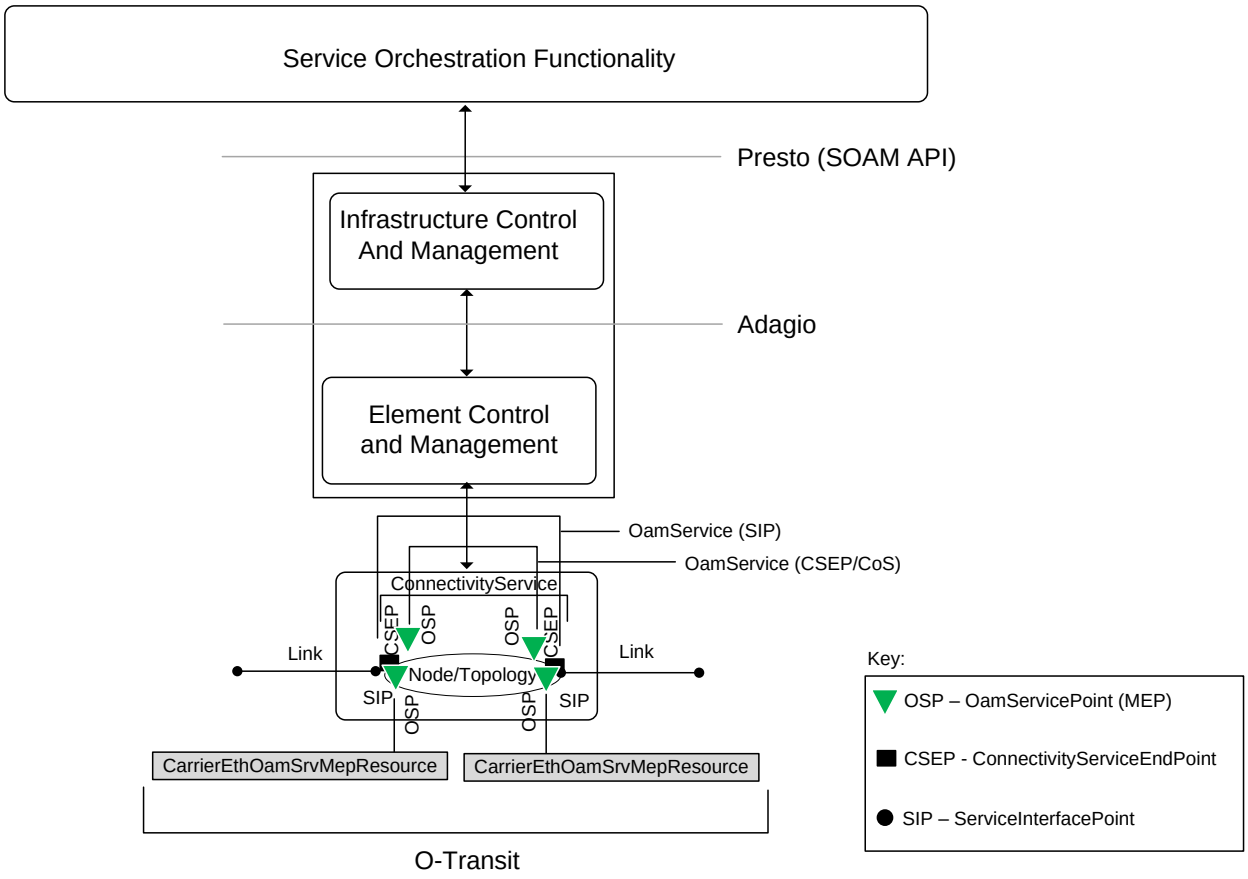


Figure 15-O-Transit

7.1.6 I-Hairpin

This scenario is support of a MEF hairpin switching within a single carrier network. Hairpin switching occurs when an ingress S-Tagged frame at a given NrpCarrierEthInniNResource results in an egress S-Tagged NrpCarrierEthInniNResource frame with a different S-VLAN ID value at the same NrpCarrierEthEnniNResource. CSEPs are created the SIP. MIPs are instantiated on the CSEPs.

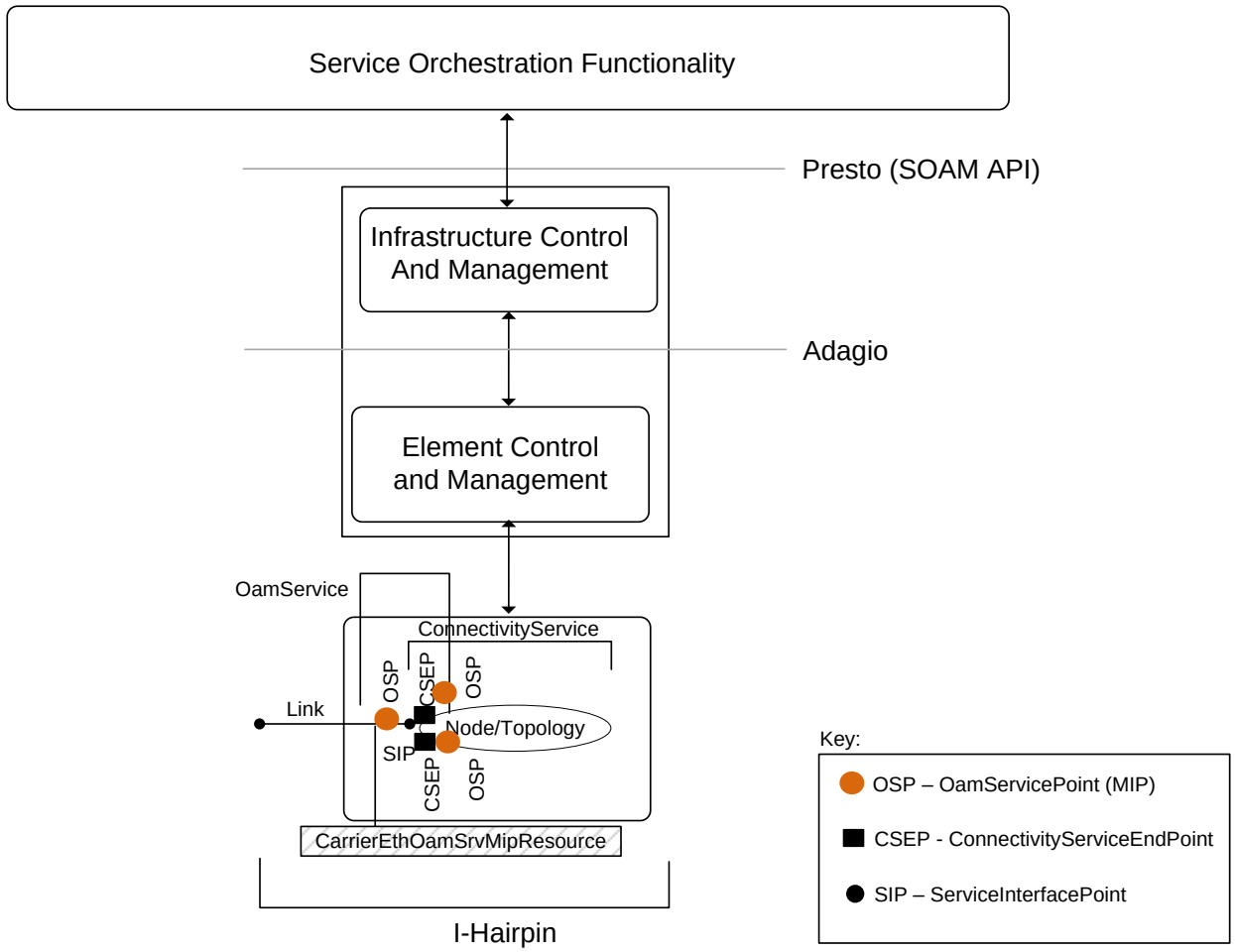


Figure 16-I-Hairpin

7.1.7 E-Hairpin

This scenario is support of a MEF hairpin switching that occurs across more than one carrier network. Hairpin switching at NrpCarrierEthEnniNResource occurs when an ingress S-Tagged frame at a given NrpCarrierEthEnniNResource results in an egress S-Tagged NrpCarrierEthEnniNResource frame with a different S-VLAN ID value at the same NrpCarrierEthEnniNResource. CSEPs are created the SIP. MIPs are instantiated on the CSEPs.

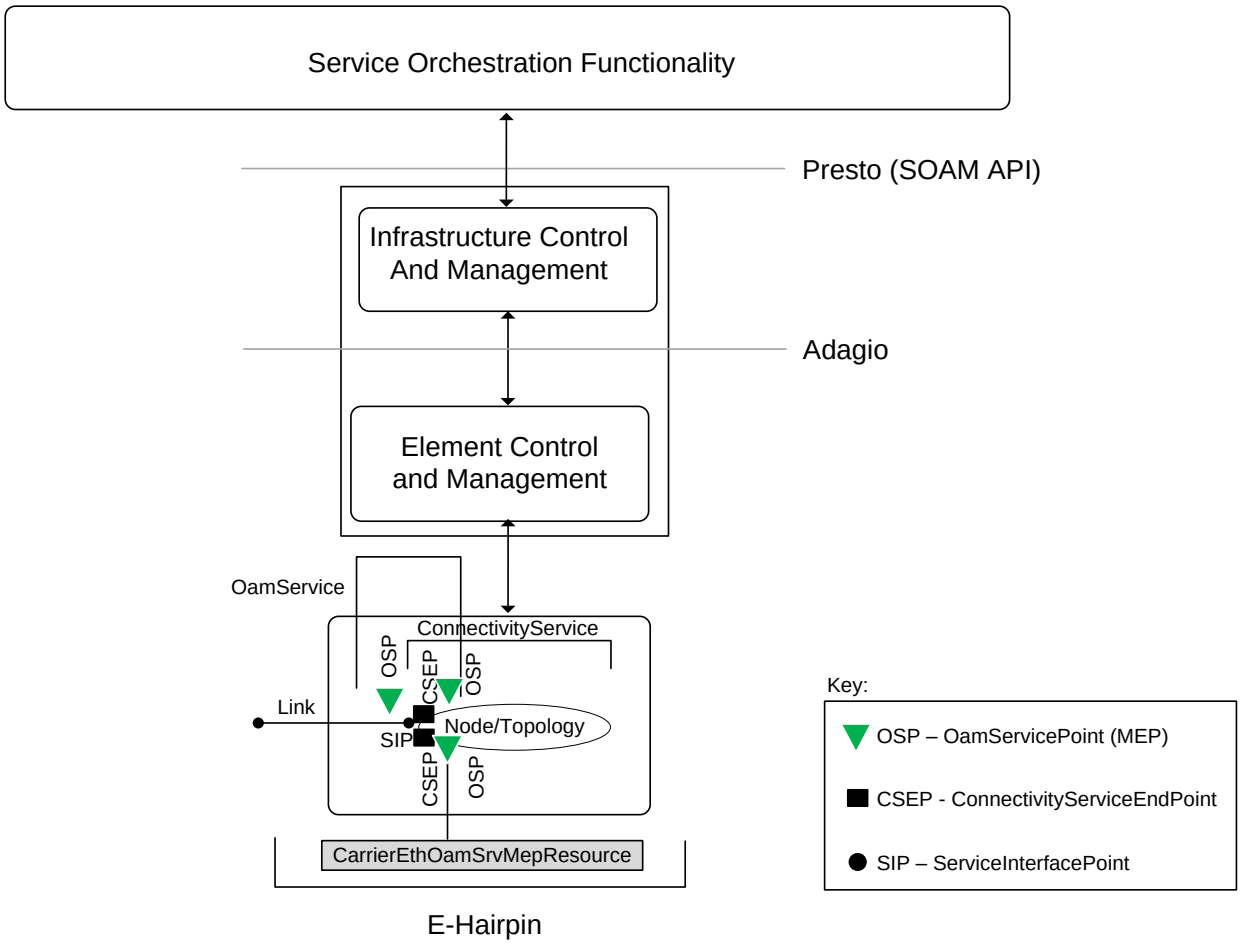


Figure 17-E-Hairpin

8 Requirements on ICM SOAM

The following section details the set of requirements for Presto SOAM Interface Profile. The requirements are about the functionality of that must be supported by both the client (i.e., SOF) and server (ICM) sides of the Presto Interface.

R_Presto_SOAM_0001	An implementation of a SOF/ICM **MUST** support the Create (C), Read(R), Update (U), Delete (D) (CRUD) and retrieval operations for OAM Profiles. *NOTE: TCA (Threshold Crossing Alert) provisioning is accomplished within the context of OamProfile provisioning.*
R_Presto_SOAM_0002	An implementation of a SOF/ICM **MUST** support Create (C), Read(R), Update (U), Delete (D) (CRUD) and retrieval operations for PM based OamService including lifecycle management of OamServicePoints. NOTE: The CRUD operations of OamService are responsible for MEG, MEP and MIP lifecycle management.
R_Presto_SOAM_0003	An implementation of a SOF/ICM **MUST** support Create (C), Read(R), Update (U), and Delete (D) (CRUD) operations for OamJob for both Proactive and On-Demand applications.
R_Presto_SOAM_0004	An implementation of a SOF/ICM **MUST** support the collection of performance management data within an Oam Collection for both Proactive and On-Demand applications.
R_Presto_SOAM_0005	An implementation of a SOF/ICM (or comparable server) **MUST** support the dynamic ability to discover a device and corresponding pre-existing configuration.
R_Presto_SOAM_0006	An implementation of a SOF/ICM **MUST** support the Publication and Subscription of Notifications for the purposes of OamService activation notification, OamJob activation, Threshold Crossing Alerts and Faults. This includes specifying if the notification is provided at the completion of the OamJob as intermediate measurements are completed or both.

9 Use Cases

The following section details the set of uses that are in support of Presto SOAM. The use cases include: OamProfile provisioning, including TCA provisioning, OamServicePoint provisioning, OamService provisioning, OamJob provisioning, OamJob collection and Notification service activation and processing.

9.1 Presto SOAM Profile Provisioning

OAM Profile Provisioning is the process of defining the attributes of the OamProfile. The attributes of the OAM Job are defined in the OAM Profile. These include attributes like the Measurement Interval, Frame Length, Delay Measurement Bins, etc. An OAM Profile can be reused for multiple OamJobs or can be created for a specific OamJob.

NOTE: TCA (Threshold Crossing Alert) provisioning is accomplished within the context of OamProfile provisioning.

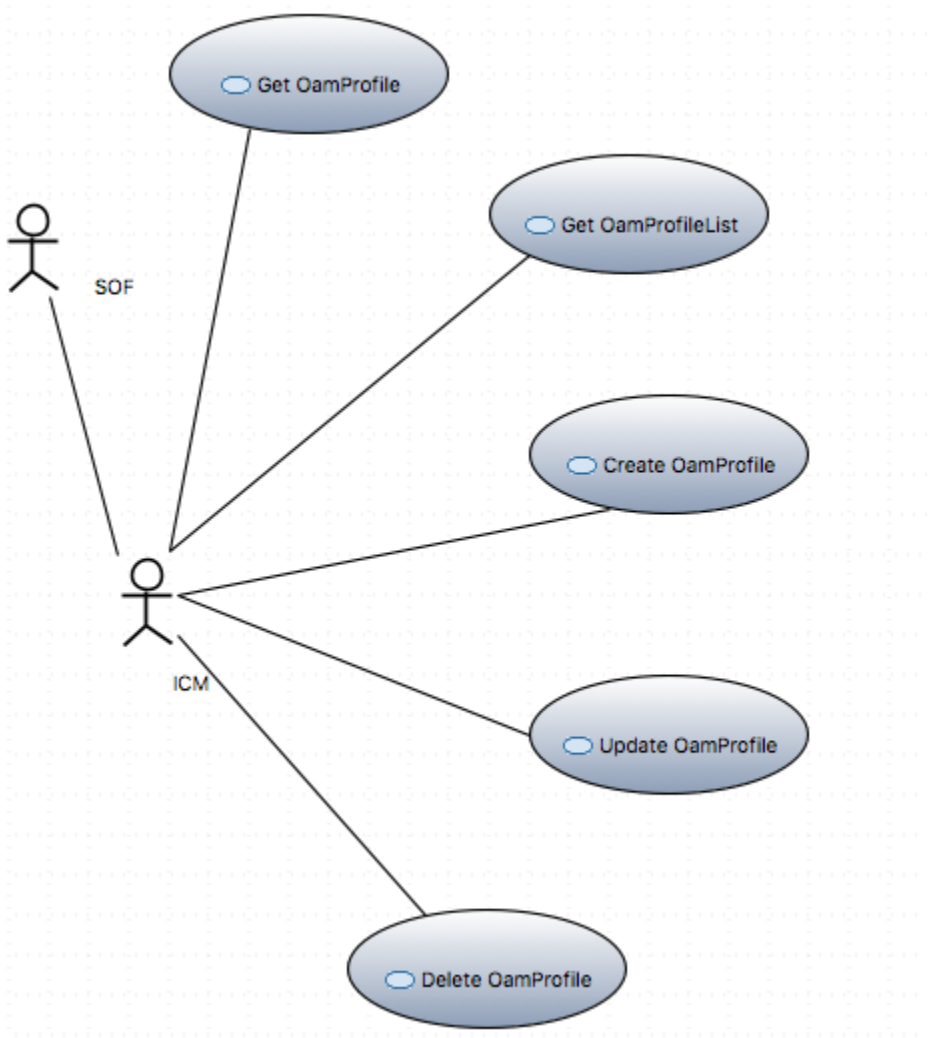
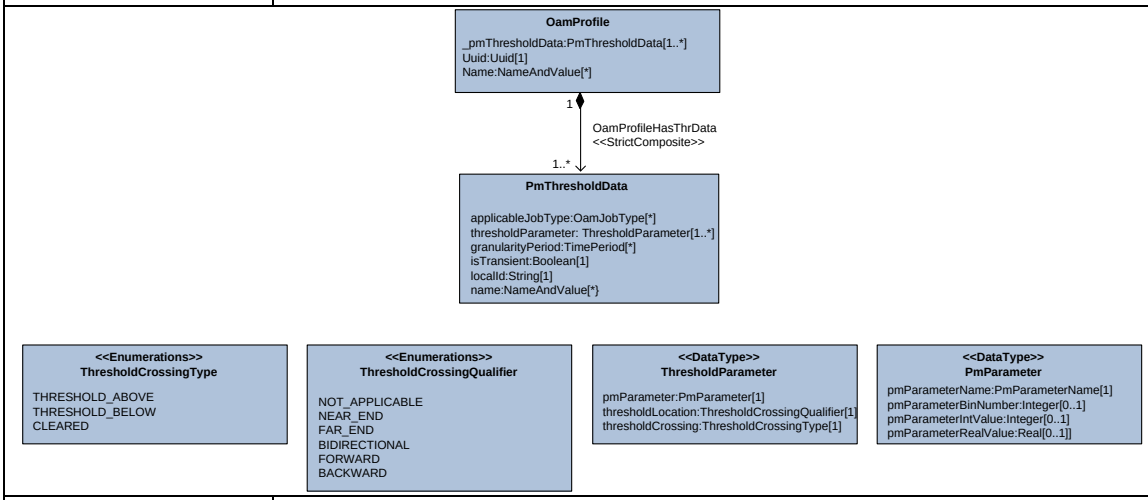
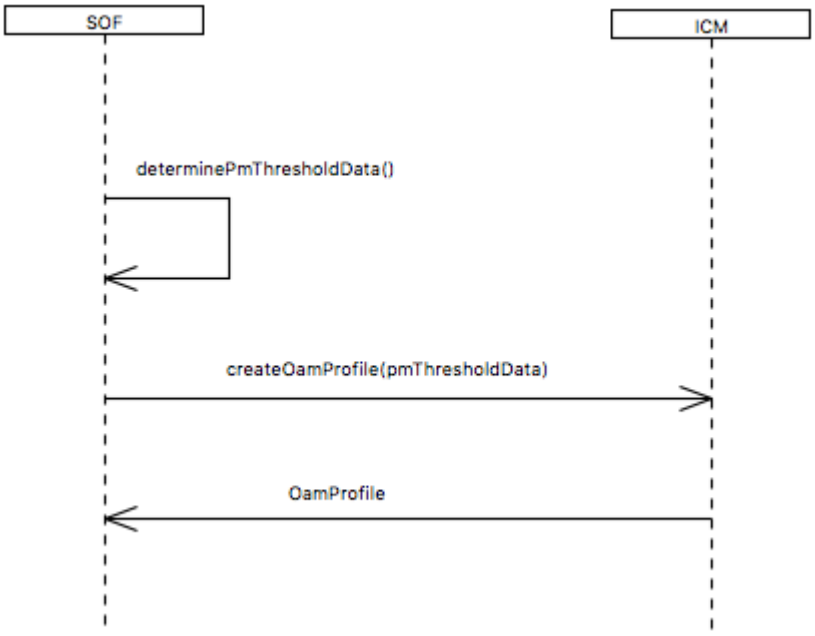


Figure 18-Presto SOAM OAM Profile Provisioning Use Cases

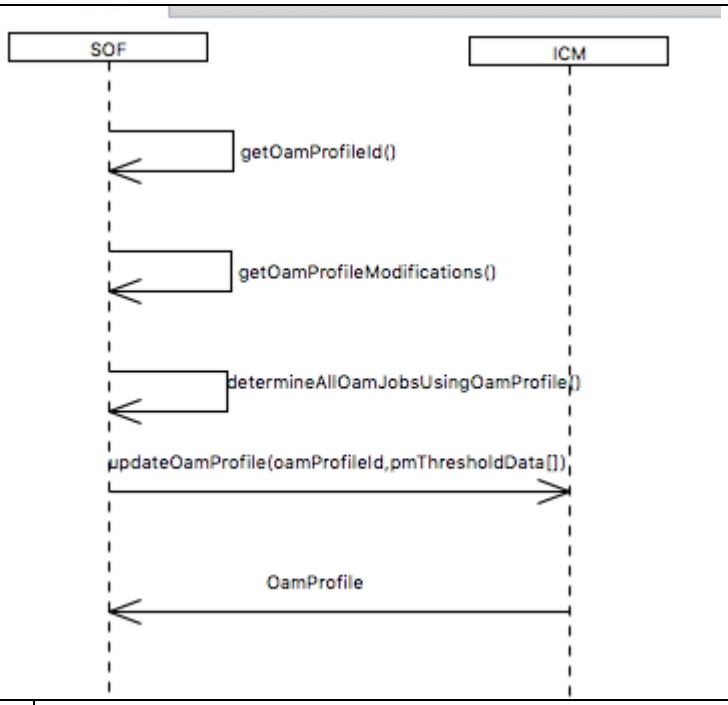
Use Case Id	**UC_PRESTO_SOAM_1**
Use Case Name	OAM Profile Provisioning
Description	The create, modification, deletion and retrieval of OAM Profile(s).
Actor(s)	Service Orchestration Function and ICM
OamProfile Creation	
Pre-Conditions	1. OamProfile does not exist.



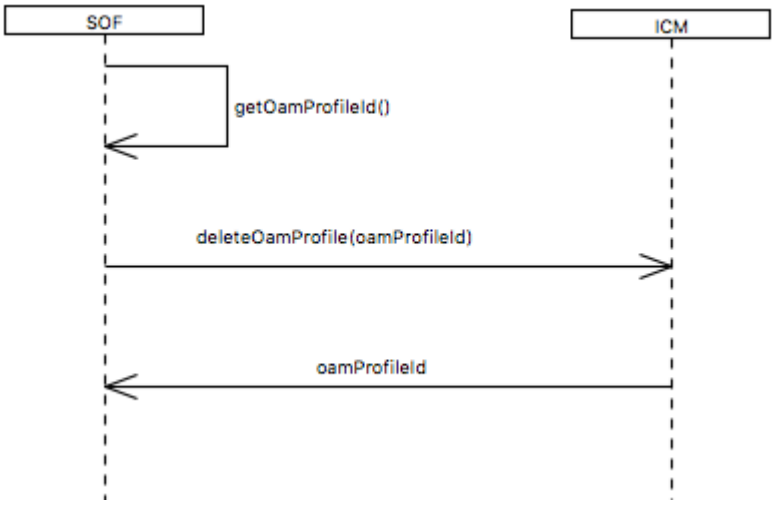
Process Steps	1. SOF determines what PM Threshold Data will be created – delay or loss. 2. SOF transmits: createOamProfile(pmThresholdData:PmThresholdData[1..*])



Post-Conditions	1. Resources are allocated and activated to support OamProfile. 2. ICM returns OamProfile[1]
Notification/Event	1. If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
OamProfile Update *NOTE: Changes to an OamProfile will have an impact on all OamJobs that are currently using that OamProfile. Therefore, it is recommended to ascertain the collection of OamJobs currently using a specific OamProfile.*	
Pre-Conditions	1. SOF has determined modification needed for OamProfile. 2. SOF has unique identifier of OamProfile. 3. SOF has determined the set of OamJobs currently using unique OamProfile.
Process Steps	1. SOF transmits: updateOamProfile(oamProfileId:Uuid, pmThresholdData:PmThresholdData[1..*])



Post-Conditions	1. Resources are allocated and activated to support updated OamProfile. 2. ICM returns OamProfile[1].
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
OamProfile Delete *NOTE: Changes to an OamProfile will have an impact on all OamJobs that are currently using that OamProfile. An implementation should consider pre-condition steps to verify the OamProfile is no longer in use by any OamJob. One mechanism would be to retrieve OamJobs with a filter on the unique OamProfile identifier.*	
Pre-Conditions	1. SOF has unique identifier of OamProfile. 2. SOF has determined the set of OamJobs currently using unique OamProfile.
Process Steps	1. SOF transmits deleteOamProfile(oamProfileId:Uuid)



Post-Conditions	1. Resources are deactivated and deallocated from OamProfile.
Notification/Event	N/A
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
OamProfile Retrieve	
Process Steps	1. OamProfile id is known. 2. SOF transmits getOamProfile(oamProfileId:Uuid) to ICM.
Post-Conditions	1. ICM returns OamProfile[1].
OamProfile List Retrieve	
Process Steps	1. SOF transmits getOamProfileList() to ICM.
Post-Conditions	1. ICM returns returns OamProfile[0..*].
Notification/Event	N/A
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented

	CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0001

9.2 Presto SOAM Service Provisioning

OAM service provisioning is the process of the activation of OamServicePoints followed by the OamService. In addition, the ability to retrieve an existing OamService(s) and OamServiceEndPoint(s).

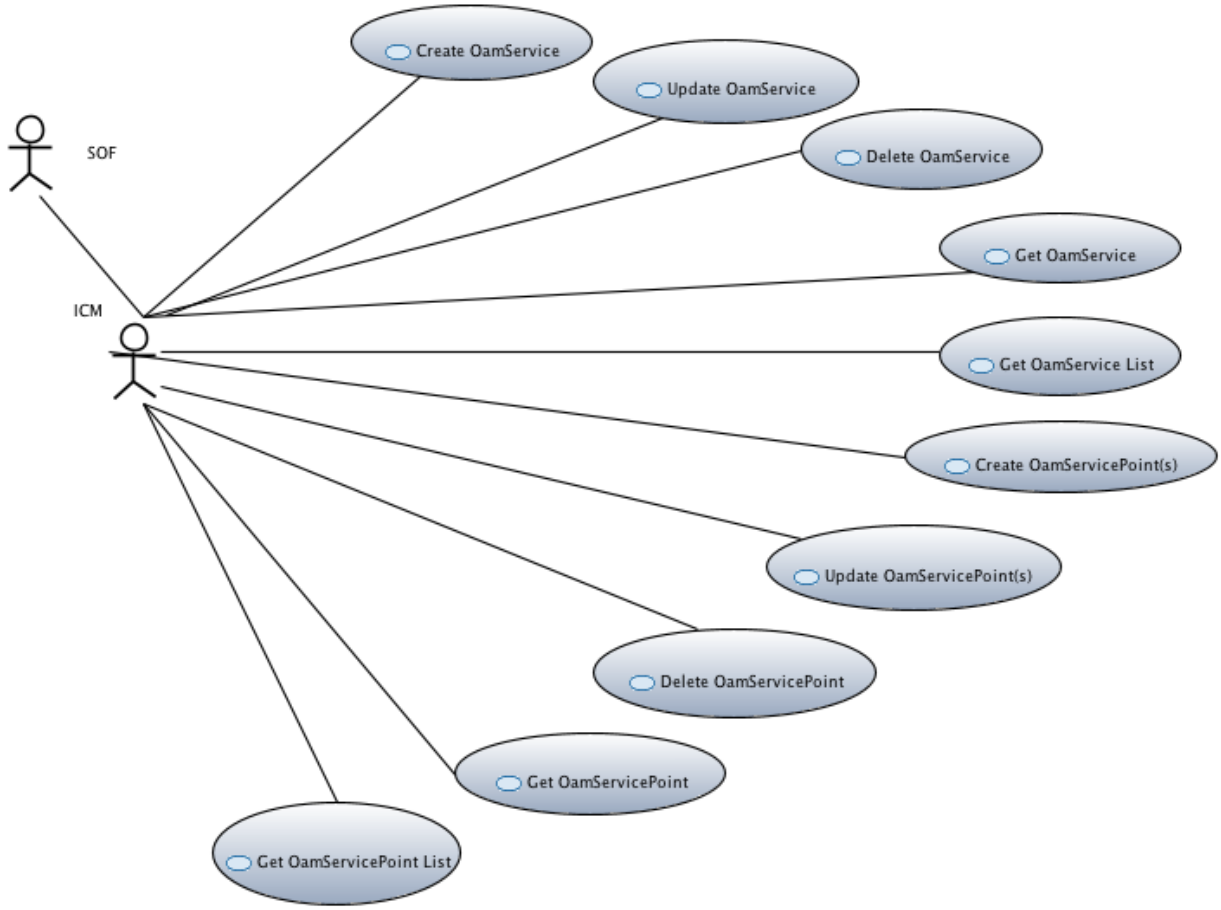
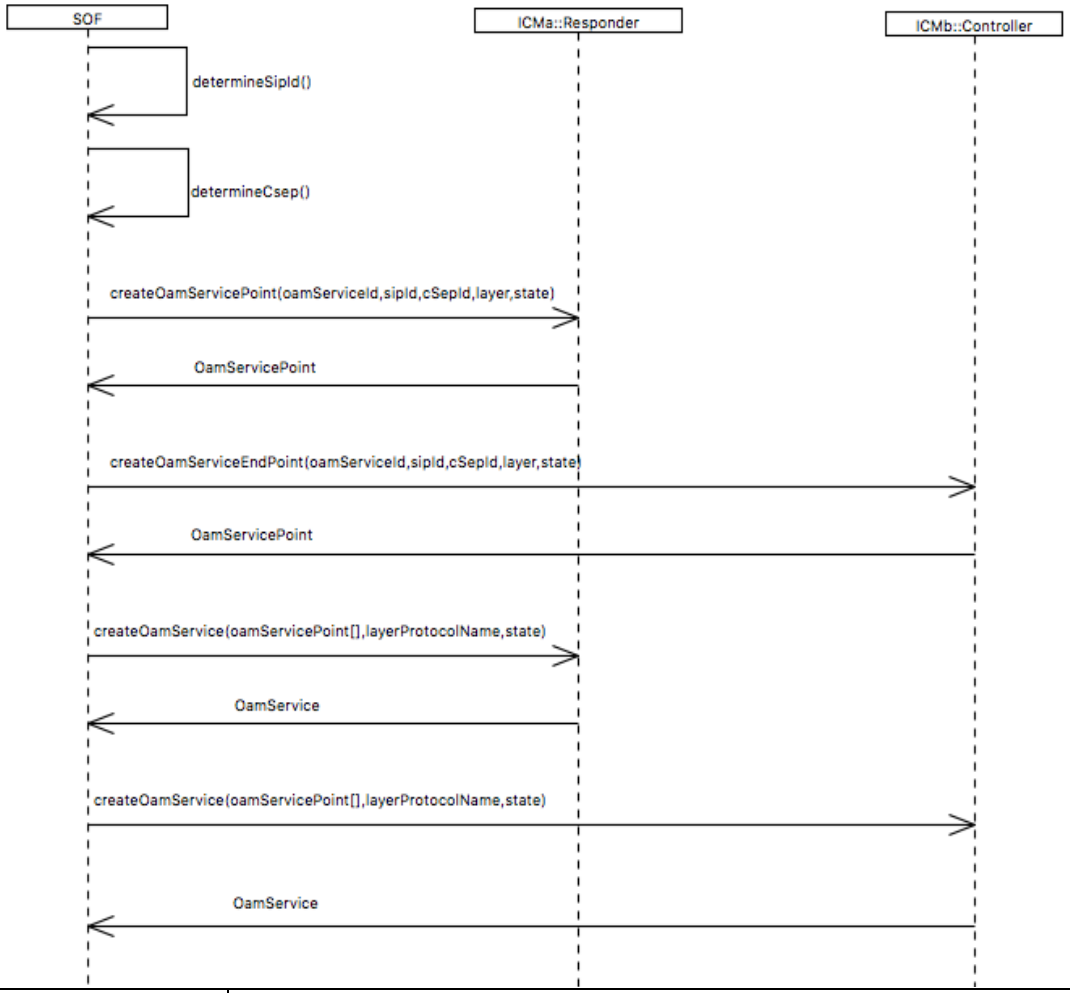
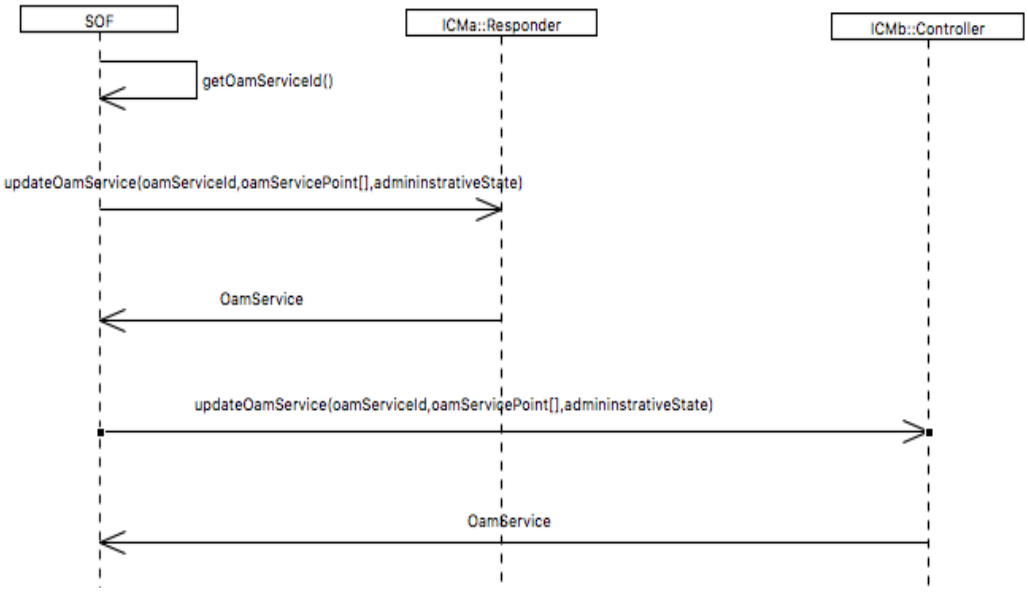


Figure 19-Presto SOAM OAM Service Provisioning Use Cases

Use Case Id	**UC_PRESTO_SOAM_2**
Use Case Name	OAM Service Provisioning
Description	The create, modification, deletion and retrieval of OAM service(s).
Actor(s)	Service Orchestration Function and ICM
	OamService/OamServicePoint Creation
Pre-Conditions	1. OamService state is Initial State (non-existent). 2. OamServicePoint(s) state if Initial State (non-existent).
Process Steps	1. SOF determines Service Interface Point unique identifier, sipId. 2. SOF determines unique ConnectivityServiceEndPoint identifier, cSepId. 3. SOF sets layer. 4. SOF sets OamServicePoint state to operationalState=ACTIVE/administrativeState=UNLOCKED. 5. SOF transmits: createOamServicePoint(oamServiceId:Uuid[1],sipId:Uuid[1],cSepId:String[0..1],layer:LayerProtocolName LayerProtocolName[1],state:AdministrativeState[1]) 6. Repeat for second OamServicePoint. 7. SOF determines and sets Meg associated with OamService. 8. SOF sets Mep/Mip attributes associated with OSP. 9. SOF sets mepIdentfier associated with OSP. 10. SOF set peerMepIdentifier associated with OSP. 11. SOF gets previously configured OamServicePoint(s). 12. SOF sets OamService state to operationalState=ACTIVE/administrativeState=UNLOCKED. 13. SOF transmits: createOamService(oamServicePoint:OamServicePoint[2..*],layerProtocolName:LayerProtocolName[1],state:AdministrativeState[1])



Post-Conditions	1. ICM returns two OamServicePoints and OamService. 2. Resources are allocated and activated to support OamService including two OamServicePoints. 3. OamServicePoints state are both: operationalState=ACTIVE/administrativeState=UNLOCKED. 4. OamService state: operationalState=ACTIVE/administrativeState=UNLOCKED.
Notification/Event	1. If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI). Note: If a conflict with the requested OamService exists, the ObjectAlreadyExists exception is returned.
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss

	AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
OamService Update	
Pre-Conditions	1. OamService state: operationalState=ACTIVE/administrativeState=UNLOCKED. 2. SOF has determined modification needed for OamService.
Process Steps	1. SOF retrieves unique OamService identifier, oamServiceId. 2. SOF determines modification(s) of OamService 3. SOF OamServicePoints. 4. SOF transmits: updateOamService(oamServiceId:Uuid,oamServicePoint:OamServicePoint[*],state:AdminstrativeState[0..1])
	
Post-Conditions	1. ICM returns OamService[1] 2. Resources are allocated and activated to support updated OamService.
Notification/Event	1. If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI). Note: If a conflict with the requested MEP ID exists, the ObjectAlreadyExists exception is returned.
OamServicePoint Update	
Pre-Conditions	1. OamServicePoint state: operationalState=ACTIVE/administrativeState=UNLOCKED.

	2. SOF has determined modification needed for OamService-Point.
Process Steps	1. SOF retrieves OamServicePoint with oamServiceId. 2. SOF determines modification(s) of OamServicePoint 3. SOF sets attributes of updated OamServicePoint 4. SOF transmits: updateOamServicePoint(oamServiceId:Uuid[1],oam-ServicePointId:String[1],state:AdministrativeState[0..1])
Post-Conditions	1. ICM returns OamServicePoint[1]. 2. Resources are allocated and activated to support updated OamServicePoint.
Notification/Event	1. If OamServicePoints notification service is active a notification of OamServicePoint update is published.
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists

OamService Delete	
Pre-Conditions	1. OamService state: operationalState=ACTIVE/administrativeState=UNLOCKED. 2. SOF has unique identifier of OamService NOTE: Cannot allow deletion of OamService if OamServicePoints are still active. 3. SOF determines if any OamServicePoints are still active.
Process Steps	1. SOF determines unique service identifier (oamServiceId). 2. SOF transmits request to delete OamService: deleteOamService(oamServiceId:Uuid[1])
Post-Conditions	1. Resources are deactivated and deallocated from OamService.
Notification/Event	If OamService notification service is active a notification of OamService deletion is published.
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
OamServicePoint Delete *NOTE: An OamServicePoint should not be attempted to be deleted if it is active, associated with an OamService or OamJob.*	
Pre-Conditions	1. OamServicePoint state: operationalState=ACTIVE/administrativeState=UNLOCKED. 2. SOF has unique identifier of OamServicePoint. NOTE: Cannot allow deletion OamServicePoints are still active or associated with OamService and/or OamJob.
Process Steps	1. SOF determines unique OamService identifier (oamServiceId). 2. SOF determines unique OamServicePoint identifier (oamServicePointId). 3. SOF transmits: deleteOamServicePoint(oamServiceId:Uuid[1],oamServicePointId:String[1])
Post-Conditions	1. Resources are deactivated and deallocated from OamServicePoint.

Notification/Event	If OamServicePoints are still active and UnableToComply exception is sent to client. If OamServicePoint notification service is active a notification of OamServicePoint deletion is published.
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
OamServicePoint Retrieve	
Process Steps	1. SOF determines OamService identifier (oamServiceId). 2. SOF determines OamServicePoint identifier (oamServicePointId). 3. If single OamServicePoint request SOF transmits: getOamServicePoint(oamServiceId:Uuid[1],oamServicePointId:String[1])
Post-Conditions	1. ICM returns returns OamServicePoint[1].
Notification/Event	N/A
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
OamService (List) Retrieve	
Process Steps	1. SOF determines OamService identifier (oamServiceId). 2. If List request SOF transmits: a. getOamServiceList() 3. If single OamService request SOF transmits:

	getOamService(oamServiceId:Uuid) returns OamService[1]
Post-Conditions	1. Specific OamService or array of OamServices is returned.
Notification/Event	N/A
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0002

9.3 Presto SOAM Job Provisioning

The Presto SOAM Job provisioning is responsible for supporting performance management and fault management functionality. There are two types of OAM Jobs with the time schedule of the job being the main difference. The first scenario is in support of a MEF EVC specified SLA with one or more ordered pairs. The OAM Job Provisioning in this scenario is called "Proactive". The second scenario is when a client requests or single job run. The OAM Job Provisioning in this scenario is called "On-Demand".

NOTE: Oam BINS are configured as part of the OamJob operation for both Single and Dual Ended Jobs.

NOTE: OamJob provisioning is responsible for measurement intervals and schedule.

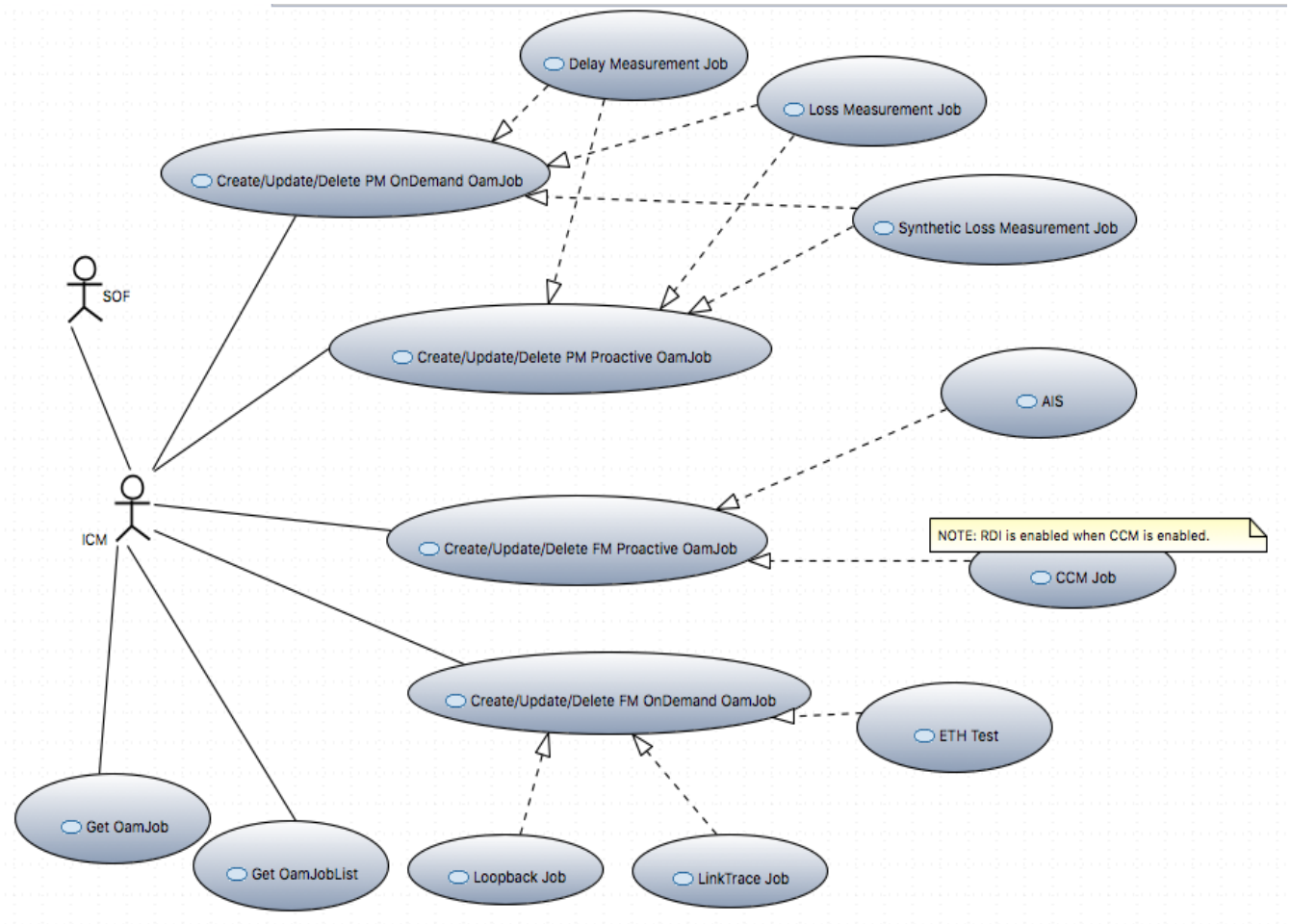


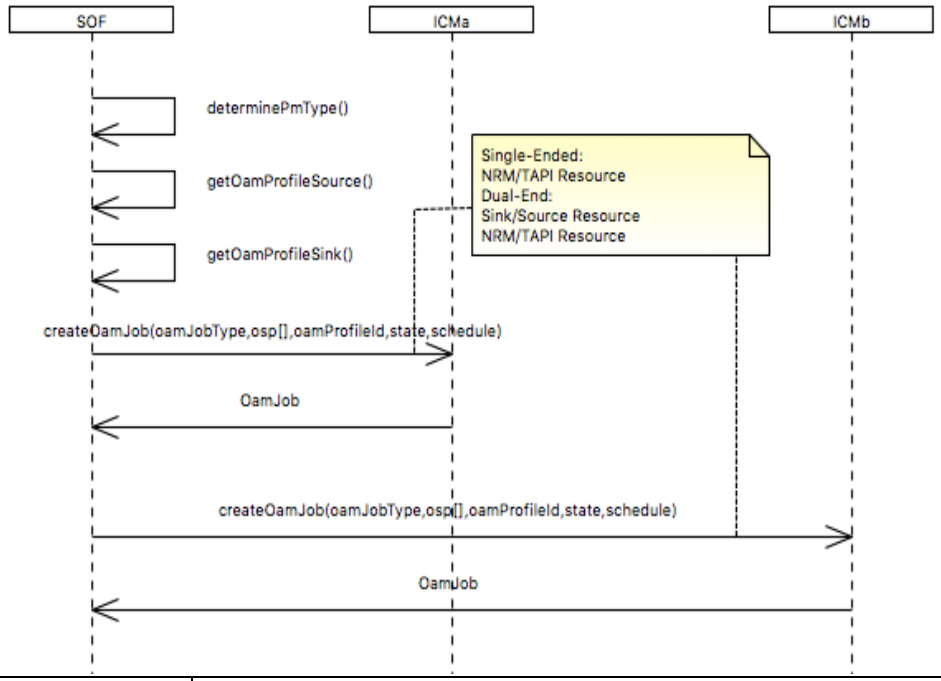
Figure 20-Presto SOAM OAM Job Provisioning Use Cases

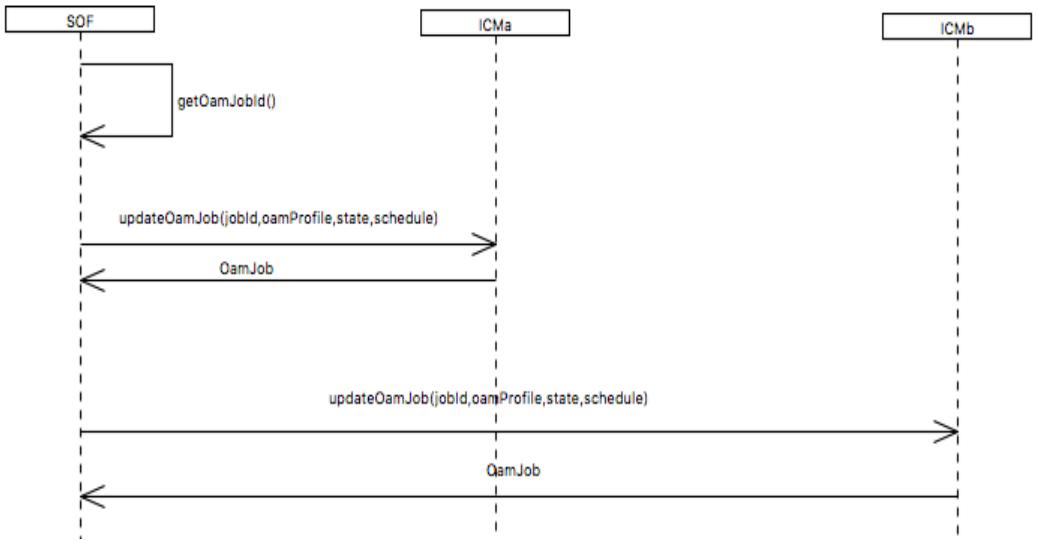
9.3.1 Presto SOAM PM Proactive and On-Demand OAM Job Provisioning Use Cases

The test cases for this area includes provisioning of delay measurement, loss measurement and synthetic loss measurement. Each use case covers creation update and deletion actions. The only difference between a Performance Management On-Demand and Proactive use case is the scheduled time. A Proactive is typically in support of a MEF Service SLA measurement and will run indefinitely, while an On-Demand is a short duration test.

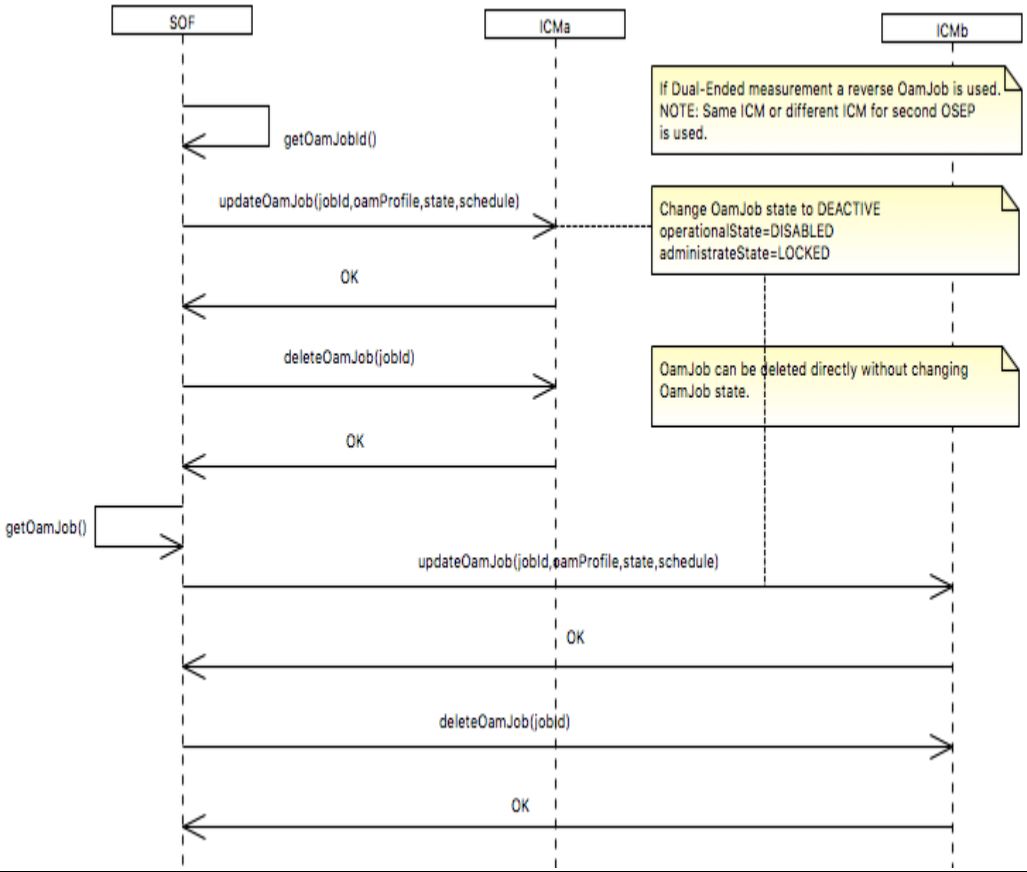
The set of use cases defined in this section are leveraging the concept termed PM Session and defined later in this document. The Presto SOAM implementation is in support of the defined set of PM-1, PM-2, PM-3 and PM-4 as defined in MEF 35.1.

Use Case Id	**UC_PRESTO_SOAM_3**
Use Case Name	Delay Measurement OAM Job Provisioning
Description	The creation, updating and deletion of Delay Measurement OAM Job *Reference Figure 5-Relationship with MEF 35.1 PM-1 and Presto SOAM.* *Reference Figure 6-Relationship with MEF 35.1 PM-2 and Presto SOAM.*
Actor(s)	Service Orchestration Function and ICM
Delay Measurement OamJob Creation	
Pre-Conditions	1. SOF has created and activated OamService. 2. SOF has determined OamServicePoints. 3. SOF has determined OamServicePoint(s) serving ICM(s). 4. SOF has determined which OamServicePoint is Controller and which OamServicePoint is Responder or Sink. 5. SOF has determined if OamJob is Proactive or OnDemand. 6. SOF has determined OamProfile for Delay Measurement. 7. SOF has determined the Oam BIN configuration. 8. SOF has determined the OamJob schedule.
Process Steps	1. Create OamJob request: If PM-1: Single-Ended Delay OamJobType=ETH_DM If ProActive: OamJob = EthProActiveSingleEndedMeasurementJob with • CarrierEthOamJobProActSingleEndSyntLossResource • *NOTE: CarrierEthOamJobProActSingleEndDelayResource is included for PM-1 only.* If OnDemand: OamJob = EthOnDemandSingleEndedMeasurementJob with: • CarrierEthOamJobOnDmdSingleEndSyntLossResource If PM-2: Dual-Ended Delay – 1 ICM *A single OamJob request is sent for each direction from SOF to ICM which includes Source and Sink jobs. The ICM is responsible for setting up two SOAM paths from respective Controllers and Sinks.* If PM-2: Dual-Ended Delay – 2 ICMs *An OamJob requests is sent to both ICMs for each Controller-to-Sink path. The reason is that the Controller ICM is responsible for*

	initiation of the OamJob and the Sink ICM is responsible for knowing to initiate the OamCollection. *If the ICM cannot perform necessary mapping from Presto request to two individual SOAM path activations, then the SOF is responsible for sending two individual OamJob requests. NOTE: There is a Source and Sink Oam Job.* OamJobType=ETH_1DM If ProActive: OamJob = EthProActiveDualEndedMeasurementJob with • CarrierEthOamJobProActDualEndedDelayResource If OnDemand: OamJob = EthOnDemandDualEndedMeasurementJob with • CarrierEthOamJobOnDemandDualEndDelayResource 2. Set State and Schedule. 3. SOF transmits: createOamJob(oamJobType:OamJobType[1],oamServiceId:Uuid[1],oamServicePointId:String[1..2],oamProfileId:Uuid[1],state:AdministrativeState[1],schedule:TimeRange)
	
Post-Conditions	1. ICM returns OamJob[1] is (are) enabled and SOAM frames are activated and are being transmitted.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).

	Note: If a conflict with the requested Oam Job exists, the ObjectAlreadyExists exception is returned.
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
Delay Measurement OamJobUpdate	
Pre-Conditions	1. OamJob state: operationalState=ACTIVE/administrativeState=UNLOCKED. 2. SOF has determined modification needed OamJob. 3. SOF has unique identifier of OamJob.
Process Steps	1. SOF transmits: 2. updateOamJob(oamJobId:Uuid[1],oamProfile:OamProfile[1],state:AdministrativeState[0..1],schedule:TimeRange[0..1]) with modified attribute(s).
	
Post-Conditions	1. ICM return returns OamJob[1]. 2. Resources are allocated and activated to support updated OamJob.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).

Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
Delay Measurement OamJob Deletion	
Pre-Conditions	1. OamJob state: operationalState=ACTIVE/administrativeState=UNLOCKED. 2. SOF has unique identifier of OamJob.
Process Steps	1. SOF transmits OamJob update to Deactivate State: operationalState=INACTIVE/administrativeState=LOCKED. 2. SOF transmits deleteOamJob(jobId) requests to ICM.

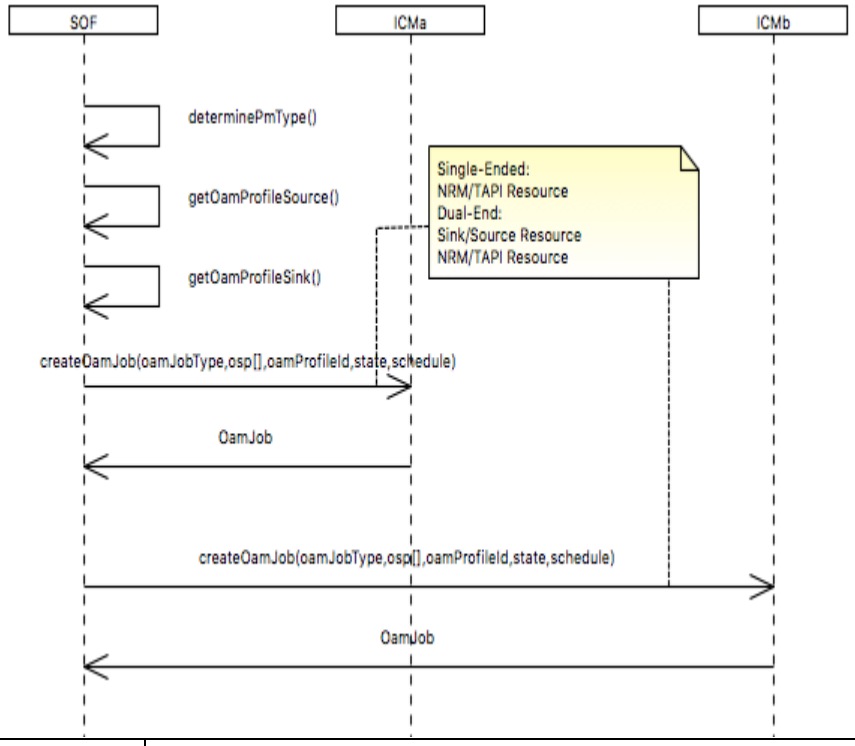


Post-Conditions	1. Resources are deactivated and deallocated from OamJob.

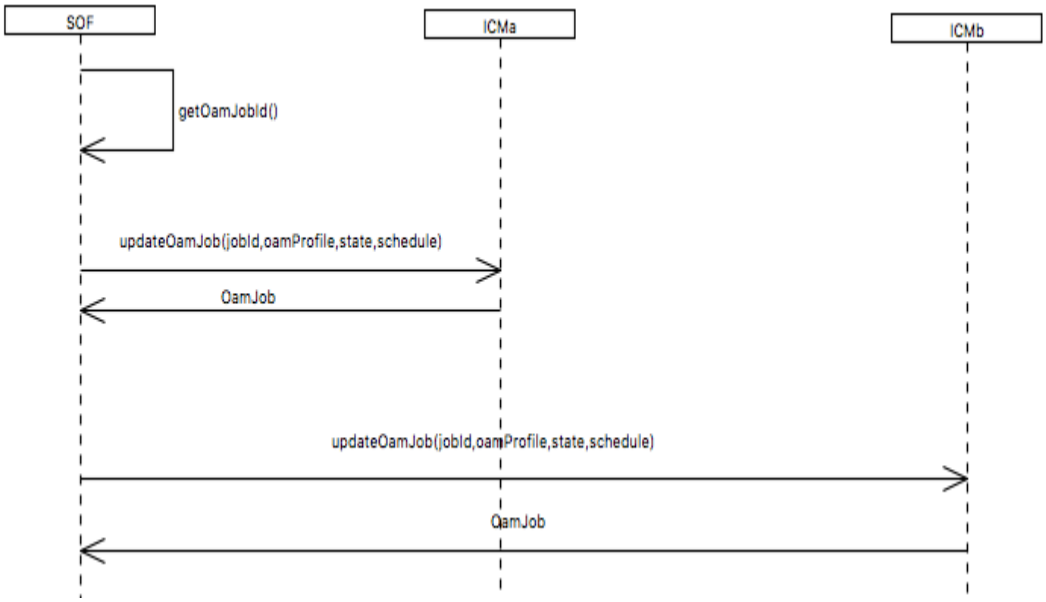
Notification/Event	OamJob Notification Enumeration indicates OamJob state change and deletion.
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0003

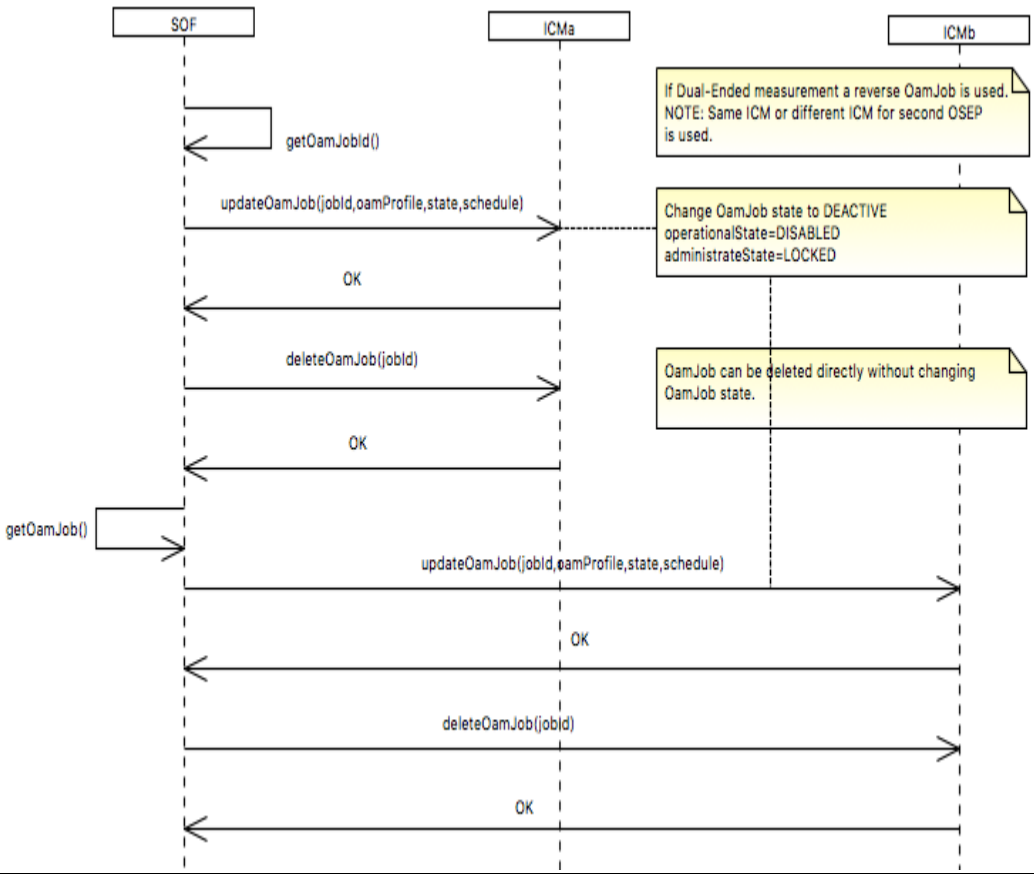
Use Case Id	**UC_PRESTO_SOAM_4**
Use Case Name	Synthetic and Service Loss Measurement OAM Job Provisioning
Description	The creation, updating and deletion of Loss Measurement OAM Job. *Reference Figure 5-Relationship with MEF 35.1 PM-1 and Presto SOAM.* *Reference Figure 7-Relationship with MEF 35.1 PM-3 and Presto SOAM.* *Reference Figure 8-Relationship with MEF 35.1 PM-4 and Presto SOAM.*
Actor(s)	Service Orchestration Function and ICM
Loss Measurement OamJob Creation	
Pre-Conditions	1. SOF has created and activated OamService. 2. SOF has determined OamServicePoints. 3. SOF has determined OamServicePoint(s) serving ICM(s). 4. SOF has determined which OamServicePoint is Controller and which OamServicePoint is Responder or Sink. 5. SOF has determined if OamJob is Proactive or OnDemand. 6. SOF has determined OamProfile for Loss Measurement. 7. SOF has determined the Oam BIN configuration. 8. SOF has determined the OamJob schedule.
Process Steps	1. Create OamJob request: If PM-1: Single-Ended Synthetic Loss OamJobType=ETH_SLM If ProActive: OamJob = EthProActiveSingleEndedMeasurementJob with • CarrierEthOamJobProActSingleEndSyntLossResource • *NOTE: CarrierEthOamJobProActSingleEndDelayResource is included for PM-1 only.* If OnDemand: OamJob = EthOnDemandSingleEndedMeasurementJob with • CarrierEthOamJobOnDmdSingleEndSyntLossResource If PM-3: Single-Ended Service Loss – 1 ICM OamJobType=ETH_LM_LMM If ProActive: OamJob = EthProActiveSingleEndedMeasurementJob with • CarrierEthOamJobProActSingleEndLossResource

	If OnDemand: OamJob = EthOnDemandSingleEndedMeasurementJob with • CarrierEthOamJobOnDmdSingleEndLossResource If PM-4: Dual-Ended Synthetic Loss – 1 ICM *A single OamJob request is sent for each direction from SOF to ICM which includes Controller and Sink jobs. The ICM is responsible for setting up two SOAM paths from respective Controllers and Sinks.* If PM-4: Dual-Ended Synthetic Loss – 2 ICMs *An OamJob requests is sent to both ICMs for each Controller-to-Sink path. The reason is that the Controller ICM is responsible for initiation of the OamJob and the Sink ICM is responsible for knowing to initiate the OamCollection.* *If the ICM cannot perform necessary mapping from Presto request to two individual SOAM path activations, then the SOF is responsible for sending two individual OamJob requests. NOTE: There is a Source and Sink Oam Job.* OamJobType=ETH_1SLM If ProActive: OamJob = EthProActiveDualEndedMeasurementJob with • CarrierEthOamJobProActDualEndSyntLossResource If OnDemand: OamJob = EthOnDemandDualEndedMeasurementJob with • CarrierEthOamJobOnDmdDualEndSyntLossResource 2. Set State and Schedule. 3. SOF transmits: createOamJob(oamJobType:OamJobType[1],oamServiceId:Uuid[1],oamServicePointId:String[1..2],oamProfileId:Uuid[1],state:AdministrativeState[1],schedule:TimeRange)



Post-Conditions	1. ICM returns OamJob[1] is (are) enabled and SOAM frames are activated and are being transmitted.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI). Note: If a conflict with the requested OamJob exists, the ObjectAlreadyExists exception is returned.
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
Loss Measurement OamJobUpdate	
Pre-Conditions	1. EthProactiveMeasurementOamJob or EthOnDemandMeasurementOamJob state is operationalState=ACTIVE/administrativeState=UNLOCKED.

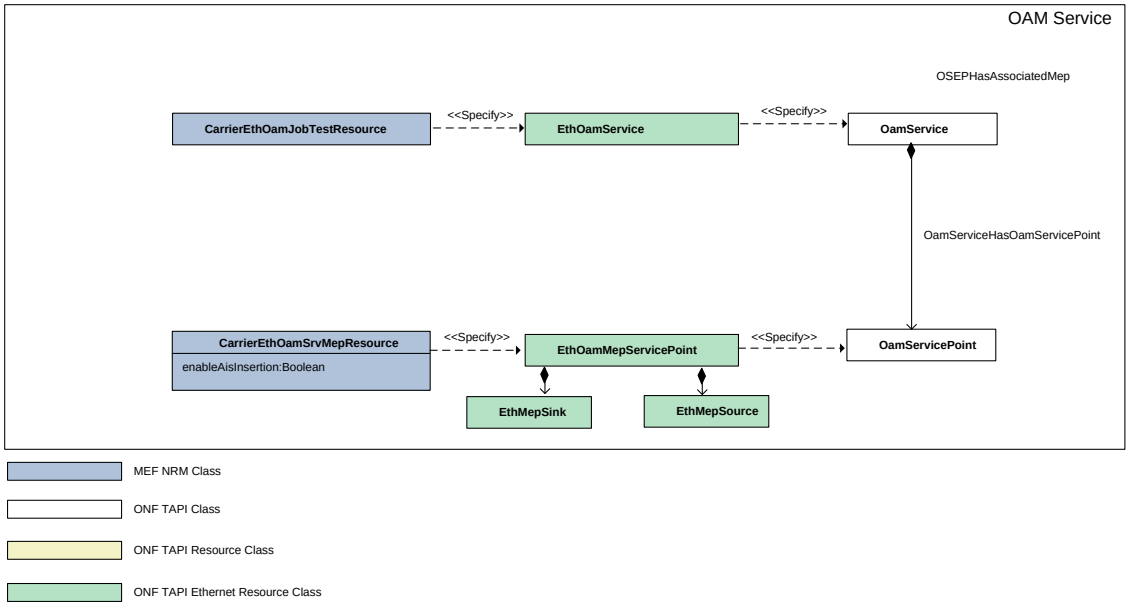
	2. SOF has determined modification needed for EthProactive-MeasurementOamJob or EthOnDemandMeasure-mentOamJob. 3. SOF has unique identifier of EthProactiveMeasure-mentOamJob or EthOnDemandMeasurementOamJob.
Process Steps	1. OamJob state: operationalState=ACTIVE/administra-tiveState=UNLOCKED. 2. SOF has determined modification needed for OamJob. 3. SOF has unique identifier of OamService. 4. SOF transmits: 5. updateOamJob(oamJobId:Uuid[1],oamProfile:OamPro-file[1],state:AdministrativeState[0..1],sched-ule:TimeRange[0..1]) with modified attribute(s).
	
Post-Conditions	1. Resources are allocated and activated to support updated EthProactiveMeasurementOamJob or EthOnDemandMeas-urementOamJob. EthProactiveMeasurementOamJob or EthOnDemandMeas-urementOamJob state: operationalState=ACTIVE/adminis-trativeState=UNLOCKED.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI). OamJob Creation Notification
Exceptions	Supported exceptions: InvalidInput InternalError

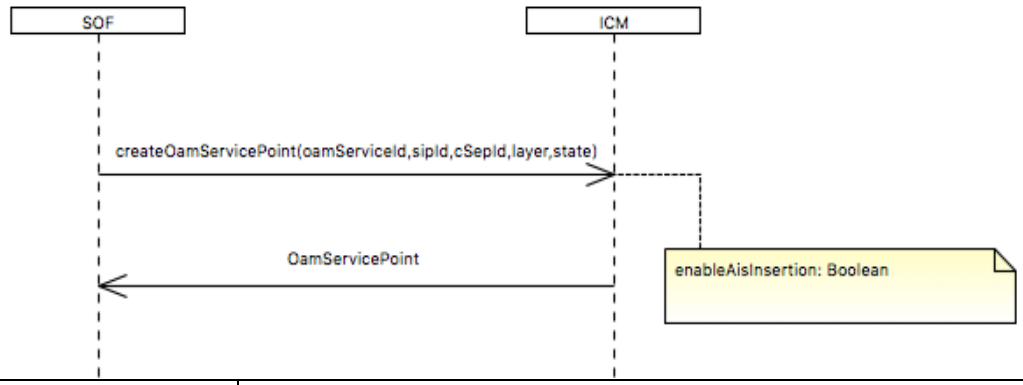
	NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
Loss Measurement OamJob Deletion	
Pre-Conditions	1. EthProactiveMeasurementOamJob or EthOnDemandMeasurementOamJob state: operationalState=ACTIVE/administrativeState=UNLOCKED. 2. SOF has unique identifier of EthProactiveMeasurementOamJob or EthOnDemandMeasurementOamJob.
Process Steps	1. SOF transmits OamJob update to Deactivate State: operationalState=INACTIVE/administrativeState=LOCKED. 2. SOF transmits deleteOamJob(jobId) requests to ICM.
	
Post-Conditions	1. Resources are deactivated and deallocated from OamJob.
Notification/Event	OamJob Deletion Notification
Exceptions	Supported exceptions:

	InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0003

9.3.2 Presto SOAM FM Proactive OAM Job Provisioning Use Cases

The set of use cases defined in this section are leveraging the concept termed FM Session and defined later in this document.

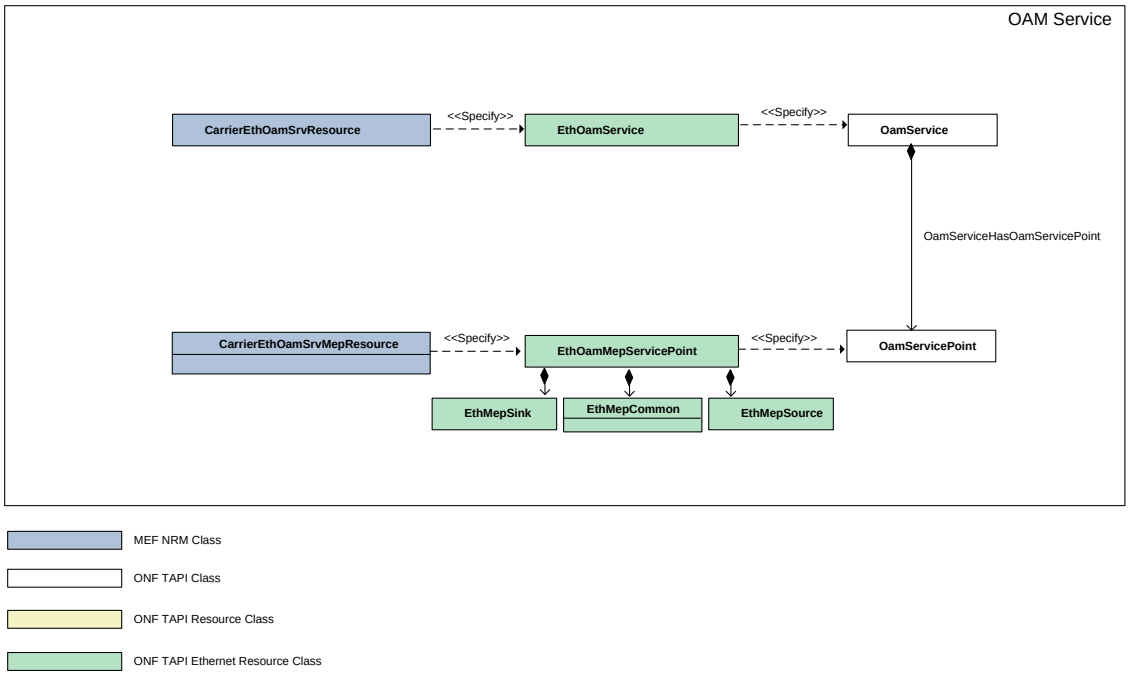
Use Case Id	**UC_PRESTO_SOAM_5**
Use Case Name	FM Proactive AIS Insertion
Description	The enabling and disabling of Fault Management AIS generation. *NOTE: Enabling AIS is an OamServicePoint provisioning action.*
	
Actor(s)	Service Orchestration Function and ICM
ProActive AIS Insertion Enabled	
Pre-Conditions	1. SOF has determined OamServicePoint and Mep configuration that will have AIS insertion enabled. 2. SOF has determined OamServicePoint serving ICM.
Process Steps	1. SOF sets CarrierEthOamSrvMepResource with enableAisInsertion “true”. 2. SOF sets EthMepSink, but intended the EthMepSink augments the OamServicePoint: a. aisPriority value b. aisPeriod 3. a. SOF transmits: createOamServicePoint(oamServiceId:Uuid[1],sipId:Uuid[1],cSepId:String[0..1],layer:LayerProtocolName LayerProtocolName[1],state:AdministrativeState[1])



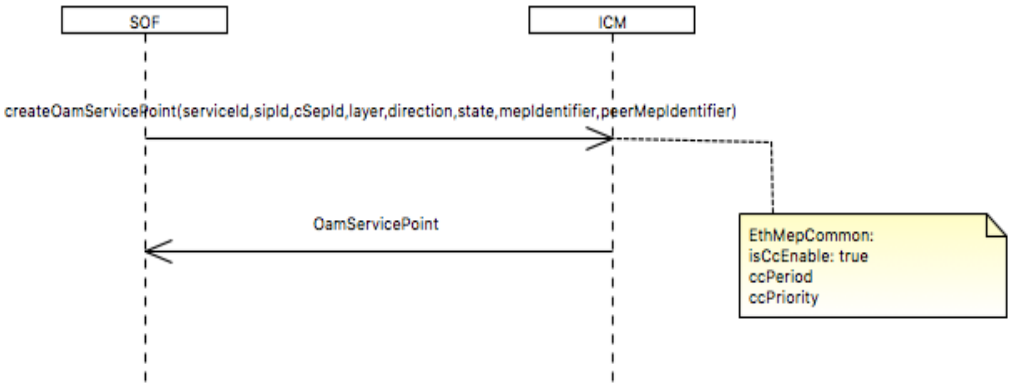
Post-Conditions	1. AIS is enabled on OamServicePoint.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI). If an AIS condition occurs and a client has subscribed to specific Notification service a Notification will occur.
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
ProActive AIS Insertion Disabled	
Pre-Conditions	1. SOF has determined OamServicePoint and Mep configuration that will have AIS disabled. 2. SOF has determined OamServicePoint serving ICM.
Process Steps	1. SOF sets CarrierEthOamSrvMepResource with enableAisInsertion “false”. 2. a. SOF transmits createOamServicePoint request. b. SOF transmits updateOamServicePoint request.
Post-Conditions	1. AIS is disabled on OamServicePoint.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput

	InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
Requirement	R_Presto_SOAM_0003

Use Case Id	**UC_PRESTO_SOAM_6**
Use Case Name	FM Proactive CCM OAM Job Provisioning
Description	The enabling and disabling of Fault Management Proactive CCM OAM Job. *NOTE: RDI is enabled when CCM is enabled.* *The Continuity Check function provides the ability to monitor connectivity between two or more MEPs within a MEG. Continuity Check Message (CCM) is sent by each MEP within the MEG to one or more other MEPs within the MEG. CCMs are transmitted at regular intervals such as 10mseconds, 100mseconds, and 1 second. If three consecutive CCMs sent to another MEP is lost, a loss of connectivity is declared.*



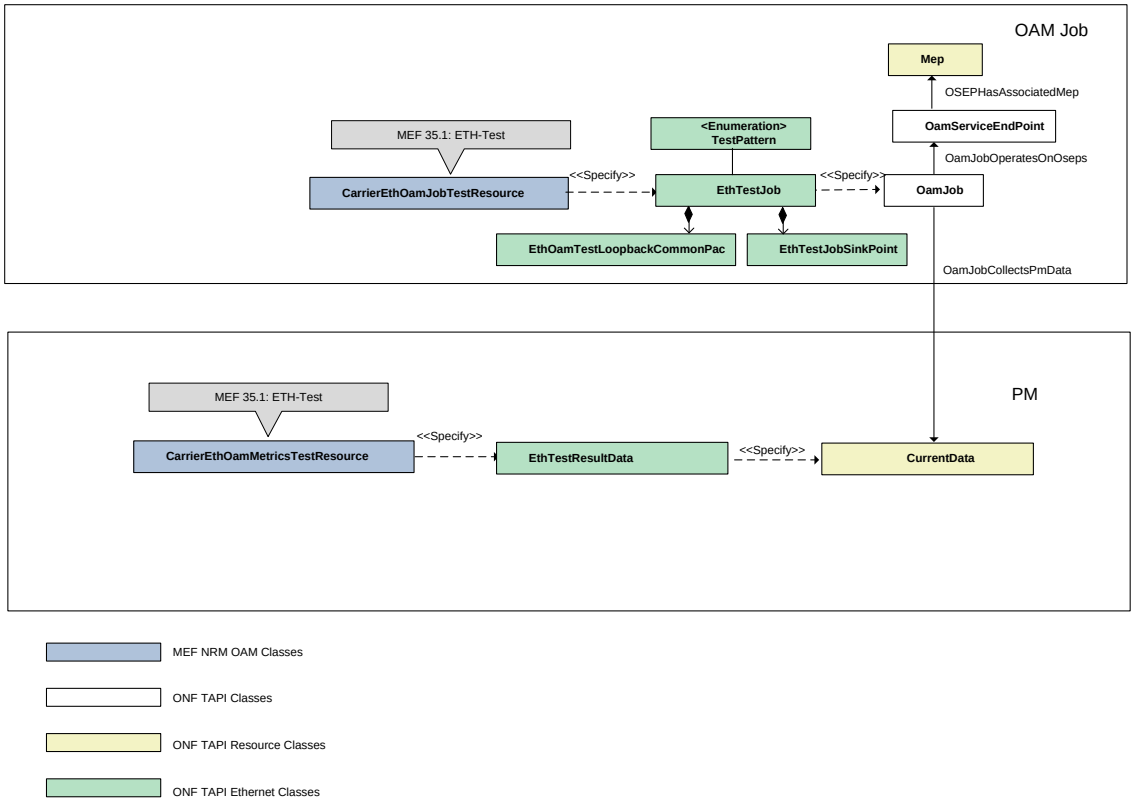
Actor(s)	Service Orchestration Function and ICM
ProActive CCM Enabled	
Pre-Conditions	1. SOF has determined OamServicePoint and Mep configuration that will have CCM and RDI enabled. 2. SOF has determined OamServicePoint serving ICM.
Process Steps	1. SOF sets EthMepCommon with isCcEnable “true”. 2. SOF sets EthMepCommon: a. ccPeriod value b. ccPriority value 3. a. SOF transmits createOamServicePoint request. If OSP already exists:

	b. SOF transmits updateOamServicePoint request.
	
Post-Conditions	1. CCM is enabled on OamServicePoint and corresponding SOAM frames are generated.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
ProActive CCM Disabled	
Pre-Conditions	1. SOF has determined OamServicePoint and Mep configuration that will have CCM and RDI enabled. 2. SOF has determined OamServicePoint serving ICM.
Process Steps	1. SOF sets EthMepCommon with isCcEnable “false”. 2. a. SOF transmits createOamServicePoint request. If OSP already exists. b. SOF transmits updateOamServicePoint request.
Post-Conditions	1. CCM is disabled and resources are removed on OamServicePoint and corresponding SOAM frames are no longer generated.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).

Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
Requirement	R_Presto_SOAM_0003

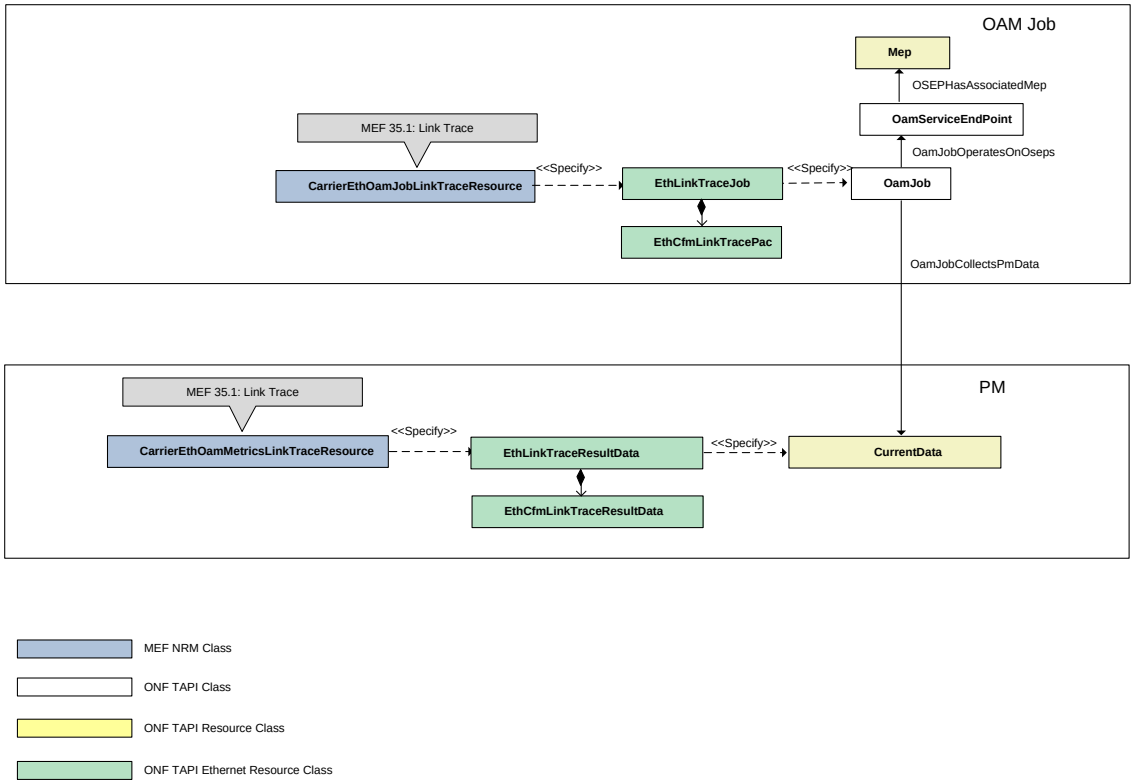
9.3.3 Presto SOAM FM On-Demand OAM Job Provisioning Use Cases

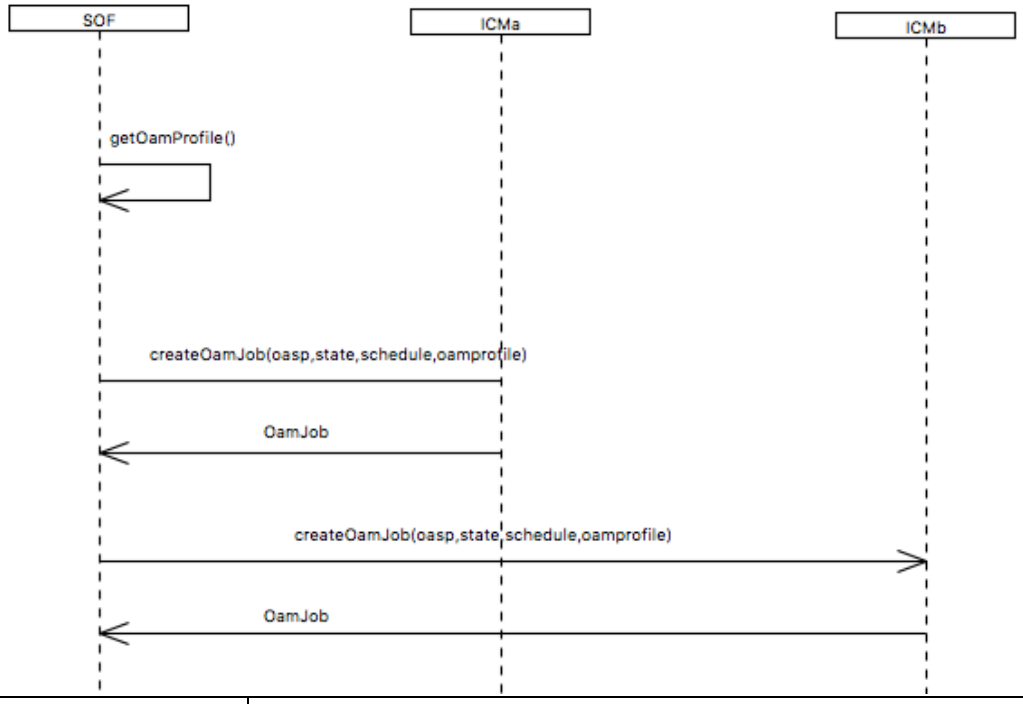
The set of use cases defined in this section are leveraging the concept termed FM Session and defined later in this document.

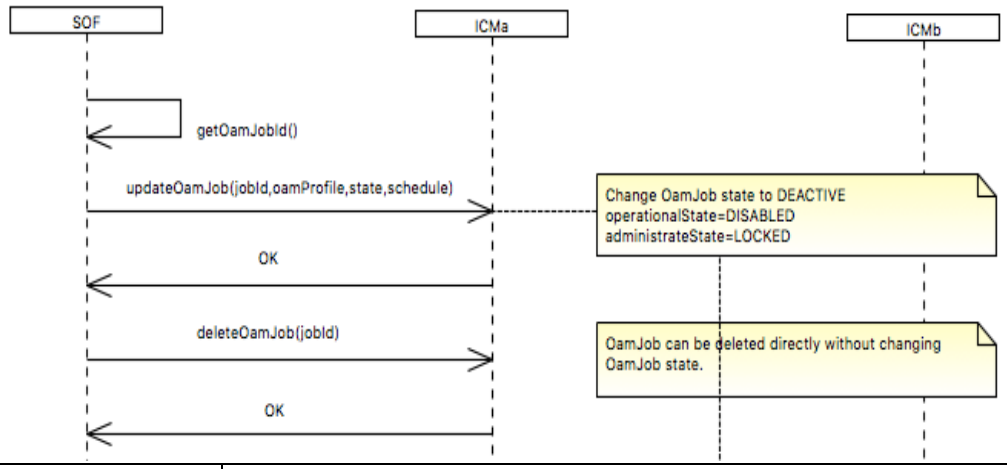
Use Case Id	**UC_PRESTO_SOAM_7**
Use Case Name	FM On-Demand ETH Test OAM Job Provisioning
Description	The creation and deletion of Fault Management On-Demand Ethernet Test OAM Job. *NOTE: It is unlikely that updating will be done when invoking an ETH Test. It would likely run to completion.* *The Test Signal (TST) function provides the ability to transmit a Test Signal PDU containing a test pattern from a source MEP to target MEP. This can be used to test for faults and frame loss counts between the MEPs in a one-way test. This can be supported in a round trip or two-way test using the data TLV contained in the LBM/LBR.*
	
Actor(s)	Service Orchestration Function and ICM
On-Demand ETH Test OAM Job Creation	
Pre-Conditions	1. SOF has created and activated OamService. 2. SOF has determined OamServicePoints.

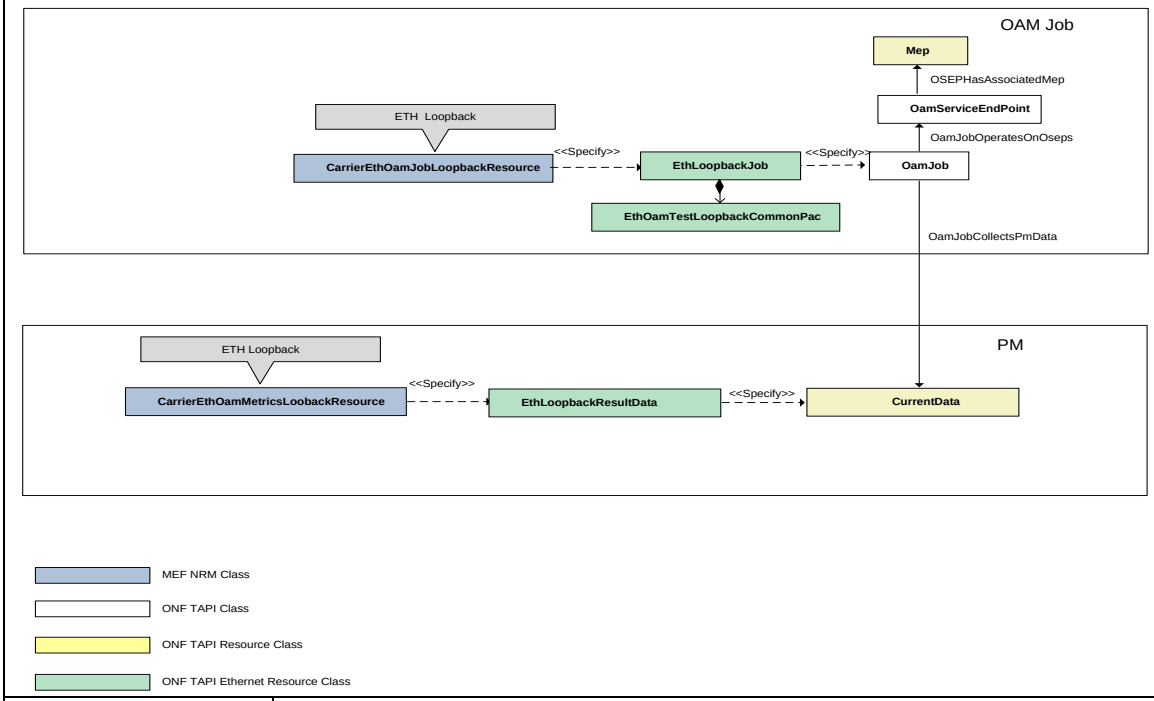
	3. SOF has determined OamServicePoint(s) serving ICM(s). 4. SOF has determined which OamServicePoint is Controller and which OamServicePoint is Sink.
Process Steps	1. Create OamJob request: OamJobType=ETH_TEST. 2. Create EthTestJob with specified TestPattern. 3. Set creationTime and schedule for OamJob. 4. SOF transmits: createOamJob(oamJobType:OamJobType[1],oam-ServiceId:Uuid[1],oamServicePointId:String[1..2],oam-ProfileId:Uuid[1],state:AdministrativeState[1],sched-ule:TimeRange) 5. Results are collected using unique OamJob ID – this is a real-time (CurrentData) use case. a. getOamJob(jobId)
Post-Conditions	1. ETH Test is enabled on OamServicePoint and corresponding Test Pattern is generated, and collection occurs.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
On-Demand ETH Test OAM Job Deletion	
Pre-Conditions	1. OamJob state: operationalState=ACTIVE/administra-tiveState=UNLOCKED. 1. SOF has unique identifier of OamJob.
Process Steps	1. SOF transmits OamJob update to Deactivate State: opera-tionalState=INACTIVE/administrativeState=LOCKED. 1. SOF transmits deleteOamJob(jobId) requests to ICM.
Post-Conditions	1. ETH Test is disabled, and corresponding Test Pattern frames are no longer generated.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).

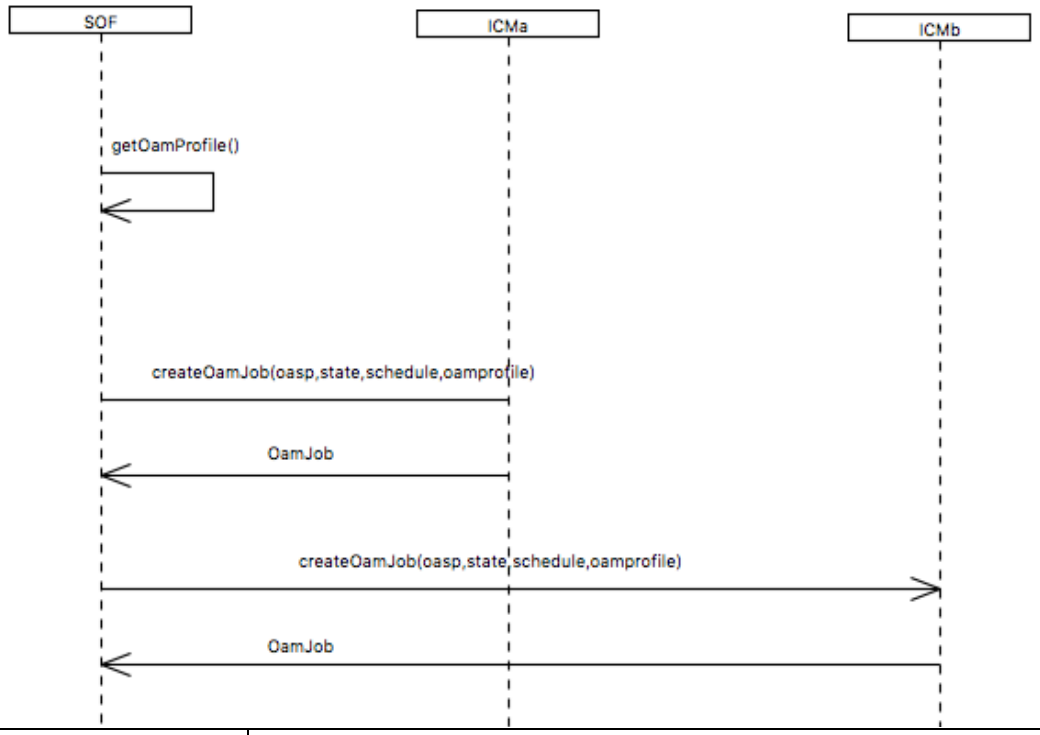
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
Requirement	R_Presto_SOAM_0003

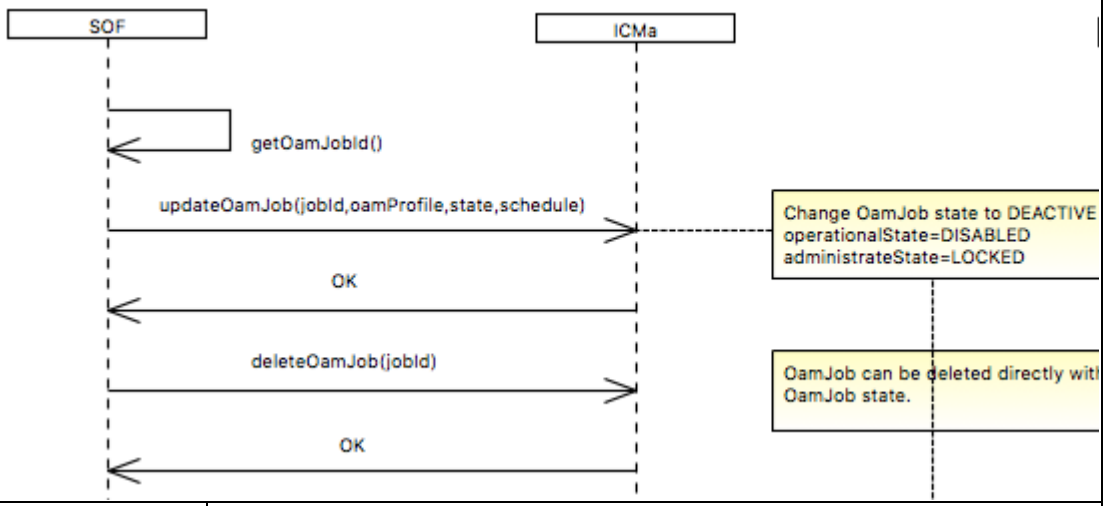
Use Case Id	**UC_PRESTO_SOAM_8**
Use Case Name	FM On-Demand Link Trace OAM Job Provisioning
Description	The creation and deletion of Fault Management On-Demand Link Trace OAM Job. *NOTE: It is unlikely that updating will be done when invoking a Link Trace. It would likely run to completion.* *The Linktrace function provides the ability to verify what MIPs and MEPs a particular MEP is connected to. The Linktrace function uses a Linktrace Message (LTM) that is transmitted by the source MEP to the target MEP(s). MIPs and MEPs that receive the LTM respond to the source MEP with a Linktrace Response (LBR). MIPs also forward the LTM to other upstream MIPs or MEPs.*
	
Actor(s)	Service Orchestration Function and ICM
On-Demand Link Trace OAM Job Creation	
Pre-Conditions	1. SOF has determined Source/Controller OamServicePoint. 2. SOF has determined Sink/Responder OamServicePoint.
Process Steps	1. Create OamJob request: OamJobType=ETH_LTC. 2. Set creationTime and schedule for OamJob.

	3. SOF transmits: createOamJob(oamJobType:OamJobType[1],oam-ServiceId:Uuid[1],oamServicePointId:String[1..2],oamPro-fileId:Uuid[1],state:AdministrativeState[1],sched-ule:TimeRange) 4. Results are collected using unique OamJob ID – this is a real-time (CurrentData) use case. getOamJob(jobId)
	
Post-Conditions	1. SOF receives confirmation that Link Trace is successful. 2. CarrierEthOamMetricsLinkTraceResource (CurrentData) is returned.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound

	ObjectAlreadyExists
On-Demand Link Trace OAM Job Deletion	
Pre-Conditions	1. OamJob state: operationalState=ACTIVE/administrativeState=UNLOCKED. 1. SOF has unique identifier of OamJob.
Process Steps	1. SOF transmits OamJob update to Deactivate State: operationalState=INACTIVE/administrativeState=LOCKED. 1. SOF transmits deleteOamJob(jobId) requests to ICM.
	
Post-Conditions	1. Link Trace is disabled and deleted.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
Requirement	R_Presto_SOAM_0003

Use Case Id	**UC_PRESTO_SOAM_9**
Use Case Name	FM On-Demand Loopback OAM Job Provisioning
Description	The creation and deletion of Fault Management On-Demand Loop-back OAM Job. *NOTE: It is unlikely that updating will be done when invoking a Loopback. It would likely run to completion.* *The Loopback function provides the ability to verify that connectivity to a target MEP within a MEG exists. The Loopback function does not require that the Continuity Check function be running between MEPs. The Loopback function uses a Loopback Message (LBM) that is transmitted by the source MEP to the target MEP(s). The target MEP(s) respond with a Loopback Response (LBR).*
	
Actor(s)	Service Orchestration Function and ICM
On-Demand Lookback OAM Job Creation	
Pre-Conditions	1. SOF has determined Source/Controller OamServicePoint. 2. SOF has determined Sink/Responder OamServicePoint serving ICM.
Process Steps	1. Create OamJob request: OamJobType=ETH_LB. 2. Set creationTime and schedule for OamJob. 3. SOF transmits:

	createOamJob(oamJobType:OamJobType[1],oamServiceId:Uuid[1],oamServicePointId:String[1..2],oamProfileId:Uuid[1],state:AdministrativeState[1],schedule:TimeRange)
	
Post-Conditions	1. SOF receives confirmation that Loopback is successful.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
On-Demand Lookback OAM Job Deletion	
Pre-Conditions	1. SOF has determined Source/Controller OamServicePoint that has Loopback enabled and active.

	3. OamJob state: operationalState=ACTIVE/administrativeState=UNLOCKED. 2. SOF has unique identifier of OamJob.
Process Steps	1. SOF transmits OamJob update to Deactivate State: operationalState=INACTIVE/administrativeState=LOCKED. 1. SOF transmits deleteOamJob(jobId) requests to ICM.
	
Post-Conditions	1. Loopback is removed.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
Requirement	R_Presto_SOAM_0003

Use Case Id	**UC_PRESTO_SOAM_10**
Use Case Name	Get OamJob (OamJobList)
Description	The retrieval of an OamJob or list of OamJobs.
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. SOF has determined OamJob unique identifier.
OamProfile Retrieve	
Process Steps	1. OamJob id (jobId) is known. 2. SOF transmits getOamJob(jobId:Uuid)
Post-Conditions	1. If OamJob exists OamJob is returned.
OamProfile List Retrieve	
Process Steps	1. SOF transmits getOamJobList()
Post-Conditions	1. Array of OamJobs are returned.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound ObjectAlreadyExists
Requirement	R_Presto_SOAM_0003

9.4 Presto SOAM Job Collection

The Presto SOAM Job collection is responsible for supporting the collection of performance management and fault management OAM job(s). There are two types of OAM Jobs with the time schedule of the job being the main difference. The first scenario is in support of a MEF EVC specified SLA with one or more ordered pairs. The OAM Job Provisioning in this scenario is called "Proactive". The second scenario is when a client requests or single job run. The OAM Job Provisioning in this scenario is called "On-Demand".

Dual-Ended PM Sessions can be configured so that one runs from MEP i to MEP j and another runs from MEP j to MEP i. The Presto SOAM use case to support Dual-Ended PM Sessions are two OAM Jobs.

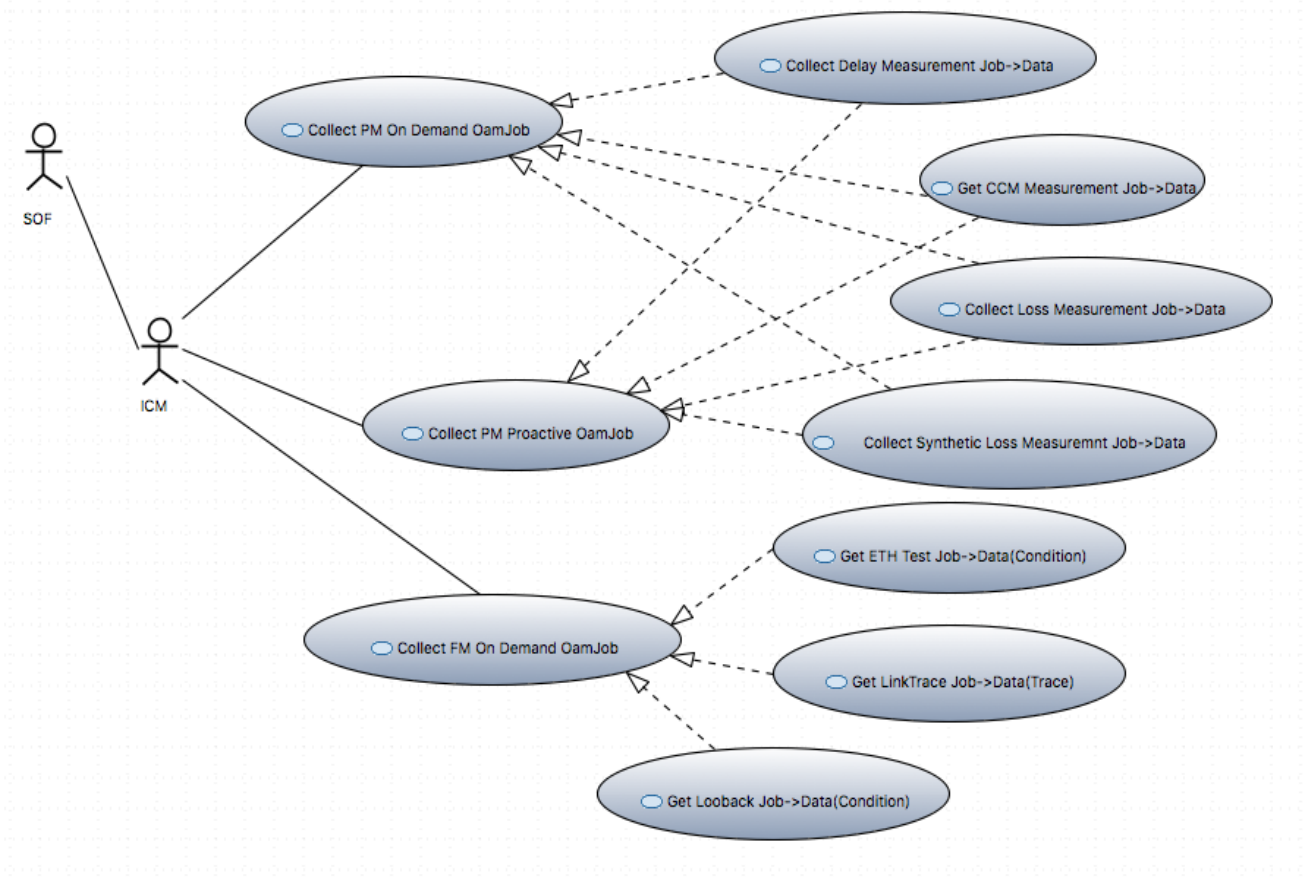
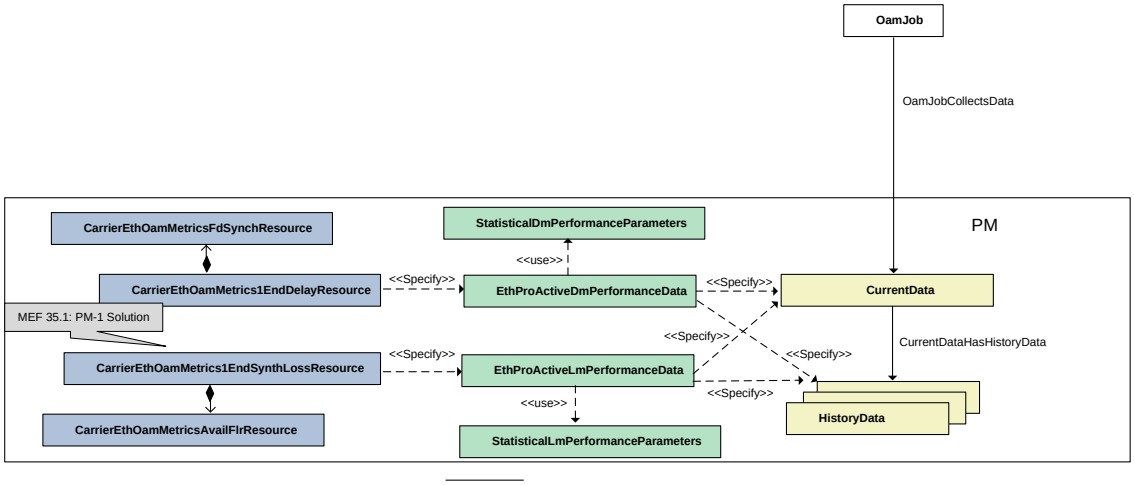
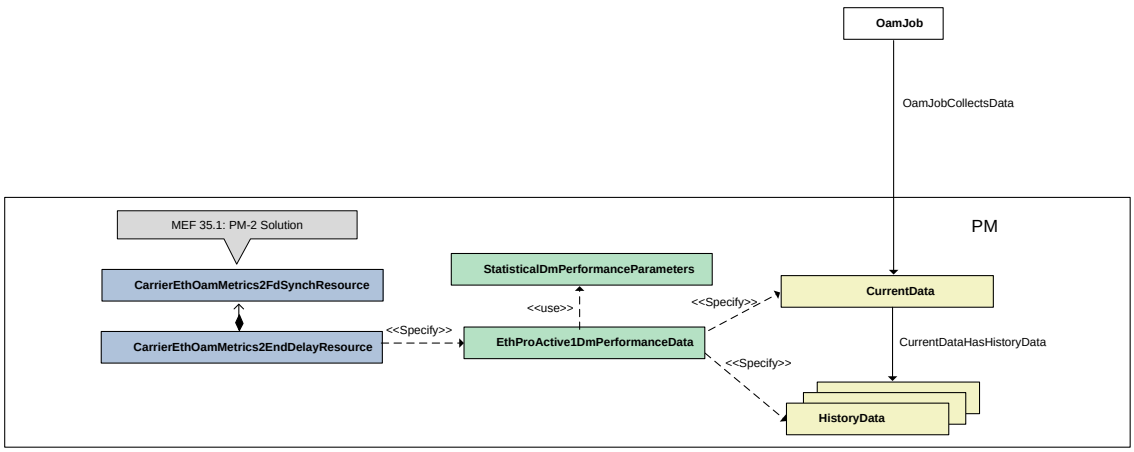
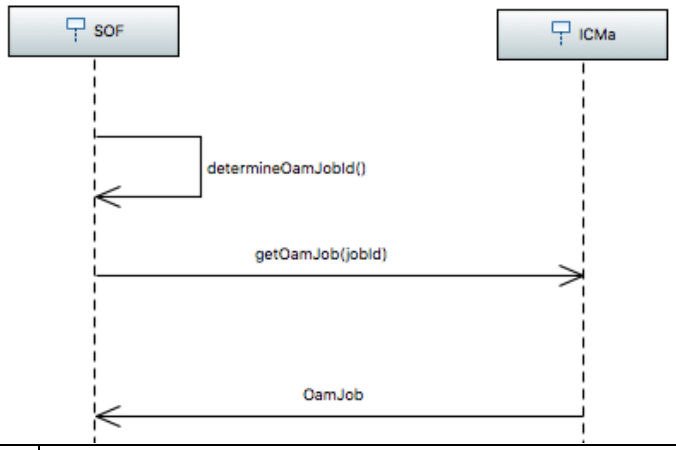


Figure 21-Presto SOAM OAM Job Collection Use Cases

9.4.1 Presto SOAM PM Proactive and On-Demand Collection Use Cases

The test cases for this area includes the collection of: delay measurement, loss measurement and synthetic loss measurement. The only difference between a Performance Management On-Demand and Proactive use case is the scheduled time.

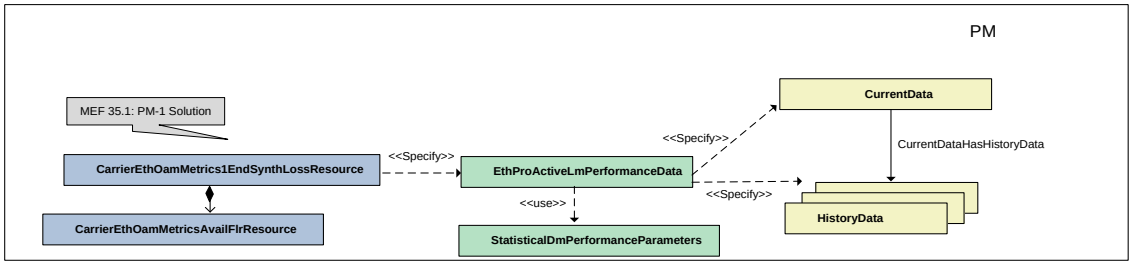
Use Case Id	**UC_PRESTO_SOAM_11**
Use Case Name	Delay Measurement OAM Job Collection
Description	The retrieval of the results of a delay measurement OAM Job.
PM-1:  PM-2:  	
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. OamJob for delay measurements has been initiated.
Process Steps	1. SOF transmits retrieval request for delay measurement getOamJob(jobId) with unique identifier.



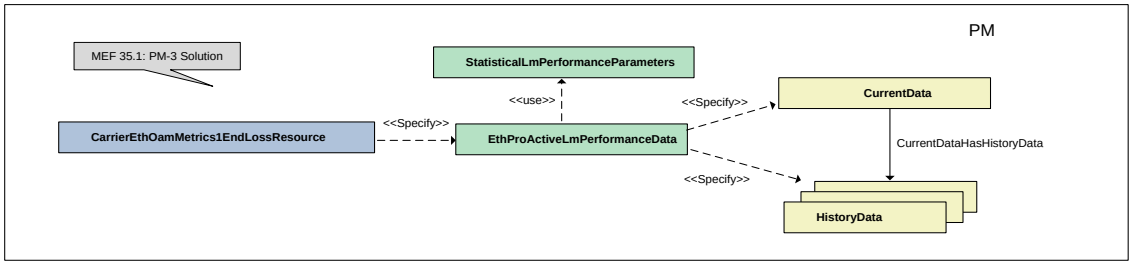
Post-Conditions	1. ICM returns delay measurement OamJob results.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0004

Use Case Id	**UC_PRESTO_SOAM_12**
Use Case Name	Synthetic and Service Loss Measurement OAM Job Collection
Description	The retrieval of the results of a loss measurement OAM Job.

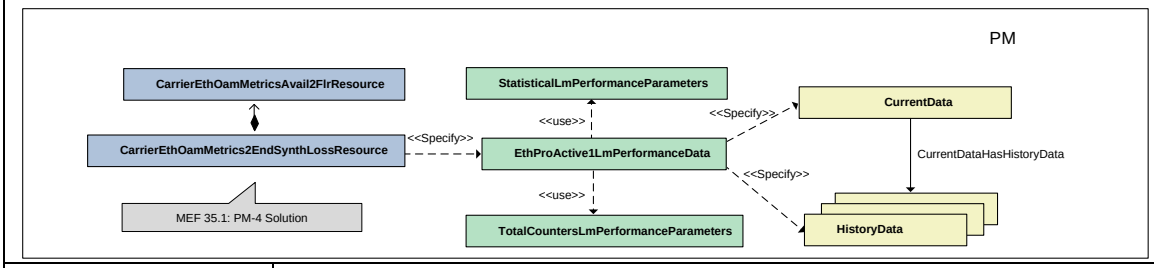
PM-1:



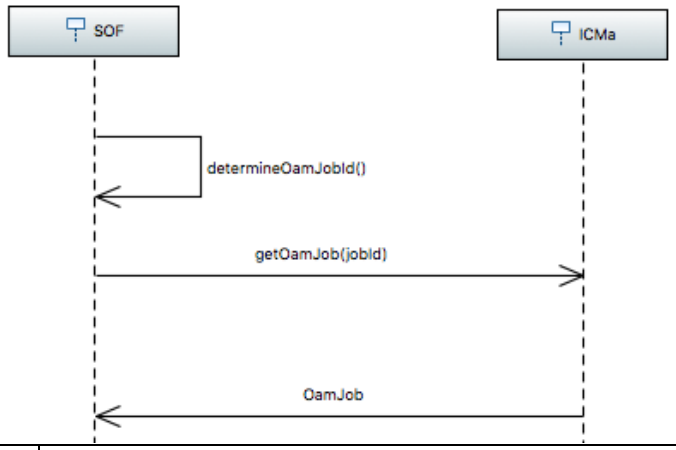
PM-3:



PM-4:

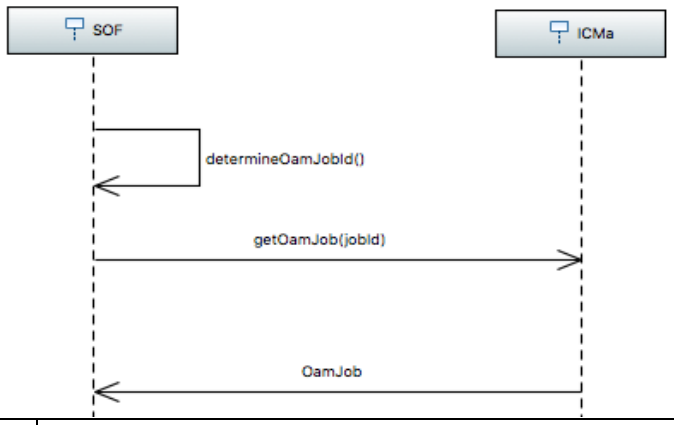


Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. OamJob for loss measurements has been initiated.
Process Steps	1. SOF transmits retrieval request for loss measurement getOamJob(jobId) with unique identifier.



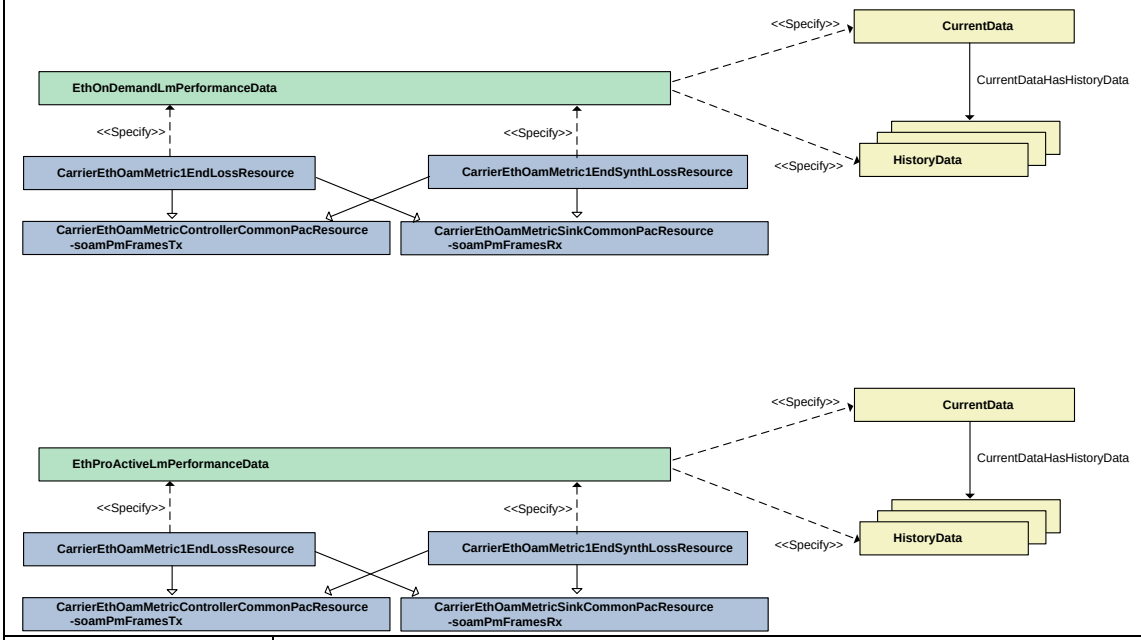
Post-Conditions	1. ICM returns loss measurement OamJob.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0004

9.4.2 Presto SOAM FM On-Demand Collection Use Cases

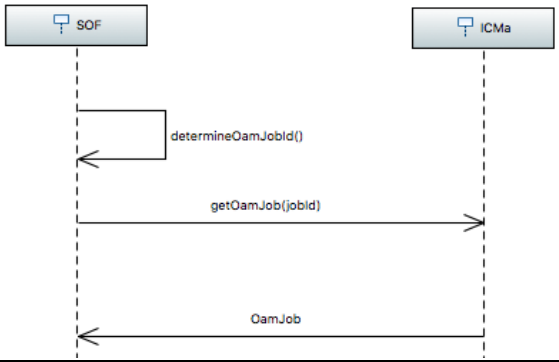
Use Case Id	**UC_PRESTO_SOAM_13**
Use Case Name	FM On-Demand ETH Test OAM Job Retrieval
Description	The retrieval of Fault Management On-Demand ETH Test OAM condition.
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. ETH Test EthOnDemandMeasurementOamJob state: operationalState=ACTIVE/administrativeState=UNLOCKED. 2. SOF has determined Source/Controller OamServicePoint serving ICM. 3. SOF has determined the ETH Test EthOnDemandMeasurementOamJob unique identifier.
Process Steps	1. SOF transmits retrieval request for ETH Test EthOnDemandMeasurementOamJob with unique identifier.
	
Post-Conditions	1. ICM returns ETH Test EthOnDemandMeasurementOamJob results.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0004

Use Case Id	**UC_PRESTO_SOAM_14**
Use Case Name	FM On-Demand AIS Setting and Condition Retrieval
Description	The retrieval of Fault Management On-Demand AIS Setting and Condition.
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. ETH Test EthOnDemandMeasurementOamJob state: operationalState=ACTIVE/administrativeState=UNLOCKED. 2. SOF has determined OamServicePoint serving ICM. 3. SOF has determined the EthOnDemandMeasurementOamJob unique identifier.
Process Steps	1. SOF transmits retrieval request for EthOnDemandMeasurementOamJob with unique identifier.
Post-Conditions	1. ICM returns EthOnDemandMeasurementOamJob results including the condition and setting.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0004

Use Case Id	**UC_PRESTO_SOAM_15**
Use Case Name	FM On-Demand/Proactive CCM/RDI Tx/Rx Counts
Description	The retrieval of Fault Management On-Demand/Proactive CCM/RDI Tx/Rx Counts

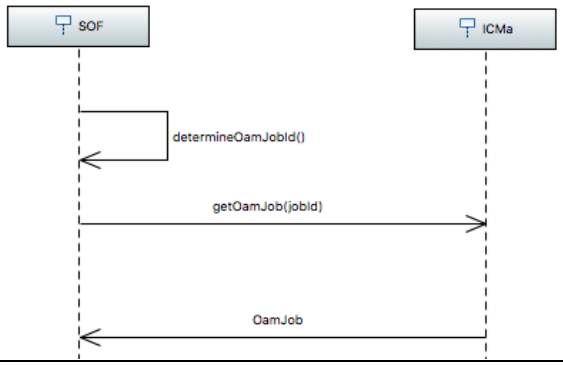


Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. OamServicePoint and Mep configuration that will have CCM and RDI enabled. 2. EthMepCommon with isCcEnable “true”.
Process Steps	1. SOF transmits retrieval request for OamJob with unique identifier: getOamJob(jobId:Uuid)



Post-Conditions	1. ICM returns OamJob results with soamPmFramesTx and soamPmFramesRx.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions:

	InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0004

Use Case Id	**UC_PRESTO_SOAM_16**
Use Case Name	FM On-Demand Link Trace OAM Job Retrieval
Description	*The retrieval of Fault Management On-Demand Link Trace OAM trace.*
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. Link Trace EthOnDemandMeasurementOamJob state: operationalState=ACTIVE/administrativeState=UNLOCKED. 2. SOF has determined Source/Controller OamServicePoint serving ICM. 3. SOF has determined the Link Trace EthOnDemandMeasurementOamJob unique identifier.
Process Steps	1. SOF transmits retrieval request for Link Trace CarrierEthOamJobLinkTraceResource with unique identifier.
	
Post-Conditions	1. ICM returns Link Trace CarrierEithOamJobLoopbackResouce results.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0004

Use Case Id	**UC_PRESTO_SOAM_17**
Use Case Name	FM On-Demand Loopback OAM Job Retrieval
Description	The retrieval of Fault Management On-Demand Loopback OAM condition.
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. Loopback EthOnDemandMeasurementOamJob state: operationalState=ACTIVE/administrativeState=UNLOCKED. 2. SOF has determined Source/Controller OamServicePoint serving ICM. 3. SOF has determined the Loopback EthOnDemandMeasurementOamJob unique identifier.
Process Steps	1. SOF transmits retrieval request for Loopback CarrierEthOamJobLoopbackResource with unique identifier.
	
Post-Conditions	1. ICM returns Loopback CarrierEthOamJobLoopbackResource results.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0004

9.5 Presto Zero Touch Activation

The following section details the test case specific to a device that is activated with a zero-touch process.

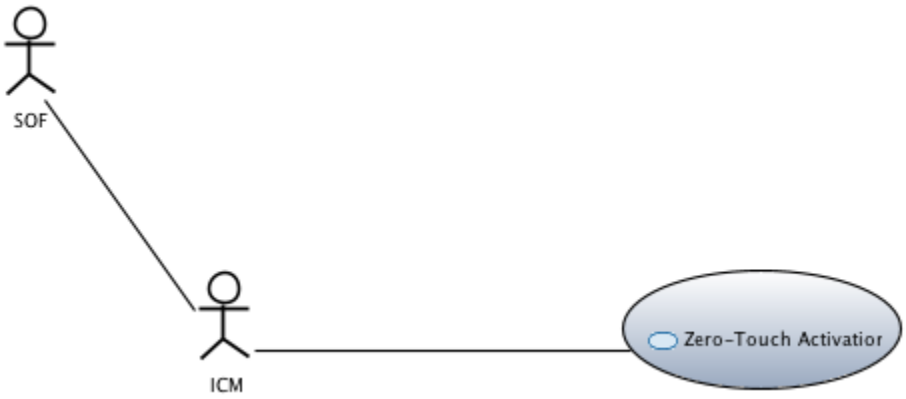
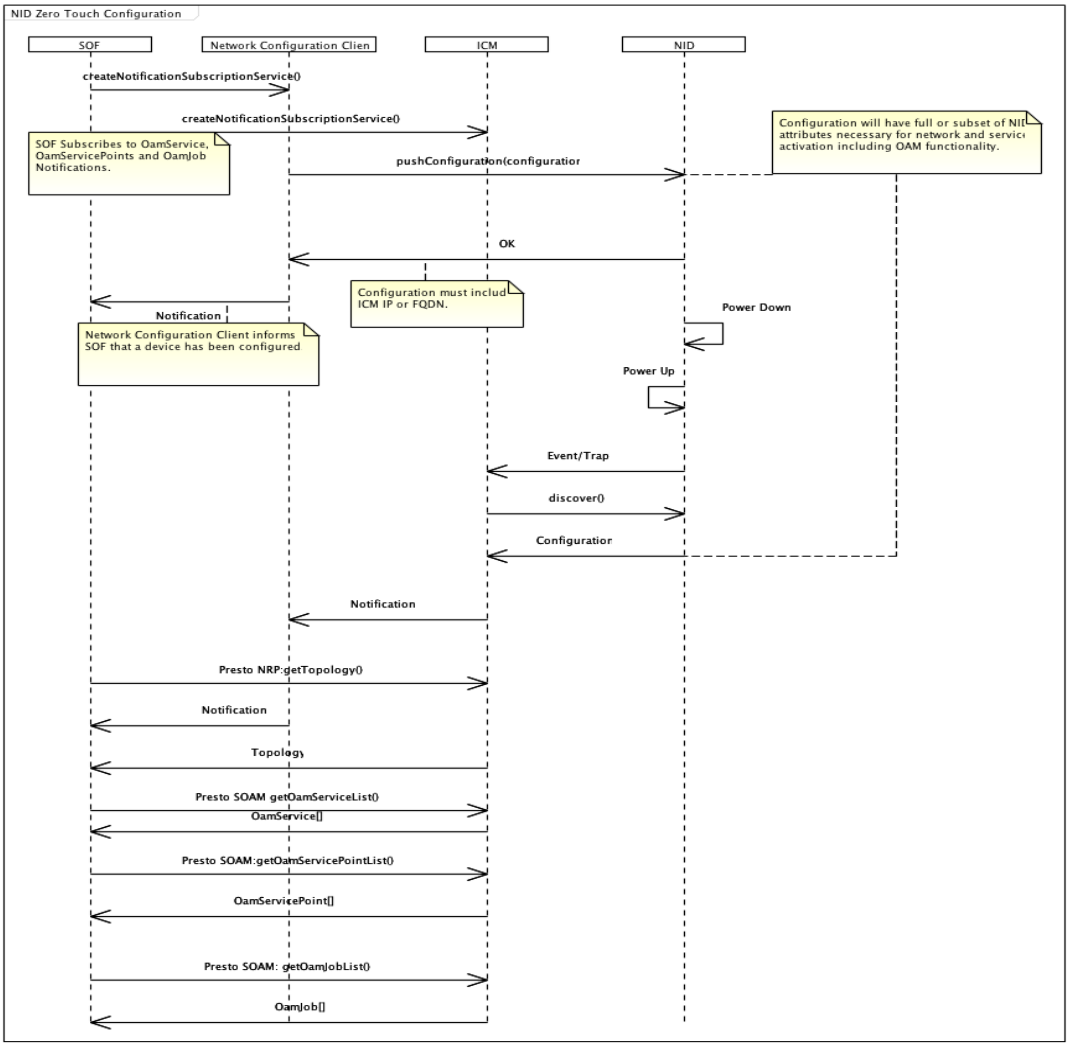


Figure 22-Presto SOAM OAM Zero-Touch Activation Use Cases

Use Case Id	**UC_PRESTO_SOAM_18**
Use Case Name	Zero-Touch Activation
Description	A PNF/VNF device is connected to a network prior to the SOF and ICM discovery and activation process. *NOTE: The information in this use case are not intended to provide the complete details on the zero-touch activation process flows.*
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. Device has been downloaded with a network and possibly service configuration including SOAM configuration.
Process Steps	1. Device is connected, and discovery process is initiated with an event being generated to ICM.



Post-Conditions	1. NID has been discovered by ICM.

	2. ICM has pulled the NID Configuration and Notified Presto SOAM Notification Subscription clients.
Notification/Event	OamService Notification(s), OamServicePoint Notification(s) OamJob Notification(s).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0005

9.6 Presto SOAM Notification Use Cases

The OAM Notifications is responsible for publication and subscriptions for various types of events including: OamService events, OamServicePoint events, OamJob events, Threshold Crossing Alerts and Faults.

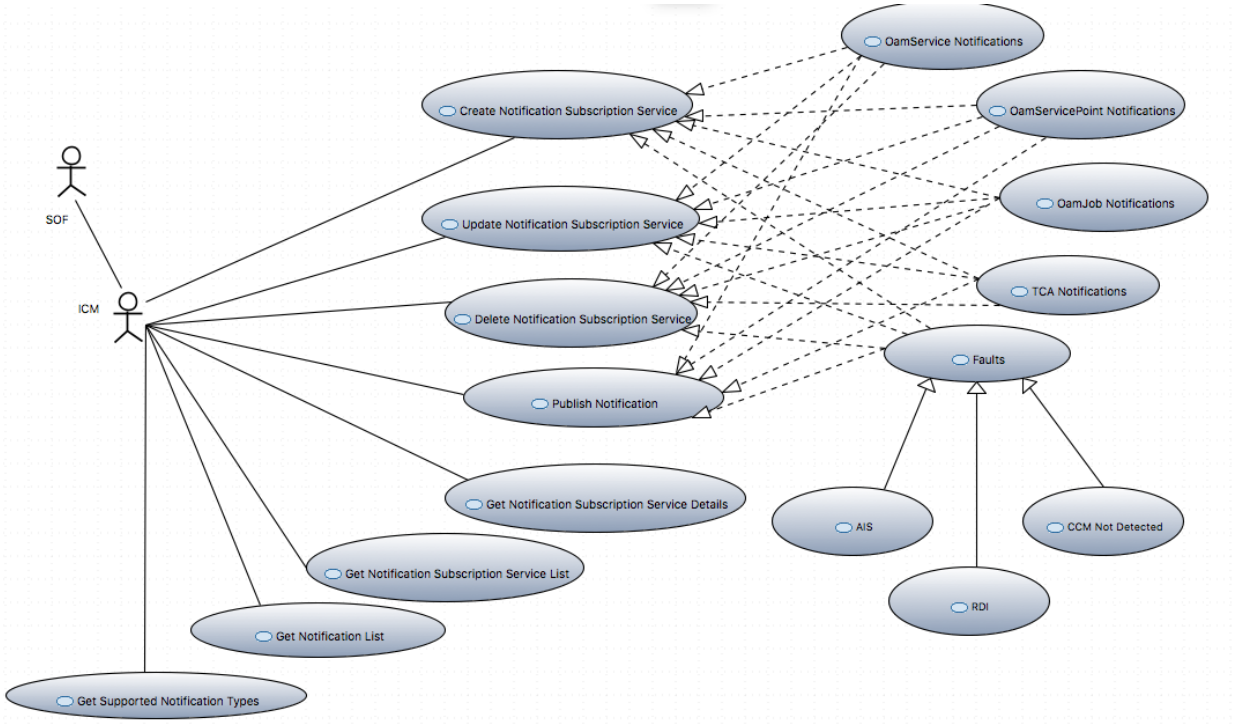


Figure 23-Presto SOAM OAM Notification Use Cases

When subscribing to Notifications for an OamJob the ability to specify if a notification is provided when the OamJob completes, when intermediate results are received, or both is provided. As an example, an OamJob for an OAM Loopback might only require a notification when the OamJob completes where an OamJob for an On-Demand measurement might require a notification when each delay measurement is completed and then a notification at when the OamJob completes.

The NotificationSubscriptionService model supports a pub/sub model where a client can subscribe to notifications – events, alarms. The server side is responsible for the generation and transmission of Notifications to subscribers.

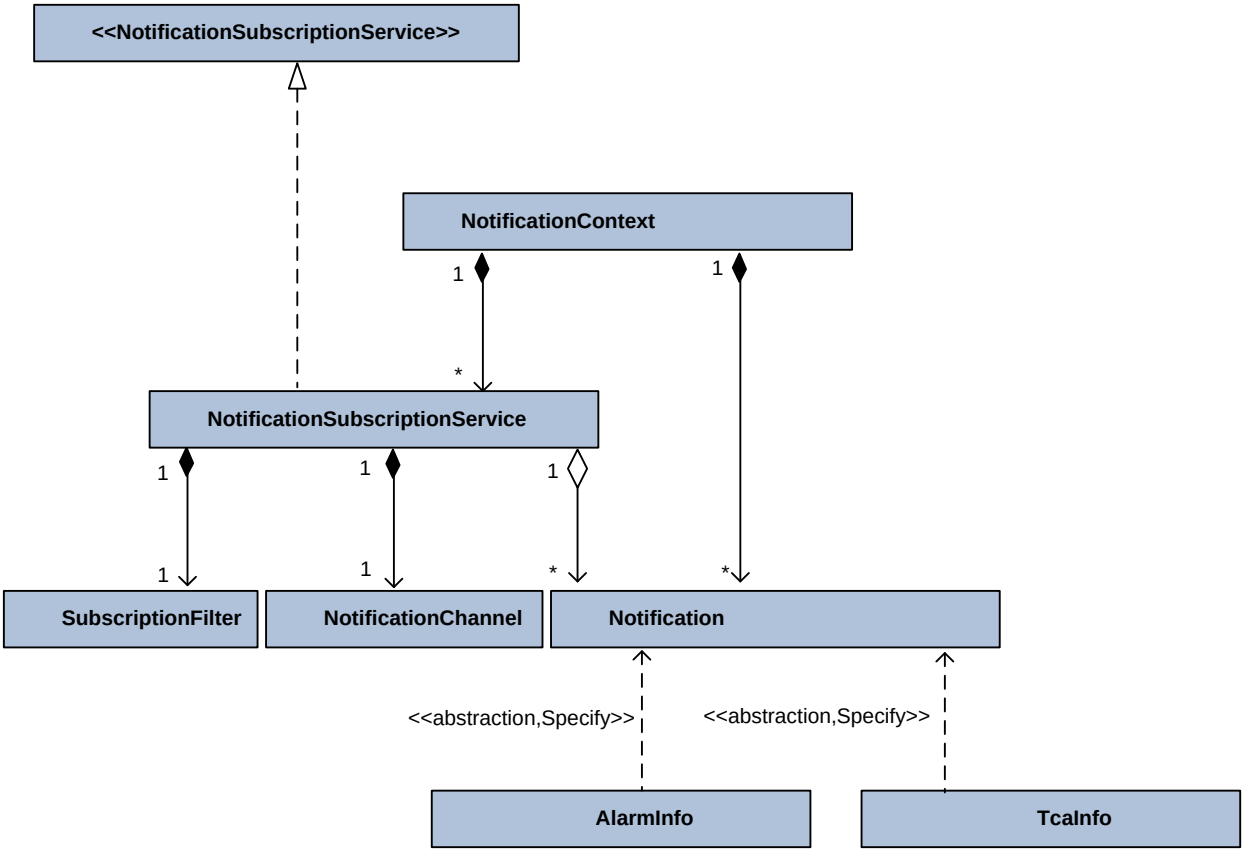
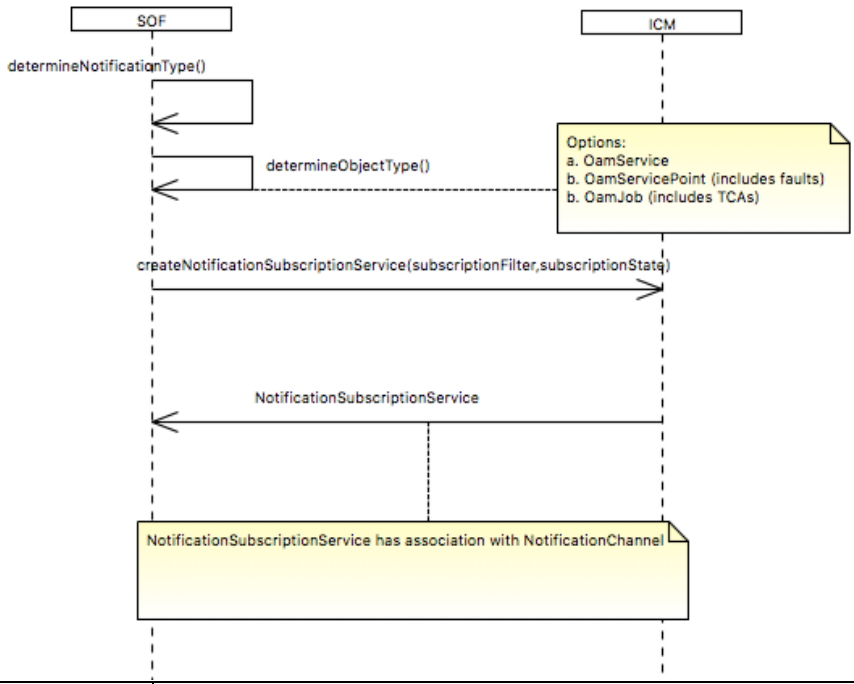


Figure 24-Presto SOAM Notification Subscription Service Model

Use Case Id	**UC_PRESTO_SOAM_19**
Use Case Name	Create Notification Subscription Service
Description	Subscribe to specific notification such as OamService events, OamServicePoint events, OamJob events, TCA events or faults. *Notifications are supported for object creation, object deletion, attribute value changes, alarm events and threshold crossing alerts for the following – OamJob (includes TCAs), OamService and OamServicePoint.*
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	None
Process Steps	1. Create SubscriptionFilter and specifically the Notification-Type(s): OBJECT_CREATION, OBJECT_DELETION, ATTRIBUTE_VALUE_CHANGE, ALARM_EVENT, THRESHOLD_CROSSING_ALERT and ObjectType(s): OAM_JOB (includes TCAs), OAM_SERVICE, OAM_SERVICE_POINT (includes faults), 2. Create a notification subscription for the set or subset of: a. createNotificationSubscriptionService(subscriptionFilter:SubscriptionFilter, subscriptionState:SubscriptionState)



Post-Conditions	1. ICM returns NotificationsSubscriptionService. 2. Client is subscribed to requested topics and has NotificationChannel to listen on for subscribed to Notifications.
Notification/Event	1. Response gives Notification Channel – where to listen for subscribed events.
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0006

Use Case Id	**UC_PRESTO_SOAM_20**
Use Case Name	Update Notification Subscription Service
Description	Modify specific notification such as OamService events, Oam-ServicePoint events, OamJob events, TCA events and faults.
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. Client is subscribed to set or subset of notifications:
Process Steps	1. Determine Subscription attribute(s) change(s). 2. Determine NotificationSubscriptionService unique identifier, subscriptionIdOrName. 3. Modify SubscriptionFilter if needed. 4. Modify SubscriptionState if needed. 5. Transmit: updateNotificationSubscriptionService(subscriptionIdOrName:String,subscriptionFilter:SubscriptionFilter,subscriptionState:SubscriptionState)
Post-Conditions	1. ICM returns NotificationSubscriptionService. 2. Client is subscribed to requested modified topics and has NotificationChannel to listen on for subscribed to Notifications.
Notification/Event	1. Response gives Notification Channel – where to listen for subscribed events.
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0006

Use Case Id	**UC_PRESTO_SOAM_21**
Use Case Name	Delete Notification Subscription Service
Description	Delete an existing Notification Subscription Service
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. Client has subscribed to one or more notification services.
Process Steps	1. Determine NotificationSubscriptionService identifier, subscriptionIdOrName. 2. Transmit: deleteNotificationSubscriptionService(subscriptionIdOrName:String)
Post-Conditions	1. Previous NotificationSubscriptionService is deleted. 2. Client is no longer connected and available to received events on NotificationChannel.
Notification/Event	1. If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0006

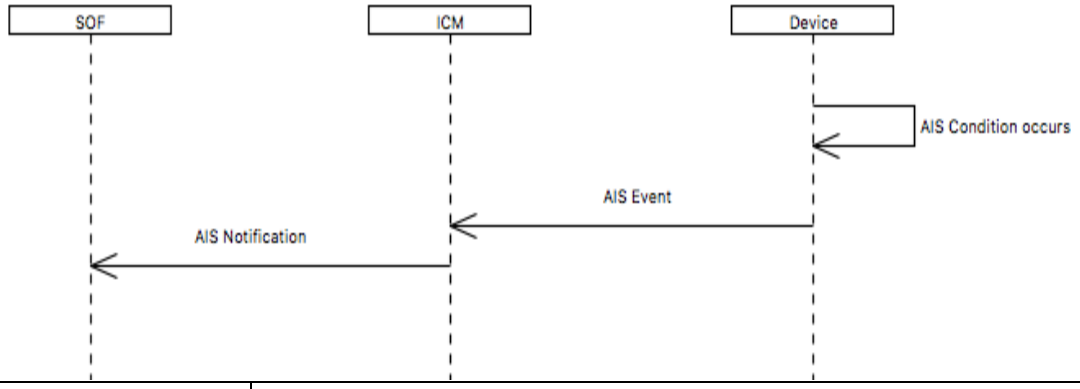
Use Case Id	**UC_PRESTO_SOAM_22**
Use Case Name	Publish Notification
Description	Server transmit notification to subscribed clients.
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. Client has subscribed to one notification services.
Process Steps	1. Client receives a Notification or either TcaInfo or Alarm-Info type.
Post-Conditions	Event is received and processed by subscriber/client,
Notification/Event	TcaInfo or AlarmInfo
Exceptions	N/A
Requirement	R_Presto_SOAM_0006

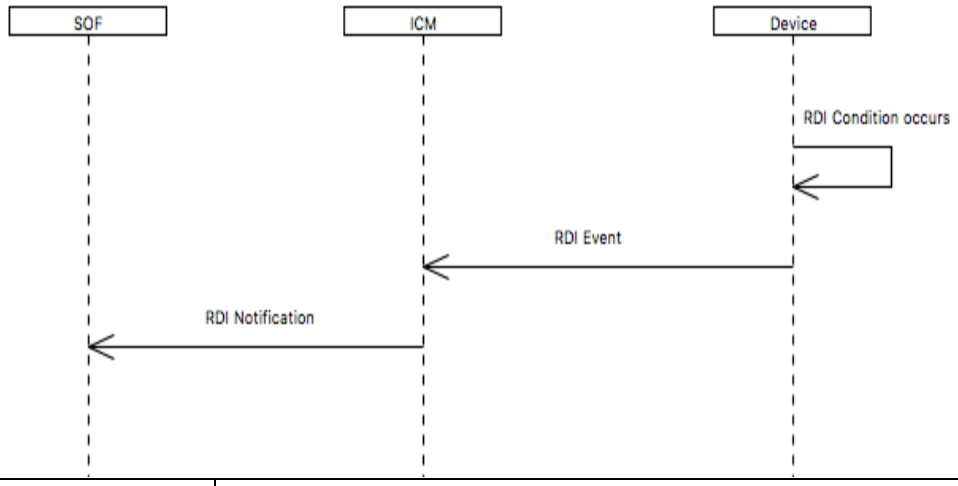
Use Case Id	**UC_PRESTO_SOAM_23**
Use Case Name	Get Notification Subscription Service Details
Description	Get NotificationSubscriptonService complete information.
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. Client has subscribed to a notification services.
Process Steps	1. SOF transmits request for a specific NotificationSubscriptionService with unique identifier, subscriptionIdOrName: getNotificationSubscriptionServiceDetails(subscriptionIdOrName:String)
Post-Conditions	1. ICM returns NotificationSubscriptionService with all attributes.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0006

Use Case Id	**UC_PRESTO_SOAM_24**
Use Case Name	Get Notification Subscription Service List
Description	Notification/Event occurs and is published to subscribers.
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. Client has subscribed to a notification services.
Process Steps	1. SOF transmits request for list of NotificationSubscription-Services. getNotificationSubscriptionServiceList()
Post-Conditions	1. Client receives an array of 0..* NotificationSubscription-Service objects.
Notification/Event	If Asynchronous API operation - Resource representation and a Location header with resource location (i.e., URI).
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0006

Use Case Id	**UC_PRESTO_SOAM_25**
Use Case Name	Get Notification List
Description	Get Notification list for a unique NotificationSubscriptionService
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. Notifications may or may not exist for a specific NotificationSubscriptionService.
Process Steps	1. Determine unique identifier for NotificationSubscriptionService, subscriptionIdOrName. 2. Determine timeRange. 3. SOF transmits request: getNotificationList(subscriptionIdOrName,timeRange:TimeRange)
Post-Conditions	1. List of 0..* of Notifications associated to Notification are returned to client in a specified time period.
Notification/Event	
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0006

Use Case Id	**UC_PRESTO_SOAM_26**
Use Case Name	Get Supported Notification Types
Description	Get list of supported Notification Types.
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	N/A
Process Steps	1. SOF transmits request for list of NotificationTypes. getSupportedNotificationTypes()
Post-Conditions	1. List of 1..* NotificationTypes are returned to client.
Notification/Event	
Exceptions	Supported exceptions: InvalidInput InternalError NotImplemented CommLoss AccessDenied UnableToComply EntityNotFound
Requirement	R_Presto_SOAM_0006

Use Case Id	**UC_PRESTO_SOAM_27**
Use Case Name	FM Proactive AIS OAM Notification
Description	The Notification of Fault Management Proactive AIS OAM condition
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. AIS condition state is Active State. 2. SOF has subscribed to FM Notification(s) – AIS.
Process Steps	1. Device/ICM detects and transmits AIS condition as a Notification.
	
Post-Conditions	N/A
Notification/Event	AIS Notification
Exceptions	N/A
Requirement	R_Presto_SOAM_0006

Use Case Id	**UC_PRESTO_SOAM_28**
Use Case Name	FM Proactive RDI OAM Job Retrieval
Description	The Notification of Fault Management Proactive RDI OAM condition
Actor(s)	Service Orchestration Function and ICM
Pre-Conditions	1. RDI condition state is Active State. 2. SOF has subscriber to FM Notification(s) – RDI.
Process Steps	1. Device/ICM detects and transmits RDI condition as a Notification.
	
Post-Conditions	N/A
Notification/Event	RDI Notification
Exceptions	N/A
Requirement	R_Presto_SOAM_0006

10 Traceability Matrices

10.1 Use Case to Requirements

Use Case Id	Use Case Name	Requirements
UC_Presto_SOAM_0001	OAM Profile Provisioning	R_Presto_SOAM_0001
UC_Presto_SOAM_0002	OAM Service Provisioning	R_Presto_SOAM_0002
UC_Presto_SOAM_0003	Delay Measurement OAM Job Provisioning	R_Presto_SOAM_0003
UC_Presto_SOAM_0004	Synthetic and Service Loss Measurement OAM Job Provisioning	R_Presto_SOAM_0003
UC_Presto_SOAM_0005	FM Proactive AIS Insertion	R_Presto_SOAM_0003
UC_Presto_SOAM_0006	FM Proactive CCM OAM Job Provisioning	R_Presto_SOAM_0003
UC_Presto_SOAM_0007	FM On-Demand ETH Test OAM Job Provisioning	R_Presto_SOAM_0003
UC_Presto_SOAM_0008	FM On-Demand Link Trace OAM Job Provisioning	R_Presto_SOAM_0003
UC_Presto_SOAM_0009	FM On-Demand Loopback OAM Job Provisioning	R_Presto_SOAM_0003
UC_Presto_SOAM_0010	Get OamJob (OamJobList)	R_Presto_SOAM_0003
UC_Presto_SOAM_0011	Delay Measurement OAM Job Collection	R_Presto_SOAM_0004
UC_Presto_SOAM_0012	Synthetic and Service Loss Measurement OAM Job Collection	R_Presto_SOAM_0004
UC_Presto_SOAM_0013	FM Proactive CCM OAM Job Retrieval	R_Presto_SOAM_0004
UC_Presto_SOAM_0014	FM On-Demand AIS Setting and Condition Retrieval	R_Presto_SOAM_0004
UC_Presto_SOAM_0015	FM On-Demand/Proactive CCM/RDI Tx/Rx Counts	R_Presto_SOAM_0004

Use Case Id	Use Case Name	Requirements
UC_Presto_SOAM_0016	FM On-Demand Link Trace OAM Job Retrieval	R_Presto_SOAM_0004
UC_Presto_SOAM_0017	FM On-Demand Loopback OAM Job Retrieval	R_Presto_SOAM_0004
UC_Presto_SOAM_0018	Zero-Touch Activation	R_Presto_SOAM_0005
UC_Presto_SOAM_0019	Create Notification Subscription Service	R_Presto_SOAM_0006
UC_Presto_SOAM_0020	Update Notification Subscription Service	R_Presto_SOAM_0006
UC_Presto_SOAM_0021	Delete Notification Subscription Service	R_Presto_SOAM_0006
UC_Presto_SOAM_0022	Publish Notification	R_Presto_SOAM_0006
UC_Presto_SOAM_0023	Get Notification Subscription Service Details	R_Presto_SOAM_0006
UC_Presto_SOAM_0024	Get Notification Subscription Service List	R_Presto_SOAM_0006
UC_Presto_SOAM_0025	Get Notification List	R_Presto_SOAM_0006
UC_Presto_SOAM_0026	Get Supported Notification Types	R_Presto_SOAM_0006
UC_Presto_SOAM_0027	FM Proactive AIS OAM Job Retrieval	R_Presto_SOAM_0006
UC_Presto_SOAM_0028	FM Proactive RDI OAM Job Retrieval	R_Presto_SOAM_0006

11 Operations and Exceptions

11.1 SOAM Provisioning Operations

The following section details the set of operations provided by the ONF TAPI OAM model and leveraged by MEF SOAM model.

11.1.1 OamProfile Operations

- createOamProfile(pmThresholdData:PmThresholdData[1..*]) returns OamProfile[1]
- updateOamProfile(oamProfileId:Uuid, pmThresholdData:PmThresholdData[1..*]) returns OamProfile[1]
- deleteOamProfile(oamProfileId:Uuid)
- getOamProfile(oamProfileId:Uuid) returns OamProfile[1]
- getOamProfileList() returns OamProfile[0..*]

11.1.2 OamService Operations

- createOamService(oamServicePoint:OamServicePoint[2..*],layerProtocolName:LayerProtocolName[1],state:AdministrativeState[1]) returns OamService
- updateOamService(oamServiceId:Uuid,oamServicePoint:OamServicePoint[*],state:AdminstrativeState[0..1]) returns OamService[1]
- deleteOamService(oamServiceId:Uuid[1])
- getOamService(oamServiceId:Uuid) returns OamService[1]
- getOamServiceList() returns OamService[*]

11.1.3 OamJob Operations

- createOamJob(oamJobType:OamJobType[1],oamServiceId:Uuid[1],oamServicePointId:String[1..2],oamProfileId:Uuid[1],state:AdministrativeState[1],schedule:TimeRange) returns OamJob[1]
- updateOamJob(oamJobId:Uuid[1],oamProfile:OamProfile[1],state:AdministrativeState[0..1],schedule:TimeRange[0..1]) returns OamJob[1]
- deleteOamJob(jobId:Uuid[1])
- getOamJob(jobId:Uuid[1]) returns OamJob[1]

- getOamJobList() returns OamJob[*]

11.1.4 OamServicePoint Operations

- createOamServicePoint(oam-ServiceId:Uuid[1],sipId:Uuid[1],cSepId:String[0..1],layer:LayerProtocolName LayerProtocolName[1],state:AdministrativeState[1]) returns OamServicePoint[1]

- getOamServicePoint(oamServiceId:Uuid[1],oamServicePointId:String[1]) returns OamServicePoint[1]

- updateOamServicePoint(oamServiceId:Uuid[1],oamServicePointId:String[1],state:AdministrativeState[0..1]) returns OamServicePoint[1]

- deleteOamServicePoint(oamServiceId:Uuid[1],oamServicePointId:String[1])

11.1.5 Meg Operations

- getMeg(oamServiceId:Uuid) returns Meg

11.2 SOAM Notification Operations

The following section details the set of operations provided by the ONF TAPI Notification model and leveraged by MEF SOAM model. The Notification Interface supports the following operations:

- getSupportedNotificationTypes() returns NotificationType[1..*], ObjectType[1..*]

- createNotificationSubscriptionService(subscriptionFilter:SubscriptionFilter,subscriptionState:SubscriptionState) returns NotificationSubscriptionService

- updateNotificationSubscriptionService(subscriptionIdOrName:String,subscriptionFilter:SubscriptionFilter,subscriptionState:SubscriptionState) returns NotificationSubscriptionService

- deleteNotificationSubscriptionService(subscriptionIdOrName:String)

- getNotificationSubscriptionServiceDetails(subscriptionIdOrName:String) returns NotificationSubscriptionService

- getNotificationSubscriptionServiceList() returns NotificationSubscriptionService [0..*]

- getNotificationList(subscriptionIdOrName:String,timeRange:TimeRange) returns Notification[0..*]

11.3 Exception Explanations

There are several possible exceptions that can be returned by the ICM to the SOF. Many of these apply to multiple use cases. A brief explanation of each of these is included below.

InvalidInput – information contained in the request from the SOF to the ICM was not valid. This can be caused by incorrect attribute settings or incorrect order of attributes.

InternalError – an error occurred within the ICM and the ICM was unable to complete the requested action.

NotImplemented – the requested feature or function has not be implemented in the ICM

CommLoss – a loss of communication between the ICM and SOF or the ICM and ECM occurred.

AccessDenied – the ICM rejected the request because the SOF does not have the permission to perform the requested action.

UnableToComply- the ICM was unable to complete the request. This could be due to the feature not being supported at the location in the request.

ObjectAlreadyExists – the requested object already exists.

NotInValidState- the object is not in a valid state to complete the request. As an example, a MEP with an AdminState = UNLOCKED cannot be deleted. The AdminState is first changed to LOCKED using a deactivate request.

12 State Diagrams

This section defines the set of Presto SOAM state machines. State machines are defined for OamService, OamServicePoint and OamJob. Each state machine defines the states and transitions a SOAM resource may be in (or follow) for behavioral operations of SOAM configuration and activation. Each of the defined state machines leverages the same states and therefore are depicted in a single diagram below.

12.1 OamService/OamServicePoint/OamJob State Machine Diagram

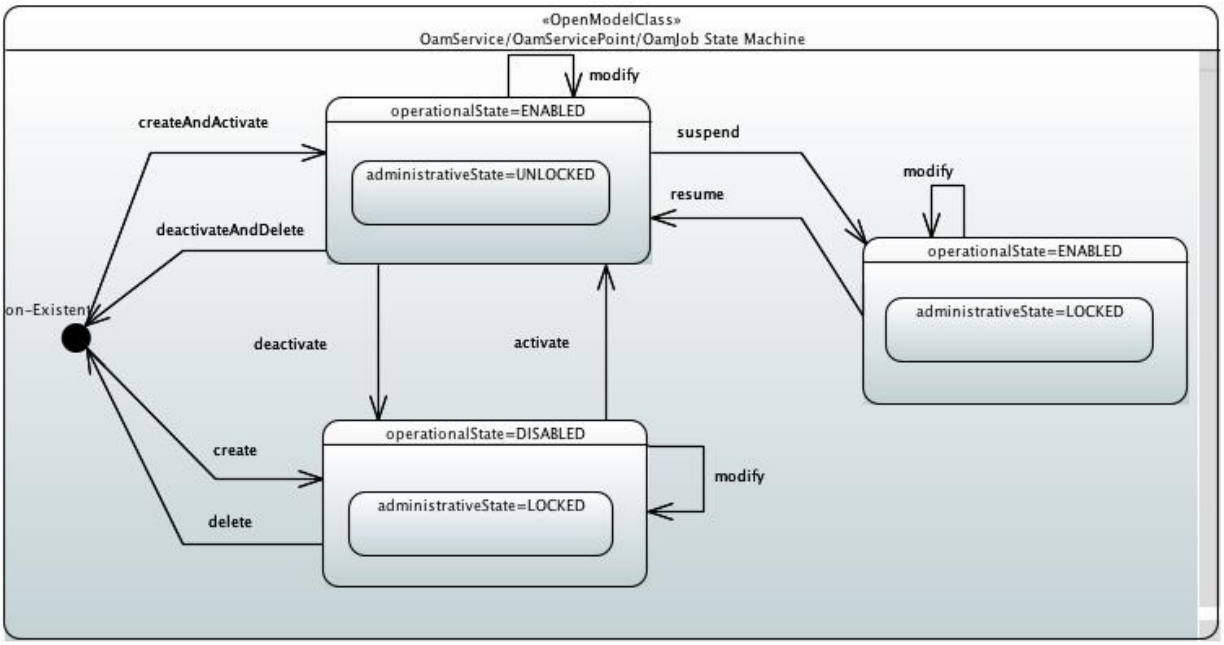


Figure 25-Presto SOAM OamService/OamServicePoint/OamJob State Machine

The common state machine implements three states, each defined with two state variables. The two state variables are operational and administrative state. The three states are active, de-active, and suspended. The active state is when the operationalState equals "ENABLED" and adminstrativeState equals "UNLOCKED". The suspended state is when the operationalState equals "ENABLED" and operationalState equals "LOCKED". The deactive state is when the operationalState equals "DISABLED" and administrativeState equals "LOCKED". The suspended state is used to provide a differentiation from de-active state for operational purposes. While the functional behavior at lower layers (i.e., on a physical device) may not differentiate "deactivated" from "suspended" states it is intended for the ICM to differentiate.

12.2 SOAM State Machines Interaction

The set of SOAM state machines have interactions that are generated from a specific action. The diagram below illustrates the interactions between the OamService, OamServicePoint and OamJob state machines.

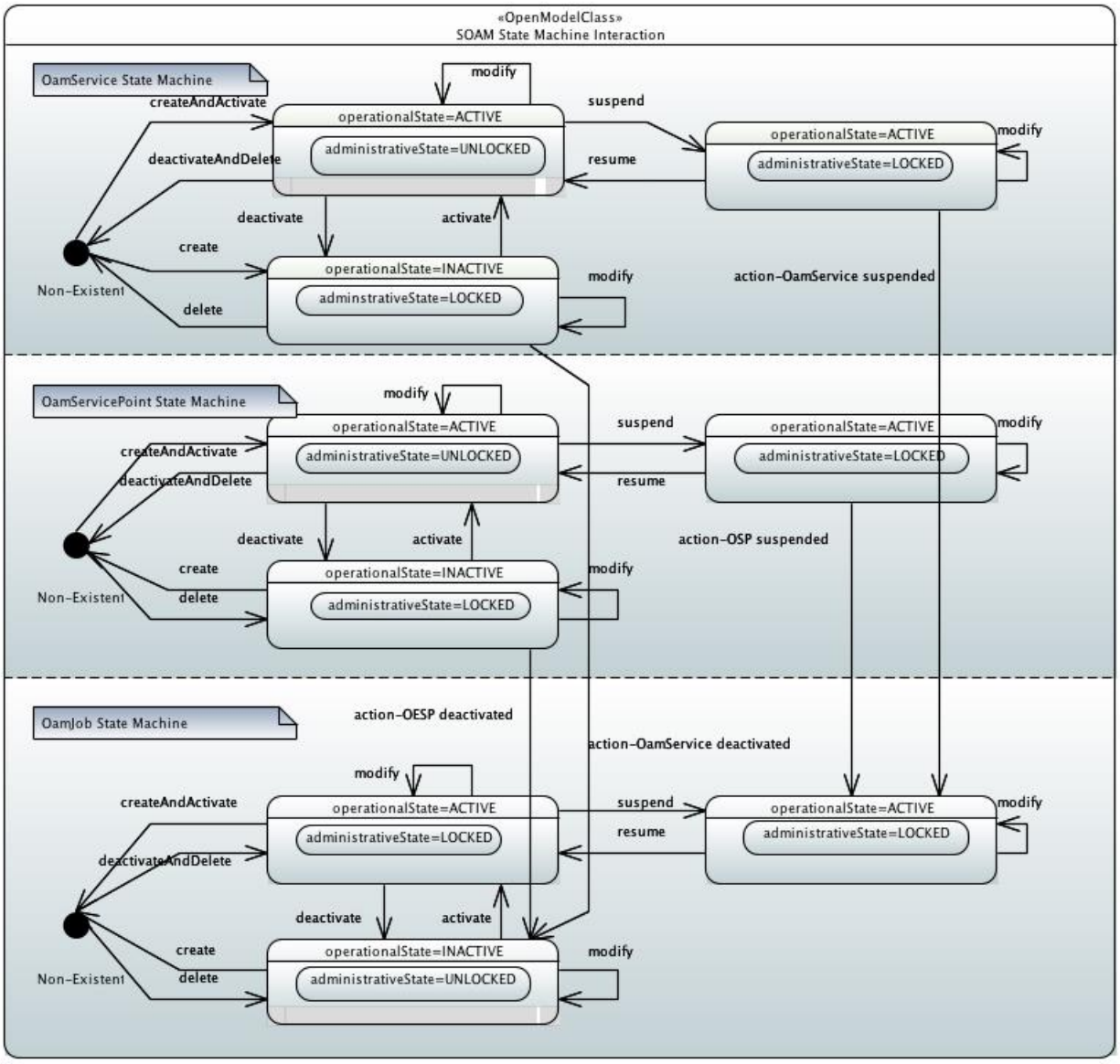


Figure 26-Presto SOAM State Machine Interaction

13 References

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Appendix A Service OAM Overview

Service Operation Administration and Maintenance (SOAM) provides a set of functions that allow providers and customers to manage Ethernet services and networks. SOAM is defined in IEEE 802.1Q [2], ITU-T Recommendation G.8013/Y.1731 [7], MEF 30.1 [14] and MEF 35.1 [15]. These documents lay out functions that cover Fault Management (FM) and Performance Management (PM). This section provides an overview of the functionality and capabilities defined in these documents.

A.1 SOAM Relationships

There are several relationships that are defined in the documents. These relationships include the Maintenance Entity (ME), the Maintenance Entity Group (MEG), the Maintenance Entity End Point (MEP), and the Maintenance Entity Intermediate Point. These are described below.

A.1.1 Maintenance Entity

A ME is a point-to-point relationship between two MEPs. This term is used by both IEEE and ITU-T.

A.1.2 Maintenance Entity Group

A MEG is a set of MEs that exist in the same administrative boundary, with the same MEG Level and MEG ID. A MEG contains two or more MEPs. The MEG ID is required to be unique within a CEN, Operator's network, where an Operator and customer connect, or where two Operators interconnect. When a MEG has MEPs in more than one network, then all involved parties must agree to the naming format. The MED ID is not the same as the MEG uuID.

A.1.3 MEG Level

In case MEGs are nested, the OAM flow of each MEG has to be clearly identifiable and separable from the OAM flows of the other MEGs. In cases where the OAM flows are not distinguishable by the ETH layer encapsulation itself, the MEG level in the OAM frame distinguishes between the OAM flows of nested MEGs.

Eight MEG levels are available to accommodate different network deployment scenarios.

When customer, provider, and operator data path flows are not distinguishable based on means of the ETH layer encapsulations, the eight MEG levels can be shared amongst them to distinguish between OAM frames belonging to nested MEGs of customers, providers and operators.
The default MEG level assignment amongst customer, provider, and operator roles is:
The customer role is assigned three MEG levels: 7, 6, and 5
The provider role is assigned two MEG levels: 4 and 3
The operator role is assigned three MEG levels: 2, 1, and 0

A.1.4 MEP

A MEP is an actively managed SOAM entity associated with a specific service instance that can generate and receive SOAM PDUs and track any responses. It is an end point of a single MEG and

is an end point of a separate Maintenance Entity for each of the other MEPs in the same MEG that it is intended to communicate with.

A.1.5 MIP

A MIP is an intermediate point in a MEG that is capable of reacting to some SOAM PDUs but does not initiate SOAM PDUs.

A.1.6 SOAM PDUs

SOAM PDUs are defined for several purposes from determining connectivity to measuring frame loss. These PDUs are defined in IEEE 802.1Q and ITU-T Recommendation G.8013/Y.1731. Further details on the PDUs are contained in the sections below.

A.2 Fault Management

FM provides capabilities that allow for the fault detection and isolation within a MEG. They include Continuity Check, Loopback, Linktrace, Remote Defect Indication, Alarm Indication Signal, Locked Signal, Test Signal and Client Signal Fail. Each of these is described below and in MEF 30.1, Service OAM Fault Management Implementation Agreement: Phase 2.

A.2.1 Continuity Check

The Continuity Check function provides the ability to monitor connectivity between two or more MEPs within a MEG. Continuity Check Message (CCM) is sent by each MEP using a multicast address so other MEPs within the MEG will be able to receive. CCMs are transmitted at regular intervals such as 10 ms, 100 ms, and 1 second. If three consecutive CCMs sent to another MEP is lost, a loss of connectivity is declared.

CCM PDUs also contain additional features that allow functions like TLVs that indicate the Port and Interface status, and the Remote Defect Indication (RDI).

A.2.2 Loopback

The Loopback function provides the ability to verify that connectivity to a target MEP/MIP within a MEG exists. The Loopback function does not require that the Continuity Check function be running between MEPs/MIPs. The Loopback function uses a Loopback Message (LBM) that is transmitted by the source MEP/MIP to the target MEP(s)/MIP(s). The target MEP(s)/MIP(s) respond with a Looback Response (LBR).

A.2.3 Linktrace

The Linktrace function provides the ability to verify what MIPs and MEPs a particular MEP is connected to. The Linktrace function uses a Linktrace Message (LTM) that is transmitted by the source MEP to the target MEP(s). MIPs and MEPs that receive the LTM respond to the source MEP with a Linktrace Response (LBR). MIPs also forward the LTM to other upstream MIPs or MEPs.

A network element containing MIP or MEP responds with a frame with ETH-LT reply information upon receiving a valid frame with ETH-LT request information only if:

• the network element where the MIP or MEP resides is aware of the TargetMAC address in the ETH-LT request information and associates it to a single egress port, where the egress port is not the same as the port on which the frame with ETH-LT request information was received; or

• the TargetMAC address is the same as the MIP's or MEP's own MAC address.

A.2.4 Alarm Indication Signal

The Alarm Indication Signal (AIS) function provides the ability to generate to a remote MEP or to higher level client MEPs that a fault has occurred. The AIS PDU is injected by a MEP that has detected the fault.

A.2.5 Client Signal Fail

The Client Signal Fail (CSF) function provides the ability to transmit an indication that a fault has occurred at a lower level to a higher level. CSF is used rather than AIS in cases where the client does not support a means to indicate that a fault has occurred.

A.3 FM Session

FM Session is a term used within this document to describe specific functions used between two or more MEPs within a MEG. A FM Session can use the continuity check, loopback, linktrace, or Test Signal functions. When the continuity check function is used, additional functions (RDI, AIS, LCK and CSF) become available.

When a FM Session is created the FM, function is specified along with any applicable attributes for that function. As an example, if a FM Session containing a CCM function is created the create message contains the MEG ID, MEP IDs, CCM Interval. The FM Session has an ID that is used to identify it between the SOF and ICM. Examples of FM Sessions are shown in the figures below.

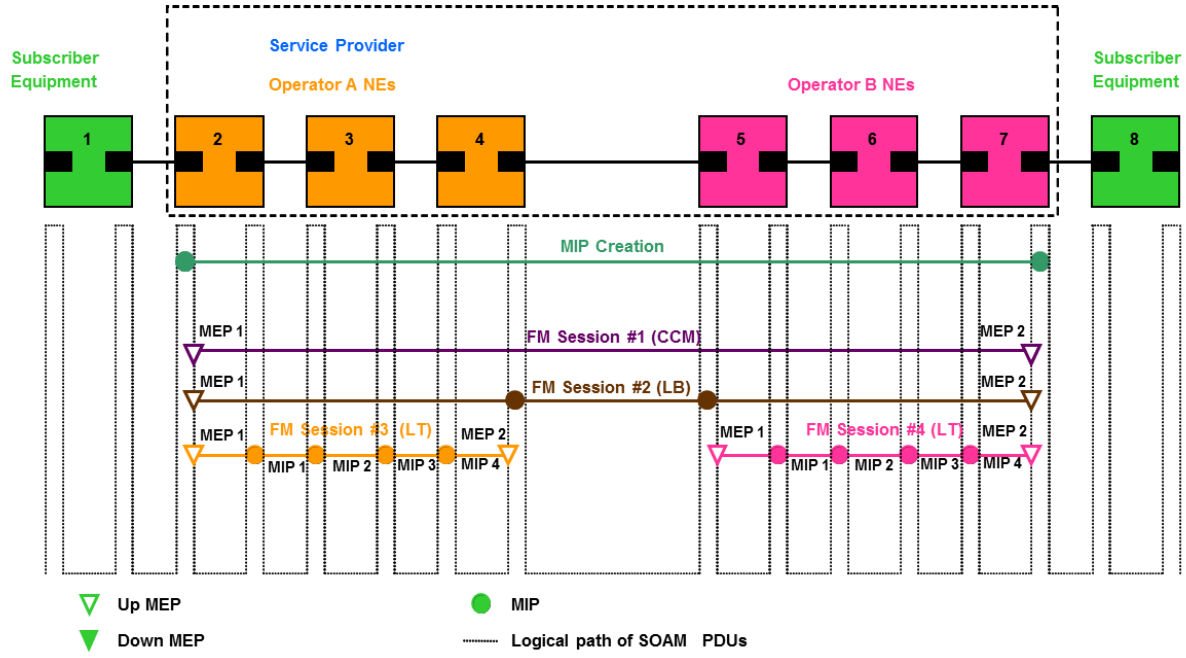

Figure 27-FM Session Types

The figure above shows examples of three FM Session types. FM Session #1 and FM Session #2 use the same MEPs in the same MEG covering the same connection. FM Session #1 uses CCMs between the MEPs in the MEG to detect fault conditions between the two MEPs shown. MEP 1 transmits CCMs to MEP 2 and receives CCMs from MEP 2. MEP 2 transmits CCMs to MEP 1 and receives CCMs from MEP 1.

FM Session #2 is a Loopback session between the two MEPs. In Session #2, LBMs are transmitted by MEP 1 and received by MEP 2. MEP 2 responds to each LBM received with an LBR. MEP 1 receives LBRs from MEP 2 and compares the number of LBMs transmitted to the number of LBRs received.

FM Sessions 3 and 4 represent FM Sessions using LT functions. FM Session 3 covers one connection and FM Session 4 covers a different connection. In each case, MEP 1 transmits LTMs with a target address of MEP 2. The LTMs are received by MIP 1. MIP 1 responds to the LTM with an LTR and transmits the LTM towards MEP 2. MEPs 2, 3, and 4 repeat this process. When the LTM reaches MEP 2, MEP 2 responds with a LTR but does not transmit the LTM since it is the target of the LTM.

A.4 Performance Management

PM is used to measure the performance of a service or connection. MEF 35.1 defines four PM solutions, PM 1, PM 2, PM 3 and PM 4. The PM solutions provide the ability to monitor Frame Delay (FD), InterFrame Delay Variation (IFDV), Frame Delay Range (FDR), and Frame Loss Ratio (FLR). PM solutions are specified as:

- PM 1 – Single-Ended Point-to-Point Delay and Synthetic Loss measurement

- PM 2 – Dual-Ended Point-to-Point Delay
- PM 3 – Single-Ended Service Loss Measurement
- PM 4 – Dual-Ended Synthetic Loss Measurement

Each of these and the PDUs that they use are discussed below.

A.4.1 Delay Measurement

There are two delay measurement processes. Dual-Ended delay measurement is a process whereby a Controller MEP sends measurement information to a peer Sink MEP that will perform delay calculations. Dual-ended processes can only be used to make One-way measurement. Single-ended delay measurement is a process whereby a Controller MEP sends a measurement request and a peer Responder MEP replies with the requested information so that the originating MEP can calculate the delay measurement. Single-Ended processes can be used to make One-way and Two-way measurements.

Dual-ended measurements use a One-way Delay Message (1DM) PDU. The Controller MEP transmits the 1DM with a timestamp of when it was transmitted. The Sink MEP timestamps the 1DM when it is received. The one-way delay is calculated by subtracting the second timestamp from the first. The roles of the MEPs can be reversed to perform a dual-ended measurement in the other direction. To accurately measure One-way FD requires synchronized clocks between the two measurement points, which are impacted by the synchronization method and clock frequency drift. In the absence of clock synchronization, One-way FD can be estimated from the Two-way FD.

The Message Period is the time period at which DMMs and 1DMs are transmitted. A Message Period could be as low as a few milliseconds and as high as a few minutes. The accuracy of the measurement can be impacted by the Message Period due to possible changes in frame delay caused by changes in network topology. The Measurement Interval (MI) is a fixed-length period of time that collects the results of all measurements performed during that time period. An example MI is 900 seconds. The collected results are known as the Measurement Interval Data Set. This data set is stored for some time period such as eight hours.

Frame delay, Frame Delay Range and IFDV measurements meeting specific ranges can be collected into measurement bins. Bins are defined to be contiguous, and each is configured with its lower bound.

Because the bins are contiguous, it is only necessary to configure the lower bound of each bin. As an example, two bins are configured. The first bin collects the count of measurements from 0useconds to 4999useconds. The second bin collects the count of measurements from 5000useconds to infinity. Separate sets of bins are used for each measurement type (FD, FDR, IFDV) for each MI.

A.4.2 Synthetic Frame Loss

There are two methods of performing frame loss measurements, Single-Ended Service loss and Dual-Ended Synthetic loss. Synthetic loss measurements use additional frames, in addition to the subscriber traffic, on the service being monitored to determine frame loss.

The SLM is transmitted by the controller MEP with the TxFCf counter indicating the number of SLM frames transmitted to the responder MEP. The responder MEP replies with a SLR that contains the count of frames copied from the SLM and the count of SLR frames transmitted in the TxFCb counter. The controller MEP compares the values received in the SLR to the number of SLM frames transmitted and the number of SLR frames received. Differences between the number of SLMs transmitted and SLRs transmitted indicate frame loss in the controller to responder direction. Differences in the number of SLRs transmitted and the count of SLRs received indicate frame loss in the responder to controller direction.

Dual-ended frame loss is measured using the One-Way Synthetic Loss (1SL) PDU. The controller MEP transmits the 1SL with the TxFCf value set to the number of 1SL frames transmitted. The sink MEP compares the number TxFCf value to the number of 1SL frames received. Any difference in the values indicates frame loss. This process can be repeated in the other direction with the roles of the MEPs reversed.

Synthetic loss uses Message Period and Measurement Intervals in a similar manner to delay measurements. The Message Period for SLM or 1SL transmission is specified and frames are transmitted at that time interval. The MI is identical to that defined for delay measurements. Measurement bins are not used for synthetic loss measurements.

Synthetic loss measurements can be used to determine High Loss Intervals (HLI), Consecutive High Loss Intervals (CHLI), and Availability measurements. These are specified in MEF 10.3. Briefly, all three of these use a value known as Δt a period of time that is less than the MI, A HLI is a small time interval equal to Δt that contains high frame loss. When sufficient HLIs are adjacent, the intervals are designated as CHLIs. Unavailability is declared when n consecutive Δts exceed a defined Frame Loss Ratio. When a service becomes unavailable, it only becomes available when n consecutive Δts do not exceed a defined Frame Loss Ratio. As an example, n=10, Δt=1 second, and the frame loss ratio is defined as 50%. If the frame loss ratio for 10 consecutive seconds is $\geq$ 50%, the service is declared unavailable. To be declared available, there must be 10 consecutive seconds where frame loss ration does not exceed 50%.

A.4.3 Loss Measurement

Loss measurement is similar to synthetic loss measurement, but it uses counts of actual traffic-bearing frames rather than synthetic frames. MEPs maintain a count of frames and insert the count

into Loss Measurement frames. Single-ended Loss measurements are performed using the Loss Measurement Message (LMM) and the Loss Measurement Response (LMR). The controller MEP transmits an LMM containing the TxFCf value. The responder MEP replies with the LMR containing the TcFCf value copied from the LMM and the RxFCf and TxFCb values from the responder MEP. The controller MEP then uses these values along with the count of frames it has received (RxFCb) to determine if frame loss has occurred in either direction.

Loss measurement uses Message Period and Measurement Intervals in a similar manner to delay measurements. The Message Period for LMM transmission is specified and frames are transmitted at that time interval. The MI is identical to that defined for delay measurements. Measurement bins are not used for loss measurements.

Loss measurements can be used to determine High Loss Intervals (HLI), Consecutive High Loss Intervals (CHLI), and Availability measurements. These are specified in MEF 10.3. Briefly, all three of these use a value known as Δt a period of time that is less than the MI, A HLI is a small time interval equal to Δt that contains high frame loss. When sufficient HLIs are adjacent, the intervals are designated as CHLIs. Unavailability is declared when n consecutive Δts exceed a defined Frame Loss Ratio. When a service becomes unavailable, it only becomes available when n consecutive Δts do not exceed a defined Frame Loss Ratio. As an example, n=10, Δt=1 second, and the frame loss ratio is defined as 50%. If the frame loss ratio for 10 consecutive seconds is ≥ 50%, the service is declared unavailable. To be declared available, there must be 10 consecutive seconds where frame loss ration does not exceed 50%.

A.5 PM Session

PM Session is a term used within this document to describe specific functions used between two or more MEPs within a MEG. A PM Session can perform delay, synthetic loss, or loss measurements. If the Message Period and MI are not the same, a PM Session is used for each function. It should be noted that either Synthetic Loss or Loss are used to measure frame loss for a given service. Both are not normally used. The PM Session directly maps to the Presto SOAM OamJob.

When a PM Session is created the PM function(s) is specified along with any applicable attributes for that function. As an example, a PM Session between two MEPs to measure single-ended delay can be created with a Message Period of 1 second and a MI of 15 minutes. A second PM session can be created between the same two MEPs to measure Synthetic Loss with a Message Period of 100mseconds and a MI of 15 minutes. This is shown in the figure below.

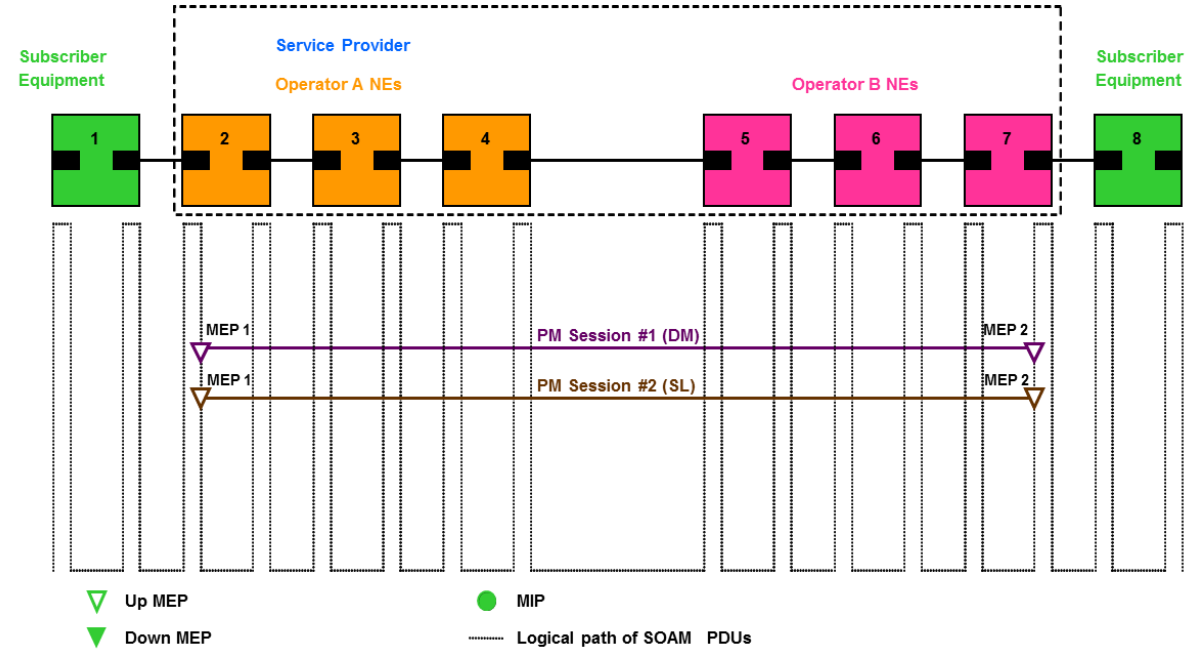

Figure 28-PM Session

The figure above shows two PM Sessions, one measuring delay and the other measuring loss, on a single service. The Message Period of these sessions are different so two sessions are required. MEP 1 is the controller MEP for each session. For Session 1, MEP 1 adds the timestamp transmits DMM to MEP 2 (responder MEP). MEP 2 replies to each DMM with a DMR. MEP 1 calculates the round-trip delay and one-way delay variation in each direction.

For Session 2, MEP 1 transmits SLMs to MEP 2. MEP 2 responds to each SLM with an SLR. MEP 1 calculates the FLR, HLI, CHLI, and Available or Unavailable state in each direction.

A.5.1 Threshold Crossing Alerts

Threshold Crossing Alerts (TCAs) can be defined for PM Sessions. A TCA uses a configured performance attribute threshold such as FD, or FDR to declare an alert when the threshold is crossed. TCAs are either stateless, meaning a set is sent when the threshold is crossed but there is no clear sent, or stateful, meaning a set is sent when the threshold is crossed and a clear is sent when the degraded condition no longer exists. One or more TCAs can be configured for the same PM Session.

TCAs are often used instead of reviewing the results of each MI. If performance is within acceptable levels a TCA is not set. If performance degrades, a TCA is set, and corrective action can be taken.