Introducing the Specifications of the Metro Ethernet Forum

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MEF 2	Requirements and Framework for Ethernet Service Protection
MEF 3	Circuit Emulation Service Definitions, Framework and Requirements in Metro Ethernet Networks
MEF 4	Metro Ethernet Network Architecture Framework Part 1: Generic Framework
MEF 6	Metro Ethernet Services Definitions Phase I
MEF 7	**EMS-NMS Information Model**
MEF 8	Implementation Agreement for the Emulation of PDH Circuits over Metro Ethernet Networks
MEF 9	Abstract Test Suite for Ethernet Services at the UNI
MEF 10	Ethernet Services Attributes Phase I
MEF 11	User Network Interface (UNI) Requirements and Framework
MEF 12	Metro Ethernet Network Architecture Framework Part 2: Ethernet Services Layer
MEF 13	User Network Interface (UNI) Type 1 Implementation Agreement
MEF 14	Abstract Test Suite for Ethernet Services at the UNI
MEF 15	Requirements for Management of Metro Ethernet Phase 1 Network Elements
MEF 16	Ethernet Local Management Interface

* MEF 10 * replaced MEF 1 and MEF 5

This Presentation

MEF 7	EMS-NMS* Information Model *Element Management System–Network Management System
Purpose	Provides a standard for carrier management systems to enable configuration and fault management of Metro Ethernet services.
Audience	Equipment Manufacturers building devices that will carry Carrier Ethernet Services. Useful for Service Providers architecting their systems.

MEF 7: EMS - NMS Information Model

- **A specification**
  - Enable consistent definition of the management information required to manage Carrier Ethernet.
- **A Model**
  - defines the specific EMS-NMS management interface using a well-defined method such as Common Object Request Broker Object (CORBA) IDL, Simple Network Management Protocol (SNMP), JAVA, XML, etc.
- **Scope**
  - Ethernet (ETH) layer UNI configuration provisioning
  - ETH layer configuration and provisioning
  - ETH layer network connection and fault management (including setup/modification, notification, testing)

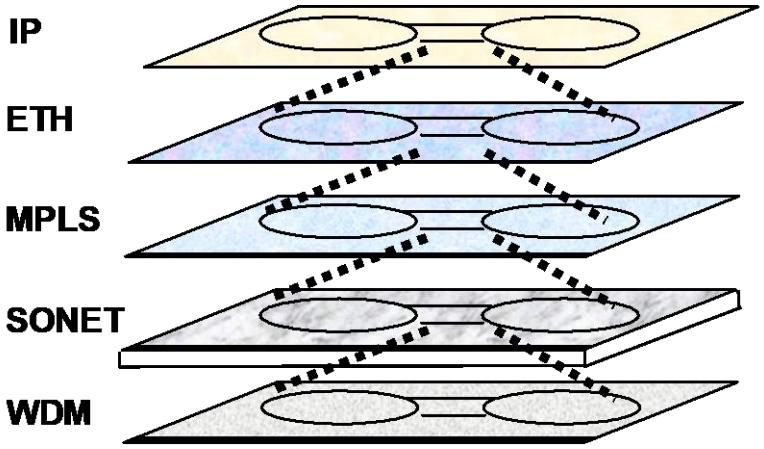
MEF Services OAM

- **MEF 7 defines a Means to provide OAM at the Ethernet Services layer**
  - Does not define OAM at the transport link/ network layers
  - Compliments/relies on the work done in the ITU, IEEE and IETF at the Transport data link and Network layers
- **Provides a frame work and concepts for managing and monitoring flows across a connectionless network**
  - from end to end
- **Provides mechanism to perform:**
  - Node Discovery, Establish connectivity, monitor CoS, and detect service impairments

Key Assumptions behind MEF OAM

- Assumes Ethernet is only common denominator
  - E.g. 802.3 Ethernet, Ethernet over SONET, RPR, etc.
  - Must use Ethernet framing for OAM communications
- Ethernet segments interconnected with forwarding entities (bridge, switch, etc.)
  - Connectionless, like IP
  - Segment can be real or virtual
- Must measure "per service" and be with data plane
  - Out-of-band OAM not possible, not accurate with data plane
  - OAM mixes with user data within core
- Small initial focus on "SLA" metrics
  - Connectivity, latency, loss, jitter
- Other function may follow later
  - Traceroute, RDI/AIS, other
- Domain oriented
  - Domain may be intra-provider, inter-provider, customer-customer, etc.

Network Layering Concepts



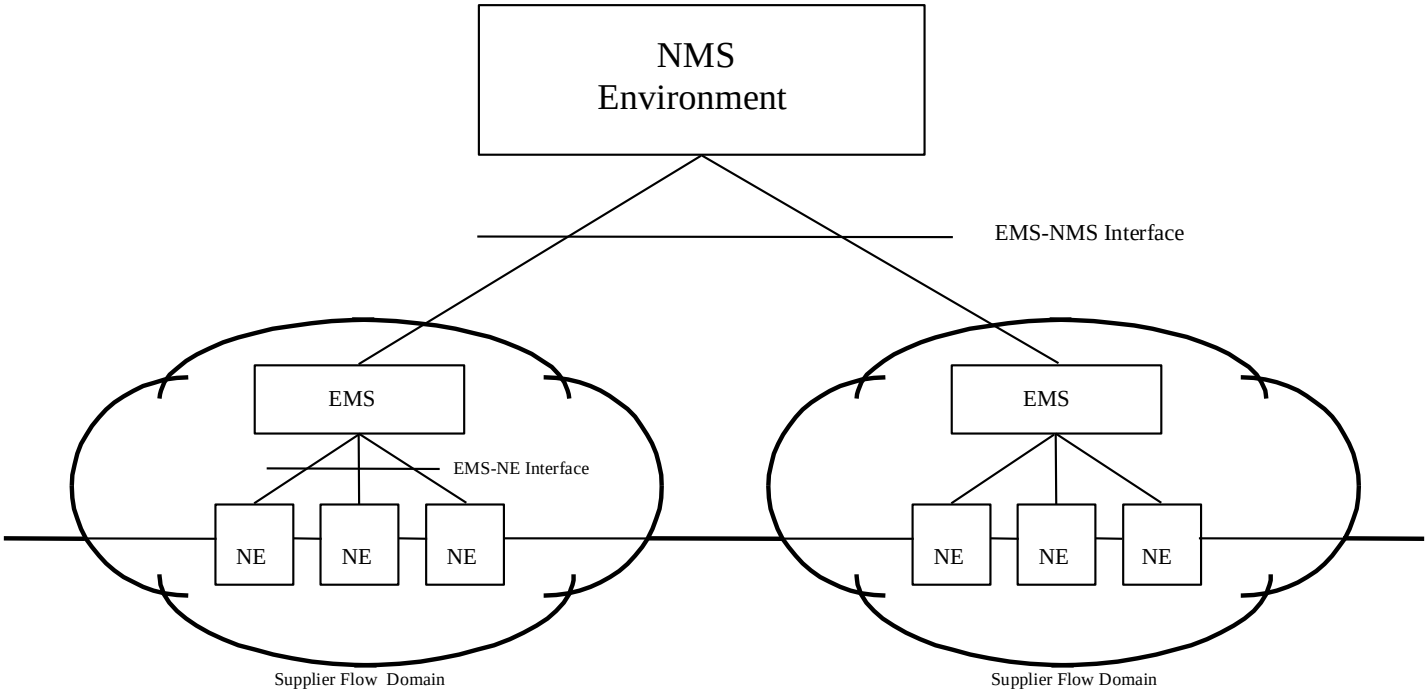
Layer Network Domains (LND)

- **Flows, connections and resources can all be managed separately at each LND**
- **Each can remain independent**
- **Each in turn can pass information to upper management domains to isolate issues.**

MEF 7
Network Mgmt Functions Addressed

- NMS Functional Model
- Node Discovery
- Service performance monitoring
- Ethernet (ETH) layer MEN topology configuration and provisioning
- ETH layer UNI configuration and provisioning
- ETH layer network flow (EVC) management
- ETH layer fault management

NMS Functional Model

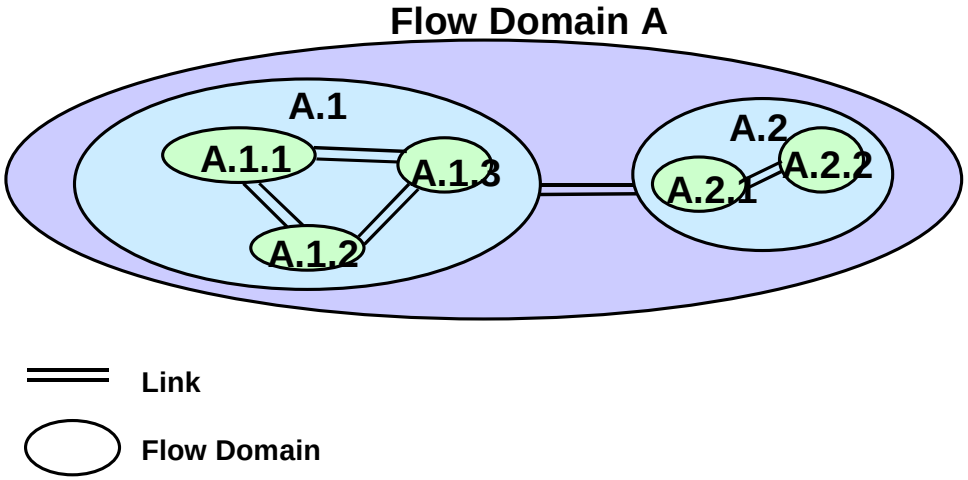


- **NMS Monitors/controls service end to end across separate EMS monitored/controlled flow domains**

Network Concepts

- **MEF 7 relies closely on the concepts defined by the ITU in G.809**
  - Ethernet services are inherently connectionless
  - Services are supported over Flows
  - Flow Domains can be set up within a providers network and interconnected
    - Useful for connection of separate underlying transport networks (SONET, vs. Switched etc..)
  - Flow Domains can also be connected between carrier networks

Flow Domain Partitioning Concept



- **Flow Domains are sub networks – interconnected by network links**
- **Flow domains can be partitioned and nested within other larger flow domains**
  - E.g. each can be managed by separate EMS and/or NOCs
  - NMS systems can manage across multiple domains at the service layer

Provisioning, Flow, Connection Management

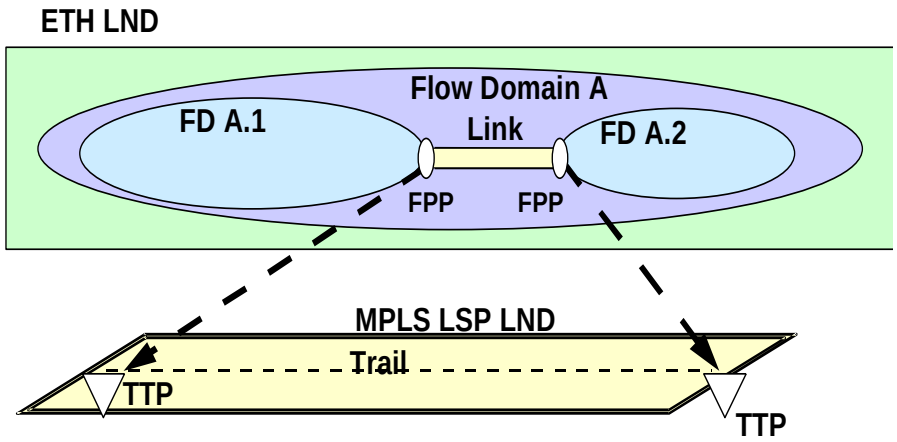


Figure 1

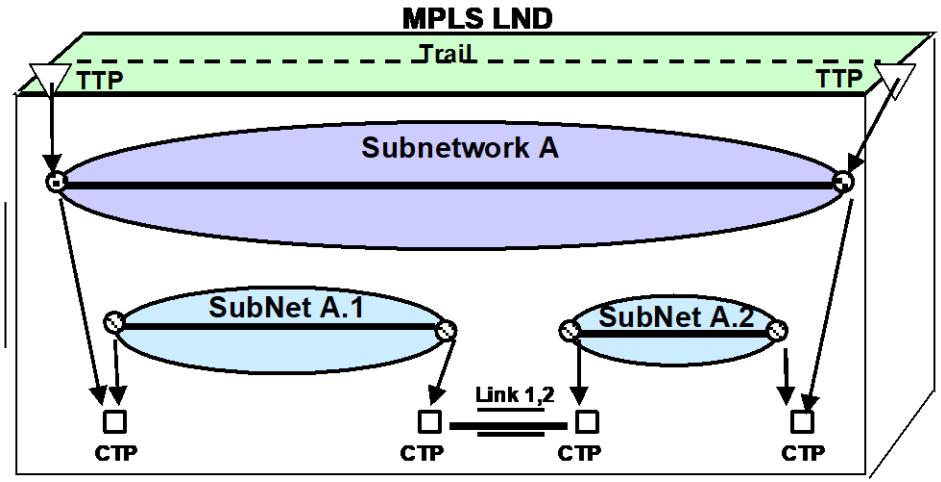


Figure 2

- **Terminations of links between flow domains are called Flow Point Pools (FPPs) or Link Ends**
  - FPPs can be associated with trail ends within a sub network topology)Fig. 1)
  - A subnetwork connection is terminated by Connection Termination Points (CTPs)
  - Multiple subnetworks can make up a flow domain link as depicted in Fig. 2

Relationship Diagrams

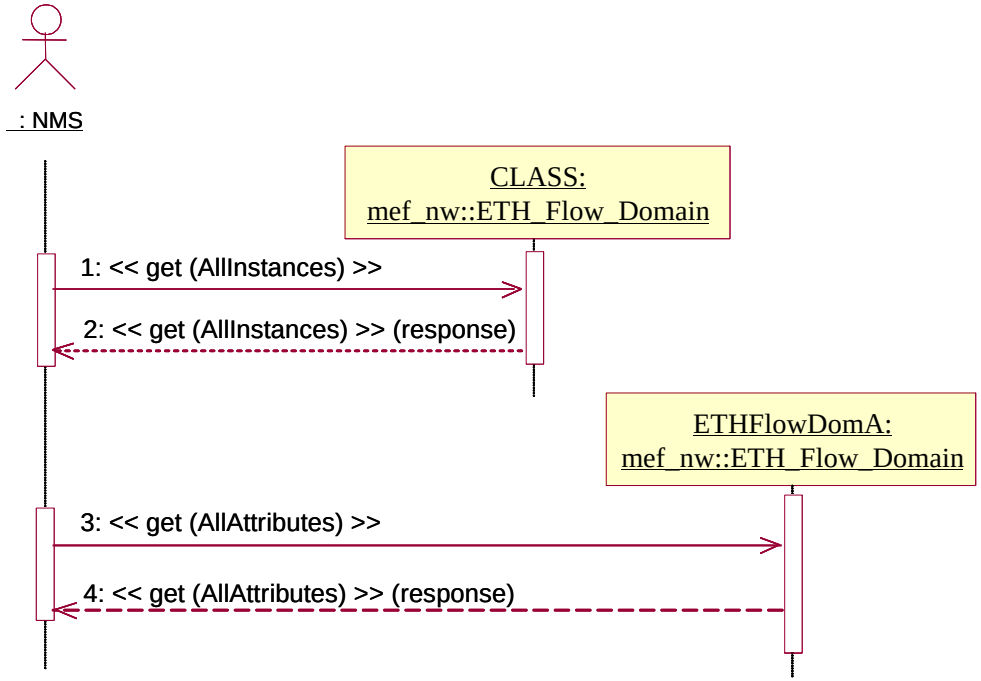
- **Information is provided in the specifications with respect to the relationship to the concepts defined.**
- **These cover:**
  - ETH Topology Information
  - ETH Connectivity Information
  - Association Relationship of ETH Topology Information
  - Association Relationship of ETH Connection Information

Applying the Model

The following are a selection of examples covering:

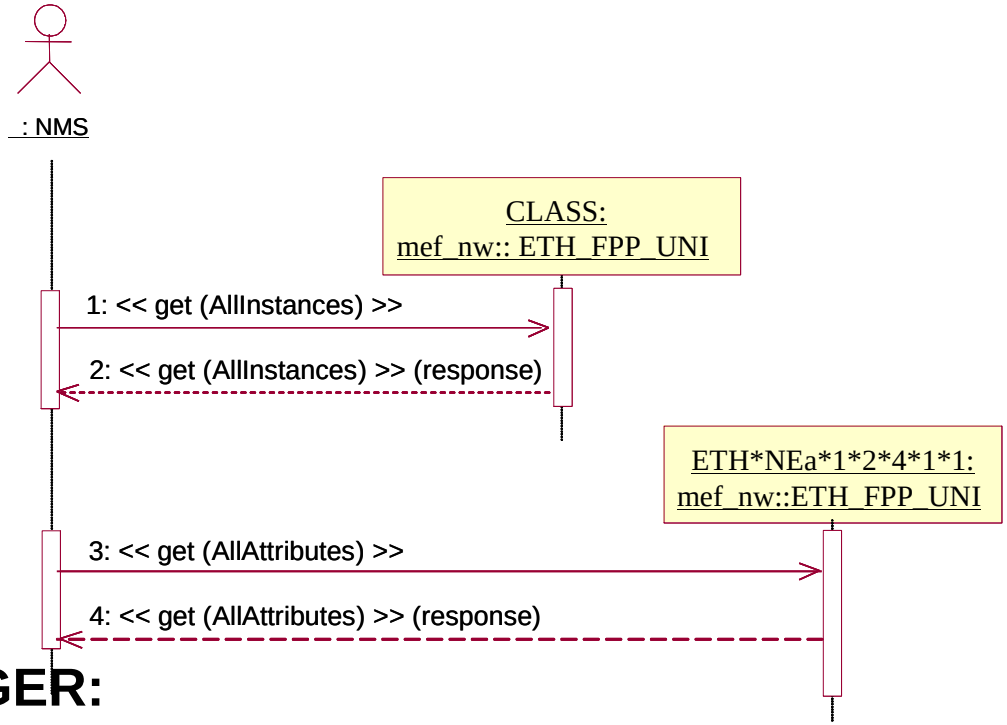
- Discovery
- Control
- Performance monitoring

On-Demand retrieval of Ethernet Flow Domains



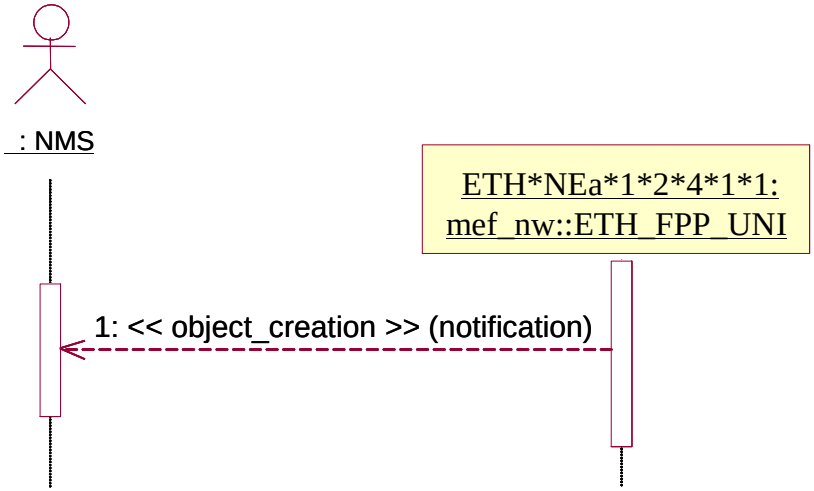
- **TRIGGER:**
  - The NMS initiates this operation to inventory all Ethernet Flow Domains managed by the EMS, and retrieve certain attributes from each.
- **PRE-CONDITIONS:**
  - EMS-NMS Connectivity is established.

On-Demand retrieval of Ethernet UNIs



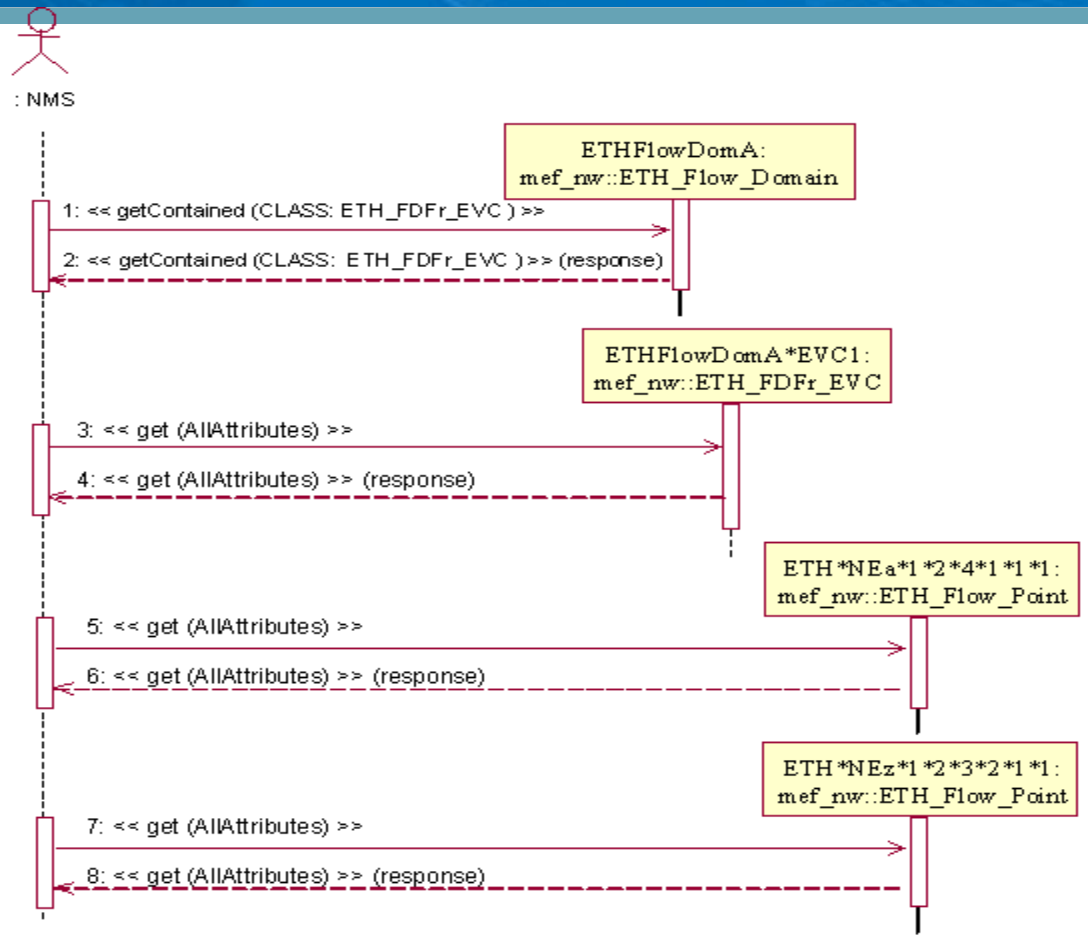
- **TRIGGER:**
  - The NMS initiate this operation to inventory all Ethernet UNIs managed by the EMS, and retrieve certain attributes from each.
- **PRE-CONDITIONS:**
  - EMS-NMS Connectivity is established.
  - The NMS is aware of or able to retrieve the names or identifiers for all Ethernet UNI instances.

Auto-discovery of Ethernet FPP UNIs



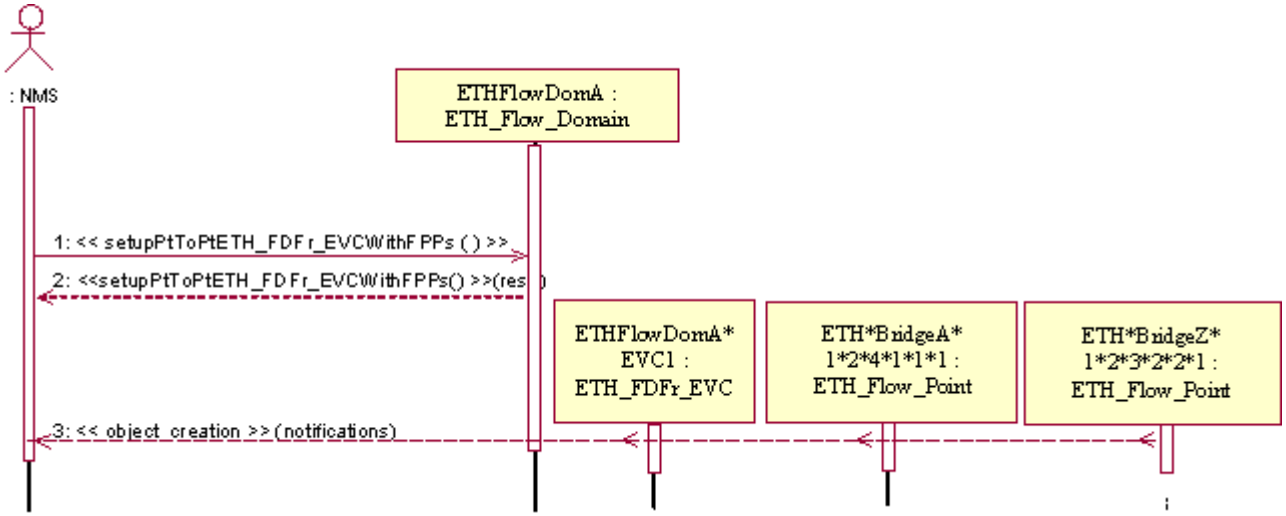
- **TRIGGER:**
  - Whenever a new Ethernet FPP is created, the EMS notifies the NMS and provides attribute information.
- **PRE-CONDITIONS:**
  - EMS-NMS Connectivity is established.

On-Demand retrieval of Ethernet EVCs



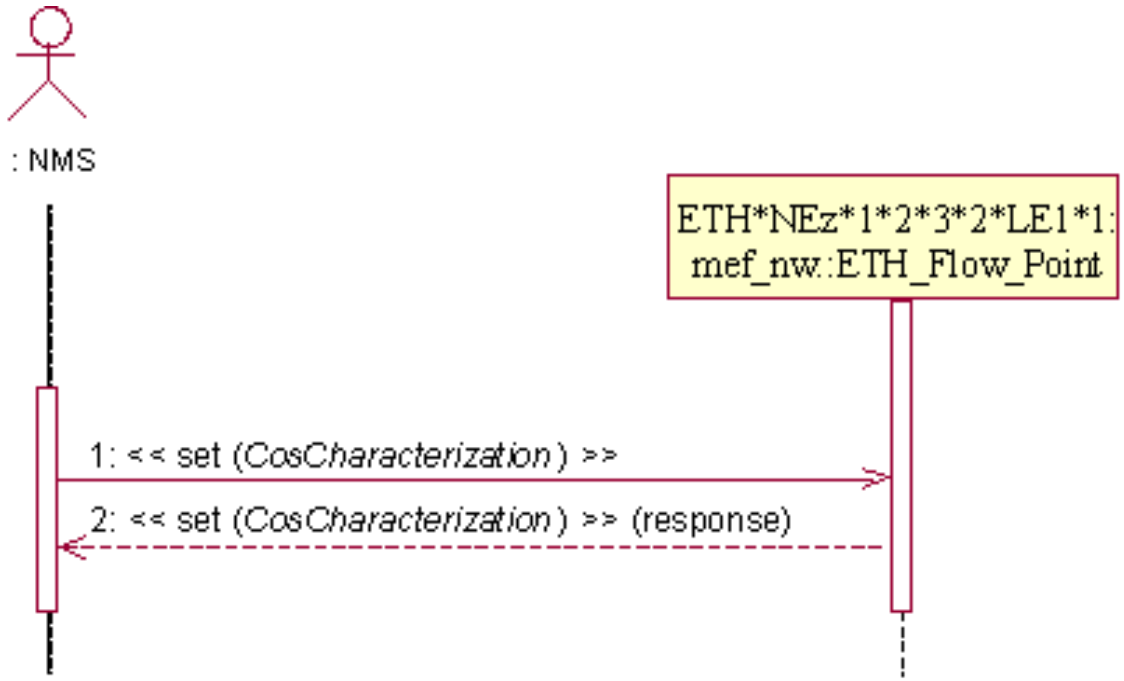
- **TRIGGER:**
  - The NMS initiate this operation to inventory all Ethernet EVCs and associated ETH_Flow_Points within a subnetwork managed by the EMS, and retrieve certain attributes from each.

Create a Point-to-Point EVC



- **TRIGGER:**
  - The NMS has provisioned an ETH_FPP_UNI representing an Ethernet UNI on a port, and is ready to create a EVC to support the customer's service.

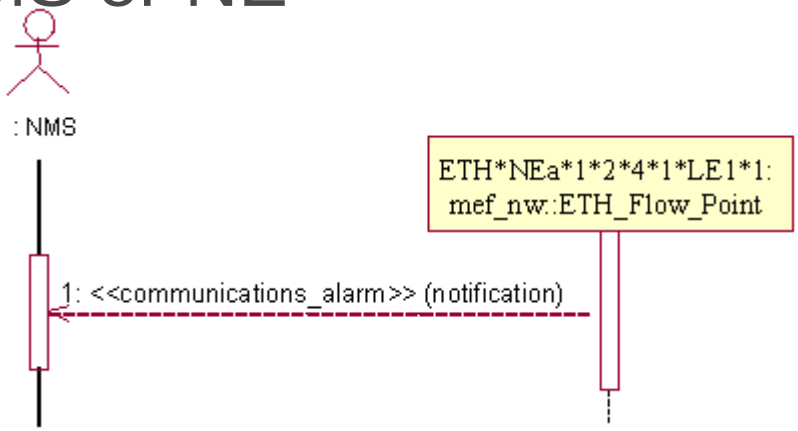
Change Ethernet Flow Point EVC Ingress COS Profile



- **TRIGGER:**
  - The NMS has a need to revise the COS Profile on an Ethernet Flow Point due to a change order.

Receiving Ethernet Flow Point Related Alarms

- **TRIGGER:**
  - An alarm notification is sent to the NMS whenever an alarmable event is detected by the EMS or NE



OAM Frame Requirements

- **Requires its own in band OAM " data channel"**
  - To perform operations
    - Service pings
  - Carry service provisioning and performance data
    - Like an ECC
  - Identifiable by Multicast Destination address and/or Ether Type field

Discovery Requirements

- Ethernet service can be multi-point to multi-point
- It is valuable to automatically discover the other endpoints of an Ethernet service
  - Plug-n-play – can eliminate some provisioning
  - Diagnostic – can detect some misconfiguration
- Utilizes multicasts capability of Ethernet
  - Edge device sends out a multicast “ping” request
  - Other edge devices respond to ping
  - Repeated for more reliability
  - Source can construct list of other edge devices

Connectivity, Latency, Loss

- Discovery has learned MAC addresses of all other edge devices
- Can validate connectivity with unicast "ping" to other edge device
  - On demand for diagnostic
  - Regularly for monitoring
- Interior devices can't tell ping from user data
  - Analogous to routers and ICMP ping
- Time from request sent to response received measures round-trip latency
  - Just like ICMP ping
- Can repeat multiple times for loss measurement
  - Ping N times, no response to M of the pings
  - Implies packet loss is M/N
  - Provides ICMP echo functionality at layer two

Delay Variation

- One-way delay variation an important SLA metric
  - Important for video, voice, and anything real-time
- OAM can measure delay variation by inclusion of timestamp in ping requests
  - Source of ping can include a (relative) timestamp in the request
  - Source can send pings repeatedly or periodically
  - Receiver can measure inter-transmit times via timestamps
  - Receiver can measure inter-receive times via actual time pings received
  - Receiver can measure delay variation by the difference in the receive times relative to the transmit times
    - Transmit timestamps say 0, 1000, 2000, 3000, 4000 (milliseconds)
    - Receive times are 3561, 4560, 5562, 6561, 7563 (milliseconds)
    - Says delay variation is around 1 millisecond

Summary

- MEF developing OAM for multi-hop networks utilizing Ethernet framing
- Focused on providing SLA measurements
  - Connectivity, Latency, Loss, Jitter
- Provides functionality using combination of
  - Automated discovery of edge devices
  - Ping like functionality at layer 2
  - Filtering mechanisms to protect a providers' domain
- Needs to be used in combination with other OAM mechanisms (e.g. IEEE 802.3ah OAM) for a more complete OAM solution

For Full Details …

… visit www.metroethernetforum.org

to access the full specification