MEF 30
Service OAM Fault Management Implementation Agreement
Agenda

• Approved MEF Specifications
• This presentation
• About this Specification
• In Scope / Out of Scope
• Terminology, Concepts & Relationship to other standards
• Section Review
  – Major topics
    • Minor topics
• Examples/Use Cases
• Summary
<table>
<thead>
<tr>
<th>REF</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEF 2</td>
<td>Requirements and Framework for Ethernet Service Protection</td>
</tr>
<tr>
<td>MEF 3</td>
<td>Circuit Emulation Service Definitions, Framework and Requirements in Metro Ethernet Networks</td>
</tr>
<tr>
<td>MEF 6.1</td>
<td>Metro Ethernet Services Definitions Phase 2</td>
</tr>
<tr>
<td>MEF 7.1</td>
<td>EMS-NMS Information Model</td>
</tr>
<tr>
<td>MEF 8</td>
<td>Implementation Agreement for the Emulation of PDH Circuits over Metro Ethernet Networks</td>
</tr>
<tr>
<td>MEF 9</td>
<td>Abstract Test Suite for Ethernet Services at the UNI</td>
</tr>
<tr>
<td>MEF 10.2</td>
<td>Ethernet Services Attributes Phase 2*</td>
</tr>
<tr>
<td>MEF 11</td>
<td>User Network Interface (UNI) Requirements and Framework</td>
</tr>
<tr>
<td>MEF 12</td>
<td>Metro Ethernet Network Architecture Framework Part 2: Ethernet Services Layer</td>
</tr>
<tr>
<td>MEF 13</td>
<td>User Network Interface (UNI) Type 1 Implementation Agreement</td>
</tr>
<tr>
<td>MEF 14</td>
<td>Abstract Test Suite for Traffic Management Phase 1</td>
</tr>
<tr>
<td>MEF 15</td>
<td>Requirements for Management of Metro Ethernet Phase 1 Network Elements</td>
</tr>
<tr>
<td>MEF 16</td>
<td>Ethernet Local Management Interface</td>
</tr>
</tbody>
</table>

* MEF 6.1 replaced MEF 6., MEF 7.1 replaced MEF 7, MEF 10.2 replaced MEF 10.1.1, MEF 10.1, MEF 10 which replaced MEF 1 and MEF 5.
## Approved MEF Specifications

<table>
<thead>
<tr>
<th>REF</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEF 17</td>
<td>Service OAM Framework and Requirements</td>
</tr>
<tr>
<td>MEF 18</td>
<td>Abstract Test Suite for Circuit Emulation Services</td>
</tr>
<tr>
<td>MEF 19</td>
<td>Abstract Test Suite for UNI Type 1</td>
</tr>
<tr>
<td>MEF 20</td>
<td>User Network Interface (UNI) Type 2 Implementation Agreement</td>
</tr>
<tr>
<td>MEF 21</td>
<td>Abstract Test Suite for UNI Type 2 Part 1: Link OAM</td>
</tr>
<tr>
<td>MEF 22</td>
<td>Mobile Backhaul Implementation Agreement Phase 1</td>
</tr>
<tr>
<td>MEF 23</td>
<td>Class of Service Implementation Agreement Part 1</td>
</tr>
<tr>
<td>MEF 24</td>
<td>Abstract Test Suite for UNI Type 2 Part 2: E-LMI</td>
</tr>
<tr>
<td>MEF 25</td>
<td>Abstract Test Suite for UNI Type 2 Part 3: Service OAM</td>
</tr>
<tr>
<td>MEF 26</td>
<td>External Network Network Interface (ENNI) – Phase 1</td>
</tr>
<tr>
<td>MEF 27</td>
<td>Abstract Test Suite For UNI Type 2 Part 5: Enhanced UNI Attributes &amp; Part 6: L2CP Handling</td>
</tr>
<tr>
<td>MEF 28</td>
<td>External Network Network Interface (ENNI) Support for UNI Tunnel Access and Virtual UNI</td>
</tr>
<tr>
<td>MEF 29</td>
<td>Ethernet Services Constructs</td>
</tr>
<tr>
<td>MEF 30</td>
<td>Service OAM Fault Management Implementation Agreement</td>
</tr>
<tr>
<td>MEF 31</td>
<td>Service OAM Fault Management Definition of Managed Objects</td>
</tr>
</tbody>
</table>
Overview of MEF 30
About this presentation

• **Purpose:**
  – This presentation is an introduction to MEF 30 - Service OAM Fault Management Implementation Agreement

• **Audience**
  – Vendors building devices supporting OAM functions for Carrier Ethernet Services.
  – Service Providers delivering Carrier Ethernet Services

• **Note: Other MEF Specifications**
  – Overview of all specifications are available on the MEF web site
Service OAM

• MEF 17 provides the framework
  – Relevant for Subscribers (customers), Operators and Service Providers

• Fault Management IA (MEF 30)
  – FM of MEF Services
  – Specifies profile of protocols defined in IEEE 802.1ag and ITU-T Y.1731

• Performance Management IA (work in progress)

• Related Work
  – MIBs (SNMP) for PM and FM covered in MEF 31
  – Interface Architecture (UNI, ENNI) covered in MEF 12.1
Fault management is a critical part of a circuit’s lifecycle

Network Management

1) Provisioning and Turn-up the Circuit
   - Verify performance to the Service Level Agreement (SLA)

2) Performance Management
   - Is the circuit meeting the SLA?
   - Is the customer happy?

3) Fault Management
   - Sectionalize the problem
   - Refer to the responsible Maintenance Entity (ME)
   - Identify and correct the problem

New Customer Order

Pass

Fail

Yes

No

End of life

Tear down Circuit
Return to inventory

MEF Service Lifecycle and SOAM
MEF Specification Section Review
Introducing MEF 30

• The presentation is organized into the following sections:
  – Overview
  – Hierarchical OAM domains
    • Default MEG Level usage
    • MEP/MIP functionality
  – SOAM FM mechanisms and Use Cases
  – Summary
Fault Management

• **Model based on IEEE 802.1ag standard**
  – Defined for IEEE 802.1 Bridged Networks
  – 8 hierarchical Maintenance Domains. Higher Maintenance domains are transparent to lower domain levels
  – Can extend across one or more Operators

• **Enhanced with ITU-T Y.1731 definitions**
  – Extended 802.1ag with additional protocols/mechanisms

• **Protocols or Fault Management mechanisms**
  – Continuity Check
  – Remote Defect Indication Signal
  – Alarm Indication Signal
  – Linktrace
  – Loopback
  – Locked Signal
  – Test Signal
Hierarchical OAM Domains

Hierarchical maintenance domains bind OAM flows & OAM responsibilities
Terminology and Concepts

• MEF 30 builds upon MEF 17 defined SOAM components including:
  – Maintenance Entity (ME)
  – Maintenance Entity Group (MEG)
  – MEG End Point (MEP)
  – MEG Intermediate Point (MIP)
  – MEG Level
  – MEG Class of Service (CoS)

MEF-30 based on terminology found in ITU Y.1731
Default MEG Level Usage

- This is the complete set of default MEG levels
- Not all MEG levels are required in every application
## Key Maintenance Entity Groups (MEGs)

<table>
<thead>
<tr>
<th>MEG</th>
<th>Suggested Use</th>
<th>Default Direction for MEPs</th>
<th>Default MEG Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subscriber MEG</td>
<td>Subscriber monitoring of an Ethernet service</td>
<td>Up or Down</td>
<td>6</td>
</tr>
<tr>
<td>Test MEG</td>
<td>Service Provider isolation of subscriber reported problems</td>
<td>Down</td>
<td>5</td>
</tr>
<tr>
<td>EVC MEG</td>
<td>Service Provider monitoring of provided service</td>
<td>Up</td>
<td>4</td>
</tr>
<tr>
<td>Service Provider MEG</td>
<td>Service Provider Monitoring of Service Provider network</td>
<td>Up</td>
<td>3</td>
</tr>
<tr>
<td>Operator MEG</td>
<td>Network Operator monitoring of their portion of a network</td>
<td>Up</td>
<td>2</td>
</tr>
<tr>
<td>UNI MEG</td>
<td>Service Provider monitoring of a UNI</td>
<td>Down</td>
<td>1</td>
</tr>
<tr>
<td>ENNI MEG</td>
<td>Network Operators' monitoring of an ENNI</td>
<td>Down</td>
<td>1</td>
</tr>
</tbody>
</table>
MEG End Point (MEP) Orientation

- Down MEP - is a MEP residing in a Bridge that receives SOAM PDUs from, and transmits them towards, the direction of the LAN. Note that in the MEF service model, the LAN is a transmission facility in the egress direction, rather than towards the Bridge Relay Entity.
- Up MEP - is a MEP residing in a Bridge that transmits SOAM PDUs towards, and receives them from, the direction of the Bridge Relay Entity. Note that in the MEF service model, the Bridge Relay Entity itself is out of scope.
- A given MEG can be terminated by either Up or Down MEPs
- Up MEPs are the most commonly used MEP and are recommended for the following MEG levels: EVC, Service Provider, Operator and optionally the Subscriber
MEG Intermediate Point – MIP

- SOAM points associated with a single MEG level (and a single Maintenance Domain)
- Can respond to SOAM protocols, but cannot generate requests
- Defined to be located at External Interfaces such as ENNIs (or UNIs). In practice can also be used in additional internal operator locations where monitoring is desired
SOAM Fault Management Mechanisms Examples/Use Cases
SOAM FM Functions

- Continuity Check (CCM)
- Remote Defect Indication Signal (RDI)
- Alarm Indication Signal (AIS)
- Linktrace
- Loopback
- Locked Signal
- Test Signal
Connectivity Check Overview

- Connectivity Check Messages (CCMs) verify basic service connectivity and health
- CCM transmissions enabled by default on the UNI MEG and the ENNI MEG
  - CCM transmissions disabled by default on the Subscriber, Test, EVC, SP and Operator MEGs
- A MEP MUST support the CCM frame transmission periods of 1 & 10 seconds (1 s default for UNI/ENNI MEG) – Other MEG level default = 10S
  - A MEP SHOULD support the CCM frame transmission periods of 3.33 ms, 10 ms, 100 ms – for time critical applications such as protection switching
  - CCM default CoS ID should correspond to the CoS which yields the lowest frame loss
- When 3 consecutive CCM messages are lost, connectivity failure is declared
- When a MEP detects a CCM fault, the RDI bit is set in the CCM message in the opposite direction

CCM = Connectivity Check Message
Continuity Check Application – Protection switching

Maintenance Entity Group (MEG)

**MEP #1**
- CCMs sent every 10ms on working/protect paths
- Check for CCMs received from MEP #2 on working/protect paths

**MEP #2**
- CCMs sent every 10ms
- Check for CCMs received from MEP #1

**MEP #1**
- No CCMs received from MEP #2 within 30ms (3 x 10ms)
- Report CC fault to management system

**MEP #2**
- Declare CC fault if no CCMs are received from MEP #1 for 30ms
- Send CCMS with RDI flag set
- Report CC alarm to management system

**MEP #2**
- Initiate protection switchover
Remote Defect Indication - RDI

- RDI is analogous to RDI found in traditional TDM/SONET networks
- RDI is signaled between peer MEPS to indicate a network fault
  - Eg MEP-A and MEP-B
- Connectivity Check Messages (CCM) must be enabled in order to detect the fault
- When a MEP detects a CCM fault, the RDI bit is set in the CCM message in the opposite direction

CCM = Connectivity Check Message
Alarm Indication Signal - AIS

- Provides indication of service interruption upstream
- Recommended for pt to pt services
- AIS is signaled by peer MEPs away from each other to indicate a network fault - Not created by MIPs
- AIS gets sent at the next available MEG level, and is propagated at higher MEG level at MEPs
  - AIS messages must be sent immediately and then at regular intervals (default = 1/second)
  - AIS default CoS ID should correspond to the CoS which yields the lowest frame loss
  - AIS is declared immediately upon reception of an AIS PDU, and cleared after not receiving an AIS PDU for 3.5 times the transmission interval
Ethernet Link Trace

- Link Trace is analogous to IP’s Traceroute
- MEP/MIPs must support Link Trace Messages (LTMs) & Link Trace Responses (LTRs)
- MIPs and the MEP(s) decrement the TTL and forward the LTM to the next MP
Loopback

- Analogous to ICMP Ping
- Loopback message/Loopback response is used for fault isolation/detection, not performance/SLA verification
- Each MEP & MIP can be uniquely addressed and individually tested
LCK is signaled by peer MEPS to indicate an administrative lock condition

- It signals to the MEP that testing may be in progress and so that the MEP can differentiate between an administratively locked and a defect condition

- It is often used in conjunction with ETH-TST

- A locked MEP transmits LCK frames to its client level MEGs, similar to the way AIS works

- LCK messages must be sent immediately and then at regular transmission intervals (default = 1/second)

- LCK default CoS ID should correspond to the CoS which yields the lowest frame loss

- LCK is declared immediately upon reception of an LCK PDU, and cleared after 3.5 times the transmission interval
• **Test** is used between peer MEPS to provide a one-way in-service or out-of-service test
  - Can measure throughput, frame-loss, bit errors, etc.
  - Out of service testing is usually preceded by setting the Eth-Lck state
• **Test default CoS ID** should correspond to the CoS which yields the lowest frame loss
• **Optional data stream** can contain: pseudo random bit stream $2^{31}-1$ pattern, all “0” or other test pattern
Summary MEF-30

• **SOAM FM IA is an important MEF specification**
  – Fault Management of MEF Services includes basic connectivity checking and troubleshooting across one or more Operators
  – Enables both Subscribers (Customers) and Operators to independently verify MEF Services

• **SOAM FM IA specifies default profiles of IEEE 802.1ag and ITU-T 1731 protocols**
  – Simplifies interoperability between Operators

• **Additional enhancements to protocol behaviors are being addressed in SOAM FM IA Phase 2 project. Some are listed below:**
  – SOAM FM interaction with LAG
  – Per-service monitoring across an ENNI
  – Extra MD levels of SP/Op hierarchy
  – VUNI/RUNI MEP and MIP requirements
  – Interactions with link OAM and E-LMI
  – Test MEG Requirements
Related Specifications

- MEF 30 section 6 lists a full list of related MEF specifications
- IEEE 802.1Q 2011 clause 18 (802.1ag)
  - Principles of Connectivity Fault Management Operation
- ITU-T Y.1731
- MEF 31 SOAM FM MIB
- MEF 17 SOAM requirements and frameworks phase 1
- MEF 12.1 Carrier Ethernet Network Architecture Part 2 – ETH Service Layer
• **Service OAM**
  – In the context of MEF 30, mechanisms are defined that support *service-level* OAM in MENs.

• **Next Actions**
  – Read the MEF 30 specification
  – Review of MEF 17, MEF 10 and MEF 15 may also be helpful
  – Understand the principal service OAM components and capabilities
  – Review also MEF 31 and MEF 12.1 specification
For Full Details …

Please visit www.metroethernetforum.org to access the full specification

E-Line Service type
Point-to-Point EVC

E-LAN Service type

Carrier Ethernet Network

Multipoint-to-Multipoint EVC

MEF certified Carrier Ethernet products

UNI: User Network Interface
CE: Customer Equipment
Accelerating Worldwide Adoption of Carrier-class Ethernet Networks and Services

www.MetroEthernetForum.org