



**Service OAM Performance Monitoring
Implementation Agreement**

Amendment 2

MEF 35.0.2

February 2014

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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.

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AT&T

Bell Canada

CableLabs

Ciena Corporation

Cisco Systems

Comcast

Ericsson AB

EXFO Inc.

InfoVista

NTT

Omnitron Systems Technology, Inc.

RAD

Microsemi

Verizon

Introduction

This amendment makes the following changes to MEF 35:

- Adds a new subsection regarding Threshold Crossing Alert to section 9 “Common Requirements”.
- Adds new terminology terms.
- Adds new references.

2. Terminology

This amendment inserts the following terms in the alphabetic order to “*Table 1 – Terminology and Definitions*”.

Term	Definition	Reference
TCA	Threshold Crossing Alert	GR-253 [A2-3]
Upper Bin Count (k)	The total count of Measurement Bin k and above, i.e., Count of Bin(k) + Count of Bin(k+1) +...+ Count of Bin(n)	This document
UBC(k)	Upper Bin Count (k)	This document

9. Common Requirements

This amendment adds new section 9.5 “Threshold Crossing Alert” as follows:

9.5 Threshold Crossing Alert

Performance Thresholds, and corresponding Threshold Crossing Alerts (TCAs), can be configured for certain performance metrics, and used to detect when service performance is degraded beyond a given pre-configured level. Thresholds are always specific to a particular PM metric and a particular PM Session. When the measured performance in a Measurement Interval for that session reaches or exceeds the configured threshold level, a TCA can be generated and sent to an Element Management System (EMS) or Network Management System (NMS).

In normal operation, performance data is collected from an NE by the EMS/NMS either periodically (eg once an hour) or on-demand. TCAs can be used as warning notifications to the EMS/NMS of possible service degradation, thus allowing more timely action to further investigate or address the problem. For example, if the maximum one-way FD threshold was set to 10ms, and a one-way FD value was measured at more than 10ms, a TCA would be generated.

[A2-O1] A SOAM PM implementation **MAY** support the Threshold Crossing Alert function as described in section 9.5.1, 9.5.2 and 9.5.3.

The requirements in the following subsections only apply if the TCA function is supported.

9.5.1 TCA Reporting

Thresholds and associated TCAs are specific to a particular performance metric, in a given PM session. There are two types of TCA reporting: stateless and stateful. With stateless reporting, a TCA is generated in each Measurement Interval in which the threshold is crossed. With stateful reporting, a SET TCA is generated in the first Measurement Interval in which the threshold is crossed, and a CLEAR TCA is subsequently generated at the end of the first Measurement Interval in which the threshold is not crossed.

Note: In ITU-T G.7710 [A2-2] terminology, stateless TCA reporting corresponds to a transient condition, and stateful TCA reporting to a standing condition.

Regardless of the type of TCA (stateless or stateful) reporting, it is not desirable to generate more than one TCA for a given threshold during each Measurement Interval, as to do otherwise could cause unnecessary load both on the NE and on the EMS/NMS receiving the TCAs.

Thresholds and TCAs are only defined for certain performance metrics, as described in section 9.5.2. Note that all of these metrics have the property that the value cannot decrease during a given Measurement Interval.

9.5.1.1 Stateless TCA Reporting

The stateless TCA reporting treats each PM Measurement Interval separately. As soon as a threshold is reached or crossed in a PM Measurement Interval for a given performance metric, a TCA is generated.

The following figure illustrates the behavior of “stateless” TCA reporting.

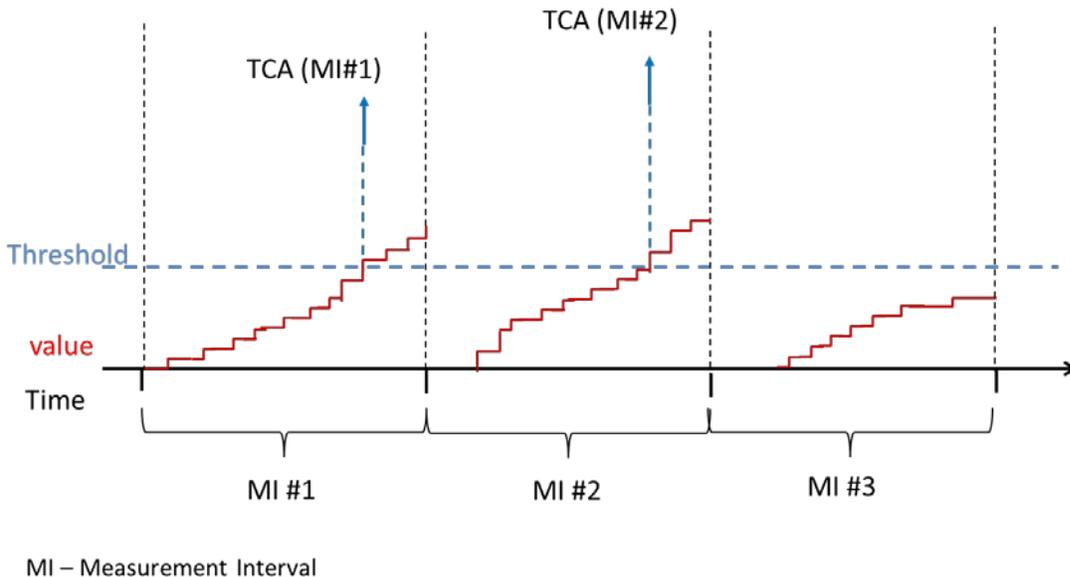


Figure A2-1 Stateless TCA Reporting Example

As shown in the example in Figure A2-1, in MI #1, the measured performance value (e.g., Maximum Frame Delay) crosses the corresponding threshold. Therefore a TCA is reported for MI#1. In MI#2, this threshold is crossed again. Another TCA is generated for MI#2. In MI#3, the measured performance value doesn't reach the threshold. There is no TCA for that performance metric for MI#3.

9.5.1.2 Stateful TCA Reporting

Stateful TCA reporting is another option for how TCAs are generated, that can reduce the total number of TCAs. The intent is to provide a notification when a degradation is first encountered, followed by another when the problem is resolved. This contrasts with stateless TCA reporting, in which TCAs are generated continuously for as long as the degradation lasts.

When using stateful TCAs, there are two thresholds: a SET threshold and a CLEAR threshold. These may be the same, or the CLEAR threshold may be lower than the SET threshold.

The Threshold begins in the 'clear' state. A SET TCA is generated in the first Measurement Interval as soon as the SET threshold is reached or exceeded. The Threshold is then considered to be in a 'set' state, and no further SET TCAs are generated in this state. In each subsequent Measurement Interval in which the CLEAR threshold is reached or exceeded, no TCA is generated. At the end of the first Measurement Interval in which the CLEAR threshold is not reached or exceeded, a CLEAR TCA is generated, and the Threshold returns to the 'clear' state. Thus, each SET TCA is followed by a single CLEAR TCA.

The following figure shows an example of stateful TCA reporting.

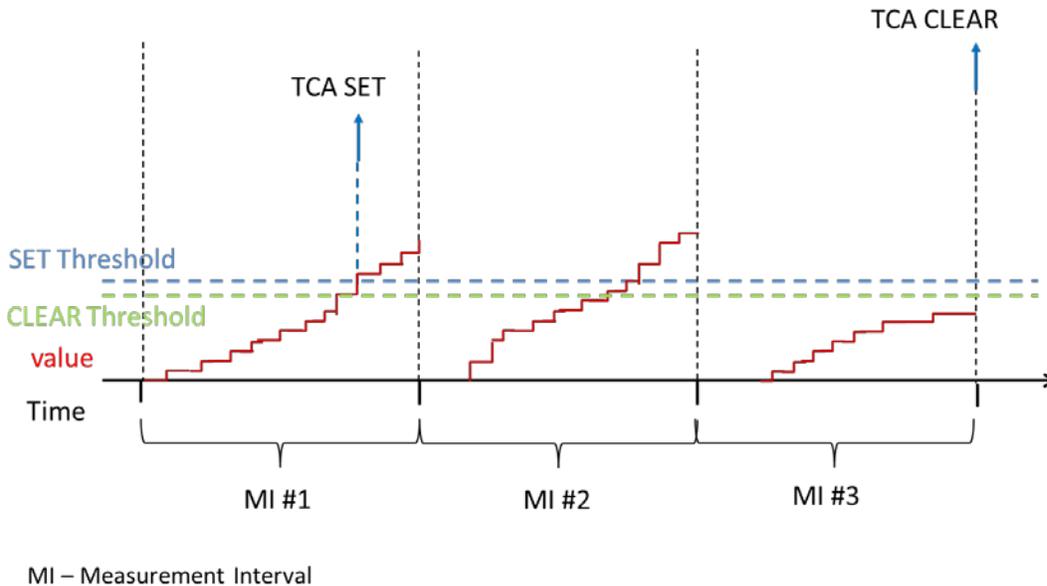


Figure A2-2 Stateful TCA Reporting Example

In the example, a SET TCA is generated in MI#1. In MI#2, the threshold is crossed again but no SET TCA is generated because a SET TCA had been generated in the previous MI. MI#3 is the first subsequent MI that the measured performance value is below the CLEAR threshold. A CLEAR TCA is generated at the end of MI#3.

It is also an option to allow configuring multiple different thresholds for the same performance metric so that the TCA reporting can be generated for different degrees of service degradation.

9.5.2 SOAM PM Thresholds for TCA

TCAs are useful for some of the PM performance metrics but may not be meaningful for others. This section describes which PM performance metrics are required and how to support TCAs.

For PM metrics that use measurement bins, thresholds are defined in terms of an Upper Bin Count (UBC). The Upper Bin Count of bin k is the total of the counts for bins k and above, i.e. $UBC(k) = \text{count of bin } (k) + \text{count of bin } (k+1) + \dots + \text{count of bin } (n)$, where n is the last bin.

To configure a threshold, both the bin number, k , and the total count, N , need to be specified - this is represented as (N, k) . A threshold (N, k) is considered to have been crossed when $UBC(k) \geq N$. Figure A2-3 illustrates how a threshold is configured using bins.

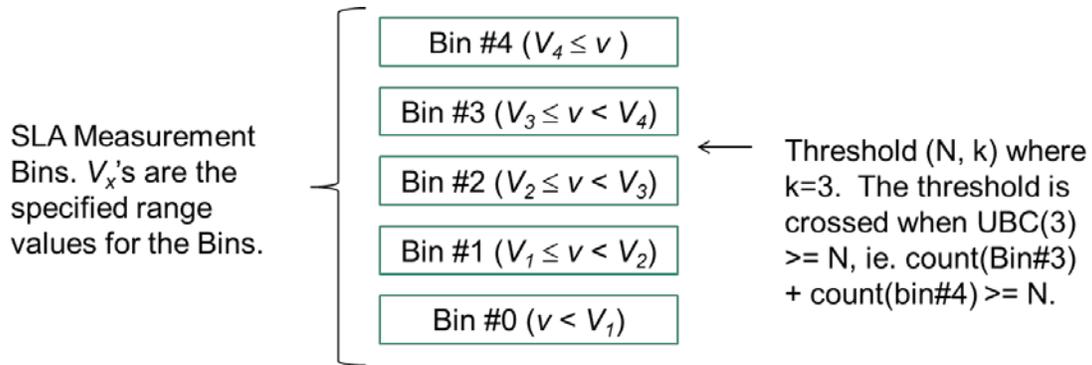


Figure A2-3 Upper Bin Count for Threshold Crossing

Some PM performance metrics, such as Frame Delay, are defined only during Available time. Since TCAs are, by definition, alerts (rather than alarms), it is acceptable to keep generating them even if the service becomes unavailable; in particular, it is not necessary to wait for n ' Δt 's after the threshold crossing is detected before generating a TCA in case the service becomes Unavailable (where Δt is the duration of an availability indicator, and n is the number of consecutive ' Δt 's required to have high loss before the service is declared Unavailable – see MEF 10.2.1 [13]). The receivers of the TCAs, e.g., EMS/NMS, may use the combined information of TCAs and Availability state change notifications to decide what actions to take.

The following table lists the applicable PM performance metrics that support TCAs. In each case, both one-way, and where applicable, two-way metrics can be used. The table describes in each case the parameters that must be configured for the threshold, and the definition of when the threshold is crossed. For stateful TCAs, the "SET" thresholds and "CLEAR" thresholds are defined in the same way (although the configured values may be different).

PM Performance Metric	Configured Threshold	Threshold Crossing Detection	Notes
One-way FD in the forward direction	Forward One-way (N_{FD}, k)	UBC(k) \geq Forward One-way N_{FD}	Using Measurement Bins. Requires ToD sync
One-way Maximum FD in the forward direction	Forward One-way V_{maxFD}	Max FD \geq Forward One-way V_{maxFD}	Requires ToD sync
One-way FDR in the forward direction	Forward One-way (N_{FDR}, k)	UBC(k) \geq Forward One-way N_{FDR}	Using Measurement Bins
One-way Maximum FDR in the forward direction	Forward One-way V_{maxFDR}	Max FDR \geq Forward One-way V_{maxFDR}	
One-way IFDV in the forward direction	Forward One-way (N_{IFDV}, k)	UBC(k) \geq Forward One-way N_{IFDV}	Using Measurement Bins
One-way Maximum IFDV in the forward direction	Forward One-way $V_{maxIFDV}$	Max IFDV \geq Forward One-way $V_{maxIFDV}$	
One-way HLI in the forward direction	Forward One-way N_{HLI}	HLI count \geq Forward One-way N_{HLI}	
One-way CHLI in the forward direction	Forward One-way N_{CHLI}	CHLI count \geq Forward One-way N_{CHLI}	
One-way FD in the backward direction	Backward One-way (N_{FD}, k)	UBC(k) \geq Backward One-way N_{FD}	Using Measurement Bins. Requires ToD sync
One-way Maximum FD in the backward direction	Backward One-way V_{maxFD}	Max FD \geq Backward One-way V_{maxFD}	Requires ToD sync
One-way FDR in the backward direction	Backward One-way (N_{FDR}, k)	UBC(k) \geq Backward One-way N_{FDR}	Using Measurement Bins
One-way Maximum FDR in the backward direction	Backward One-way V_{maxFDR}	Max FDR \geq Backward One-way V_{maxFDR}	
Backward One-way IFDV in the backward direction	Backward One-way (N_{IFDV}, k)	UBC(k) \geq Backward One-way N_{IFDV}	Using Measurement Bins
One-way Maximum IFDV in the backward direction	Backward One-way $V_{maxIFDV}$	Max IFDV \geq Backward One-way $V_{maxIFDV}$	

PM Performance Metric	Configured Threshold	Threshold Crossing Detection	Notes
One-way HLI in the backward direction	Backward One-way N_{HLI}	HLI count \geq Backward One-way N_{HLI}	
One-way CHLI in the backward direction	Backward One-way N_{CHLI}	CHLI count \geq Backward One-way N_{CHLI}	
Two-way FD	Two-way (N_{FD}, k)	UBC(k) \geq Two-way N_{FD}	Using Measurement Bins.
Two-way Maximum FD	Two-way V_{maxFD}	Max FD \geq Two-way V_{maxFD}	
Two-way FDR	Two-way (N_{FDR}, k)	UBC(k) \geq Two-way N_{FDR}	Using Measurement Bins
Two-way Maximum FDR	Two-way V_{maxFDR}	Max FDR \geq Two-way V_{maxFDR}	
Two-way IFDV	Two-way (N_{IFDV}, k)	UBC(k) \geq Two-way N_{IFDV}	Using Measurement Bins
Two-way Maximum IFDV	Two-way $V_{maxIFDV}$	Max IFDV \geq Two-way $V_{maxIFDV}$	
Two-way HLI	Two-way N_{HLI}	HLI count \geq Two-way N_{HLI}	
Two-way CHLI	Two-way N_{CHLI}	CHLI count \geq Two-way N_{CHLI}	

Table A2-1 SOAM PM Performance Metrics TCA

Note that not all performance metrics are listed in Table A2-1. They are either not suitable or not necessary. For example:

- MFD – MFD is a performance metric measuring average and thus a poor metric for immediate attention, compared to FD, FDR and IFDV.
- FLR – FLR is a performance metric for long time period and thus not suitable for immediate action, compared to HLI and CHLI.
- Availability – Since Availability state transition reporting is required ([R83]), having a TCA would be redundant.

If TCA functionality is supported, the following requirements are applicable for a SOAM PM implementation:

[A2-R1] A SOAM PM implementation **MUST** support per PM metric, per PM session, configuration of PM Thresholds for TCAs, using the parameters described in Table A2-1

- one-way FDR in the forward direction
- one-way maximum FDR in the forward direction
- one-way IFDV in the forward direction
- one-way maximum IFDV in the forward direction
- one-way HLI in the forward direction

- one-way CHLI in the forward direction
- one-way FDR in the backward direction
- one-way maximum FDR in the backward direction
- one-way IFDV in the backward direction
- one-way maximum IFDV in the backward direction
- one-way HLI in the backward direction
- one-way CHLI in the backward direction
- two-way FD
- two-way maximum FD
- two-way FDR
- two-way maximum FDR
- two-way IFDV
- two-way maximum IFDV
- two-way forward HLI
- two-way forward CHLI

[A2-R2] If time-of-day synchronization is supported, a PM implementation **MUST** support PM Thresholds and TCAs for the following PM metrics:,,

- one-way FD in the forward direction
- one-way maximum FD in the forward direction
- one-way FD in the backward direction
- one-way maximum FD in the backward direction

[A2-R3] A SOAM PM implementation **MUST** support stateless TCA reporting.

[A2-D1] A SOAM PM implementation **SHOULD** support stateful TCA reporting.

[A2-R4] If a SOAM PM implementation supports stateful TCA, it **MUST** support a configurable parameter per configured threshold to indicate whether the threshold uses stateful or stateless reporting.

[A2-R5] If a SOAM PM implementation supports stateful TCA, it **MUST** support the CLEAR threshold being equal to the SET threshold..

[A2-O2] If a SOAM PM implementation supports stateful TCA, it **MAY** support the CLEAR threshold being different to the SET threshold.

For thresholds defined using bins, a CLEAR threshold (N_c, k_c) is defined to be less than or equal to a SET threshold (N_s, k_s) if either $k_c = k_s$ and $N_c \leq N_s$, or if $k_c < k_s$.

[A2-R6] If a SOAM PM implementation supports stateful TCA with different SET and CLEAR thresholds, the CLEAR threshold **MUST** be less than or equal to the SET threshold

- [A2-R7] If a PM Threshold is configured to use stateless reporting, a TCA **MUST** be generated for each Measurement Interval in which the Threshold is crossed as defined in Table A2-1
- [A2-D2] If a PM Threshold is configured to use stateless reporting, the TCA for a given Measurement Interval **SHOULD** be generated as soon as the threshold is crossed.
- [A2-R8] If a PM Threshold is configured to use stateless reporting, the TCA for a given Measurement Interval **MUST** be generated within 1 minute of the end of the Measurement Interval.
- [A2-R9] If a PM Threshold is configured to use stateful reporting, in the 'clear' state a SET TCA **MUST** be generated for a given Measurement Interval if the SET threshold is crossed as defined in Table A2-1 during that Measurement Interval.
- [A2-R10] If a PM Threshold is configured to use stateful reporting, in the 'clear' state, if the SET Threshold is crossed during a given Measurement Interval, the state **MUST** be changed to 'set' by the end of that Measurement Interval.
- [A2-D3] If a PM Threshold is configured to use stateful reporting, the SET TCA for a given Measurement Interval **SHOULD** be generated as soon as the SET Threshold is crossed.
- [A2-R11] If a PM Threshold is configured to use stateful reporting, the SET TCA for a given Measurement Interval **MUST** be generated within 1 minute of the end of the Measurement Interval.
- [A2-R12] If a PM Threshold is configured to use stateful reporting, SET TCAs **MUST NOT** be generated when in the 'set' state.
- [A2-R13] If a PM Threshold is configured to use stateful reporting, in the 'set' state a CLEAR TCA **MUST** be generated for a given Measurement Interval if the CLEAR threshold is not crossed as defined in Table A2-1 during that Measurement Interval.
- [A2-R14] If a PM Threshold is configured to use stateful reporting, in the 'set' state, if the CLEAR Threshold is not crossed during a given Measurement Interval, the state **MUST** be changed to 'clear' at the end of that Measurement Interval.
- [A2-D4] If a PM Threshold is configured to use stateful reporting, the CLEAR TCA for a given Measurement Interval **SHOULD** be generated immediately at the end of the Measurement Interval.

[A2-R15] If a PM Threshold is configured to use stateful reporting, the CLEAR TCA for a given Measurement Interval **MUST** be generated within 1 minute of the end of the Measurement Interval.

[A2-R16] If a PM Threshold is configured to use stateful reporting, CLEAR TCAs **MUST NOT** be generated when in the 'clear' state.

[A2-R17] For a given configured threshold applying to a given PM performance metric, a SOAM PM Implementation **MUST NOT** generate more than one TCA for each Measurement Interval.

[A2-R18] A SOAM PM Implementation **MUST** support the configuration of at least one threshold for each performance metric listed in Table A2-1, for each PM session.

Note: this does not require that a SOAM PM Implementation is able to support configuration of a threshold for every performance metric for every PM session simultaneously.

[A2-O3] A SOAM PM Implementation **MAY** support the configuration of more than one threshold for a performance metric, for each PM session.

9.5.3 SOAM PM TCA Notification Messages

Table A2-2 lists the SOAM PM TCA Notification message attributes used when sending a TCA to an EMS/NMS.

Field Name	Field description
Date and Time	Time of the event, in UTC. For stateless TCAs, and stateful SET TCAs, this is the time the threshold was crossed; for stateful CLEAR TCAs, it is the time at the end of the Measurement Interval for which the CLEAR TCA is being generated.
PM Session	Identification of the PM Session for which the Threshold was configured. The specific parameters needed to uniquely identify a PM Session are implementation-specific.
Measurement Interval	Measurement Interval: The time, in UTC, at the start of the Measurement Interval for which the TCA was generated.
Performance Metric Name	Performance Metric for which the threshold was configured, i.e., one of those listed in Table A2-1 .
Configured Threshold	The configured threshold parameters. For bin-based thresholds, this includes the bin number and the total count, i.e., (N, k).
Measured Performance Metric	Measured value that caused the TCA to be generated. For bin-based thresholds configured as (N, k), this is

Field Name	Field description
	always equal to N for stateless TCAs and stateful SET TCAs; for stateful CLEAR TCAs, it is the value of UBC(k) at the end of the Measurement Interval. For "maximum" performance metrics, for stateless TCAs and stateful SET TCAs, this is the first value in the measure interval that reaches or exceeds the configured threshold; for stateful CLEAR TCAs it is the maximum value at the end of the Measurement Interval. For HLI and CHLI thresholds, this is always equal to the configured threshold value for stateless TCAs and stateful SET TCAs; for stateful CLEAR TCAs it is the total count at the end of the Measurement Interval.
Suspect Flag	Value of the Suspect Flag for the Measurement Interval for which the TCA was generated. Suspect flag is true when there is a discontinuity in the performance measurements conducted during the Measurement Interval.
TCA type	The type of TCA, ie one of STATELESS (if stateless reporting was configured for the threshold), STATEFUL-SET (if stateful reporting was configured and this is a SET TCA) or STATEFUL-CLEAR (if stateful reporting was configured and this is a CLEAR TCA).
Severity	WARNING (for stateless or stateful SET) or INFO (for stateful CLEAR)

Table A2-2 TCA Notification Message Fields

[A2-R19] A SOAM PM Implementation **MUST** include the fields in the TCA notification messages listed in Table A2-2

Table A2-3 shows the correlation between the threshold crossing notification attributes described in MEF 36 [A2-1], the general alarm and event notification parameters described in ITU-T X.733 and X.734, and the notification attributes considered in this document.

MEF 36	ITU-T X.733, X.734	Consideration for MEF 35
Date and time	Event time	Event time
Threshold ID (OID)	Managed Obj Class	PM session ID
	Managed Obj Instance	Included in PM session
	Monitored Attribute	Performance metric, Measurement Interval, Threshold ID

Threshold Conf	Threshold Info	Value configured in the threshold configuration
Threshold Value		Measured value
Suspect		Suspect flag of the MI
Crossing type	Event type (service degraded)	Stateless TCA, Stateful SET/CLEAR
Destination MEP		Included in PM session
	Severity	WARNING (for SET) INFO (for CLEAR)
	Probable cause	Not applicable

Table A2-3 MEF 36 and ITU-T X.73x for TCA Consideration

13. References

This amendment inserts the following references in section 13.

[A2-1] MEF Technical Specification MEF 36 (1/2012), “Service OAM SNMP MIB for Performance Monitoring”.

[A2-2] International Telecommunication Union, Recommendation G.7710 (02/2012), “Common equipment management function requirements”.

[A2-3] GR-253, (09/2000), “SONET Transport Systems: Common Generic Criteria”.