

Performance Monitoring (PM)

Overview

SOAM Performance Management (PM) handles the methods and procedures to measure the performance attributes of a given EVC or OVC. It is used to verify that the EVC/OVC's performance meets the SLS. Performance metrics are defined in [MEF 10.3](#).

Attributes

- Frame Delay (FD) – the time required to transmit a Service Frame from ingress UNI to egress UNI
- Inter-frame Delay Variation (IFDV) – the difference in delay of two Service Frames belonging to the same CoS instance
- Frame Loss Ratio (FLR) – a measure of the number of lost frames between ingress UNI and egress UNI expressed as a percentage
- Availability – a measure of the percentage of time that a service is useable

For any given SLS, performance objectives related to these attributes may or may not be specified. If an SLS contains an objective for a given performance attribute, then the SLS MUST specify the related parameters for that objective.

Qualified Service Frames

Performance objectives apply only to **Qualified Service Frames**. Qualified Service Frame are frames that meet the following criteria for a given ordered pair of UNIs and a given Class of Service:

- Each Service Frame MUST be the first egress Service Frame at the same UNI *j* resulting from an ingress Service Frame at the other UNI *i* of the ordered pair. The Service Frame MAY be a Unicast, Multicast, Broadcast, or Layer 2 Control Protocol Service Frame. Note that a single ingress Service Frame can result in multiple egress Service Frames, e.g., a Multicast Service Frame.
- The first bit of each Service Frame MUST arrive at the ingress UNI within the time interval *T*.
- Each Service Frame MUST have the Class of Service Identifier for the Class of Service instance in question.
- Each ingress Service Frame that is subject to an Ingress Bandwidth Profile MUST have an Ingress Bandwidth Profile compliance of Green (or uncolored if no Bandwidth Profile).



Frames Discarded by Bandwidth Profiles

1. Frames discarded by Ingress BWP at the UNI *are not* counted against the SLS.
2. Frames discarded by Egress BWP at the UNI *are* counted against the SLS.
3. Frames discarded by a BWP on an E-NNI (that were green at the UNI) *are* counted against the SLS.

PM Monitoring Framework



Unknown Attachment

PM Framework

- **PM Function** – a MEP capability specified for performance monitoring purposes (e.g., Single-Ended Delay, Single- Ended Synthetic Loss).
- **PM Session** – the application of a given PM Function between a given pair of MEPs and using a given CoS Frame Set over some (possibly indefinite) period of time.
- **PM Solution** – a set of related requirements that when implemented allow a given set of performance metrics to be measured using a given set of PM functions.
- **PM Tool** – a generic term used to discuss the application of a PM Function.

The network element is responsible for conducting performance measurements, while the EMS/NMS components are responsible for configuring, collecting, and processing these performance measurements to determine one or more performance metrics for the MEG. An implementation of a PM solution consists of a MEG, supported by NEs, in which the MEPs of that MEG are implemented, and the management functionality supported by the EMS and NMS system(s) that typically manage them as shown in the diagram (right).

PM Computations

For E-Line services, the one-way performance attributes (Frame Delay, Frame Loss Ratio, etc.) are measured and computed separately in each direction (UNI A to UNI B and UNI B to UNI A). A Service Provider may set performance objectives and measure performance for both directions or only one direction.

An E-LAN service has n UNIs associated with it. Since measurement is made between pairs of UNIs, scalability and complexity issues may require monitoring only a subset of the UNI pairs. Note that for E-LAN with N UNIs, there are $N*(N-1)$ (ordered) UNI pairs. The Service Provider specifies a subset (denoted by S) of the UNI pairs for which to perform performance monitoring. This could be the entire list, an empty list, or any subset of that list.

An E-Tree service is similar to an E-LAN service, but there are fewer ordered pairs since each pair must contain at least one UNI that is designated as a Root since Leaf UNIs cannot communicate with each other. For an E-Tree service with R root UNIs and L leaf UNIs, there are $2*R*L$ ordered UNI pairs between the roots and leaves and an additional $R*(R-1)$ ordered pairs between the roots.

For each UNI pair within the subset S , the procedures are carried out and summarized every time interval T (T can be different per attribute), and the value for the service is the *maximum value* over all ordered pairs in S for this time interval T . (See example at right). There are two exceptions:

- **One-Way Mean Frame Delay** is calculated as the *arithmetic mean* over all Mean Frame Delays of the ordered UNI pairs.
- **Availability** is calculated as the *minimum value* over all ordered pairs in S .



Example of Frame Loss Ratio Computation

The following equation defines the Frame Loss Ratio (FLR) for time interval, T , for a service measured on each of the UNI pairs $\langle i, j \rangle$ in S that had at least one Service Frame received in T .

$$FLR_{T,S} = \begin{cases} \max \{ FLR_T^{(i,j)} \mid \langle i, j \rangle \in S \text{ and where } I_T^{(i,j)} > 0 \} \\ Undefined \text{ when all } I_T^{(i,j)} = 0 \mid \langle i, j \rangle \in S \end{cases}$$