

PCEP Extensions for Reporting MPLS-TE LSP Performance Measurements with Stateful PCE

[draft-gandhi-pce-pm-07](#)

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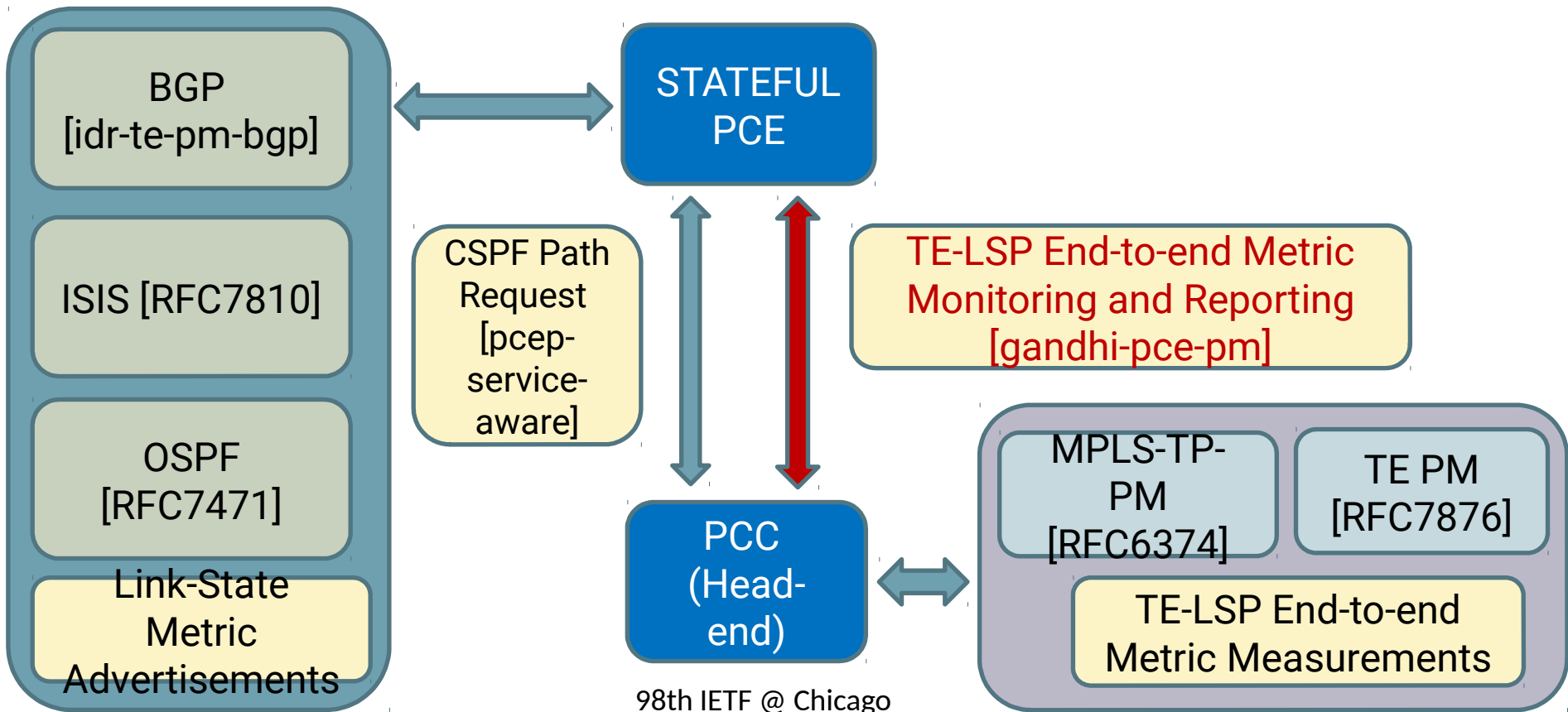
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Agenda

- Requirements and Scope
- Overview of the PCEP Extensions
- Delay Measurement Reporting
- Loss Measurement Reporting
- Bandwidth Utilization Reporting
- Notification Message
- Next Steps

Performance Metrics Protocol Landscape



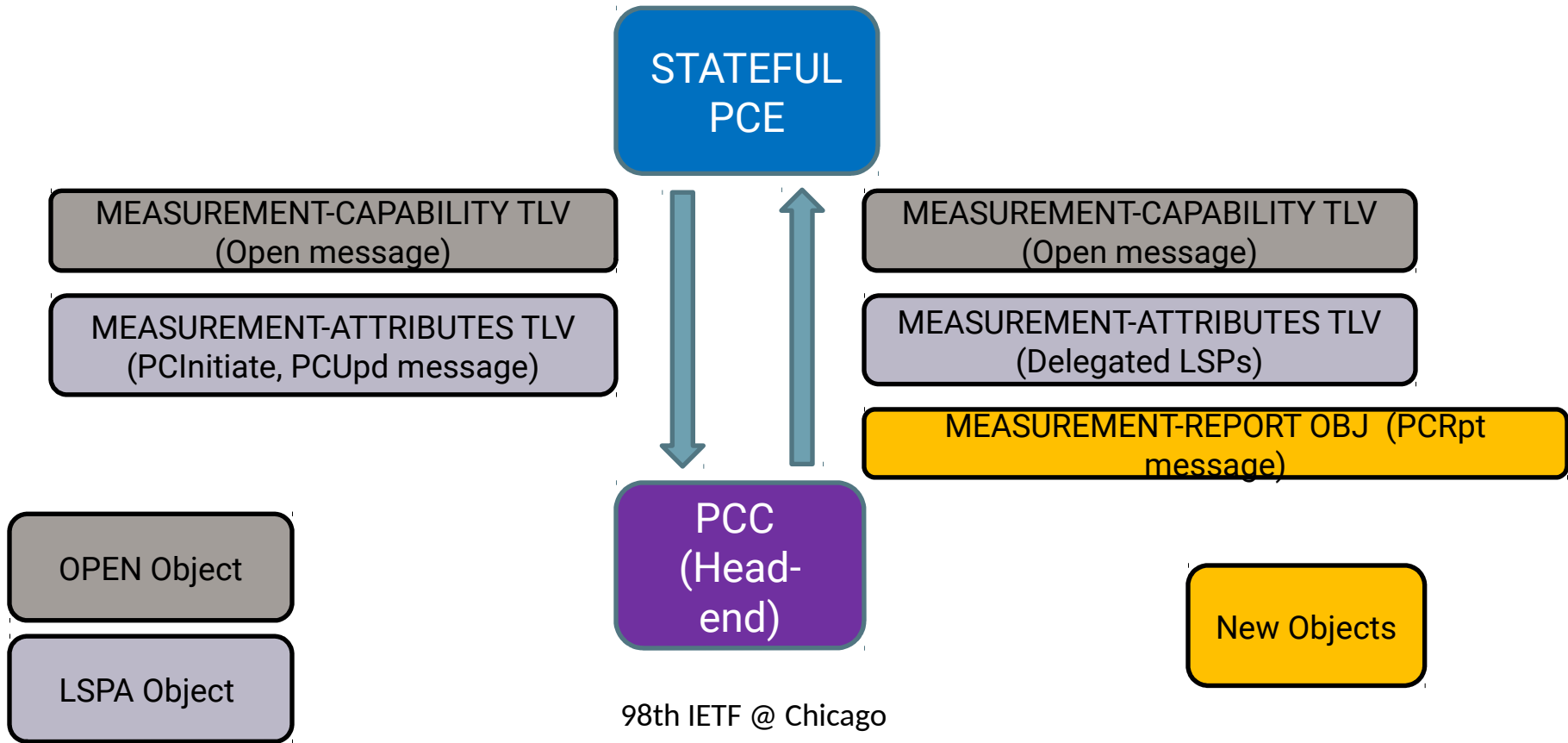
Requirements

- Stateful PCE to Monitor MPLS-TE LSP's real-time performance in terms of **end-to-end** delay and packet loss to ensure SLAs
 - Initial path computation finds the path in the network using the link metrics that can meet the performance requirements of an LSP
 - However, there is still a need to monitor the LSP's **end-to-end** performance metrics and report to Stateful PCE
- Stateful PCE to monitor MPLS-TE LSP's bandwidth utilization for capacity planning and reserving required bandwidth for the LSP in the network
 - Can be used to implement auto-bandwidth at Stateful PCE
 - Where, Stateful PCE decides the “adjusted” bandwidth

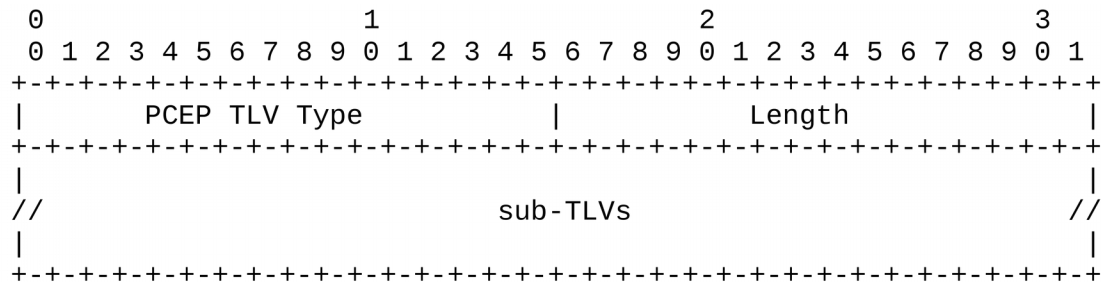
Scope

- In-scope
 - **Requesting and reporting** of MPLS-TE LSP delay measurement, loss measurement and bandwidth utilization with given measurement parameters when using Stateful PCE
 - PCE-Initiated MPLS-TE LSPs
 - PCC-Initiated MPLS-TE LSPs
- Out-of-scope
 - Usage of the reported performance metrics by the Stateful PCE
 - Mechanisms for measuring the delay, loss and bandwidth utilization of an MPLS-TE LSP on the PCC

Overview of the PCEP Extensions



Measurement Attributes TLVs



MEASUREMENT-ATTRIBUTES TLV Format

TLV	
Types	
TBD4	DELAY-MEASUREMENT-ATTRIBUTES
TBD1 6	LOSS-MEASUREMENT-ATTRIBUTES
TBD1 7	BW-UTILIZATION-MEASUREMENT-ATTRIBUTES

Sub-TLVs

1	Measurement-Enable Flags (Bit-position) (mandatory sub-TLV)	<ul style="list-style-type: none"> 31 One-Way Delay Measurement Enabled 30 Two-Way Delay Measurement Enabled 29 Unidirectional Loss Measurement Enabled 28 Bidirectional Loss Measurement Enabled 27 Inferred Loss Measurement Enabled 26 Bandwidth Utilization Reporting Enabled
2	Measurement-Interval	Measurement interval in seconds (default 300 seconds)
3	Report-Threshold, Count	Measurements reported immediately if report-threshold is crossed for consecutive "count" times when comparing last reported value with the current interval
4	Report-Threshold-percentage, Count	Measurements reported immediately if report-threshold-percentage is crossed for consecutive "count" times when comparing last reported value with the current interval
5	Report-Interval	Measurements reported at the end of report-interval configured in seconds (default 3600 seconds)

Measurement Report Objects

```

      0           1           2           3
      0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
| Class=TBD5   |   OT |Res|P|I|   Object Length (bytes)   |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|
//                               (Object body)                               //
|
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+

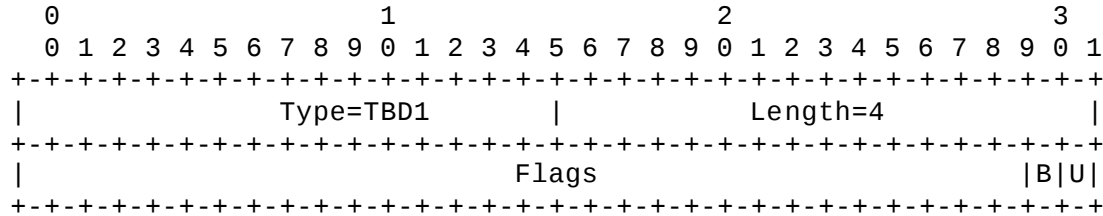
```

DELAY-MEASUREMENT Object Format

Object-Class

TBD5	DELAY MEASUREMENT Object
TBD6	LOSS MEASUREMENT Object
5	BANDWIDTH Object

Delay Measurement Capability TLV



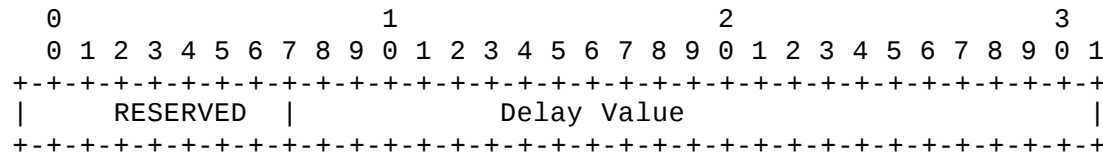
DELAY-MEASUREMENT-CAPABILITY TLV Format

TLV presence indicates PCE/PCC DM capable

U	Unidirectional Delay Measurement - 1 bit
B	Bidirectional Delay Measurement - 1 bit

Delay Measurement Report Object

For Object-Type 1 and 4:



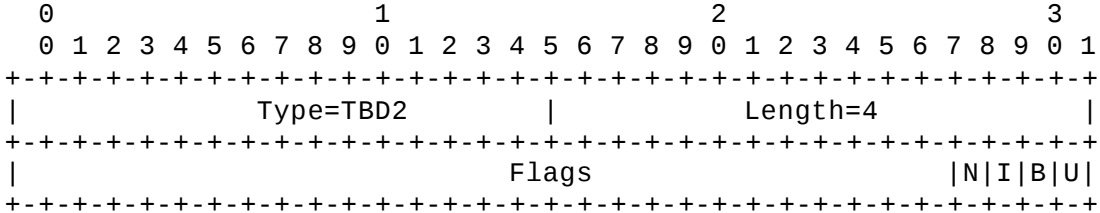
Metric types/units aligned with RFC7471

DELAY-MEASUREMENT Object Body Formats (One-Way and Two-Way)

Object-Types

1	One-Way Delay Measurement value	End-to-end average delay for the LSP in one (forward) direction, encoded as 24-bit integer
2	One-Way Delay Measurement Min/Max values	Minimum and maximum values of the one-way delay, encoded as 24-bit integer
3	One-Way Delay Variation Measurement value	Delay variation value for the LSP in one (forward) direction, encoded as 24-bit integer
4	Two-Way Delay Measurement value	End-to-end average delay for the bidirectional LSP in both (forward and reverse) directions, encoded as 24-bit integer
5	Two-Way Delay Measurement Min/Max values	Minimum and maximum values of the two-way delay, encoded as 24-bit integer
6	Two-Way Delay Variation Measurement Value	Delay variation value for the bidirectional LSP in both (forward and reverse) directions, encoded as 24-bit integer

Loss Measurement Capability TLV

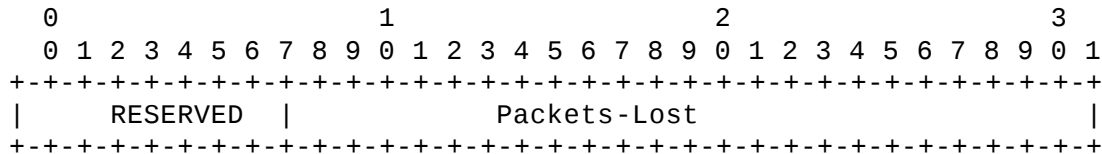


LOSS-MEASUREMENT-CAPABILITY TLV Format

TLV presence indicates PCE/PCC LM capable

U	Unidirectional Loss Measurement - 1 bit
B	Bidirectional Loss Measurement - 1 bit
I	Inferred Loss Measurement Mode - 1 bit
N	Direct Loss Measurement Mode - 1 bit

Loss Measurement Report Object

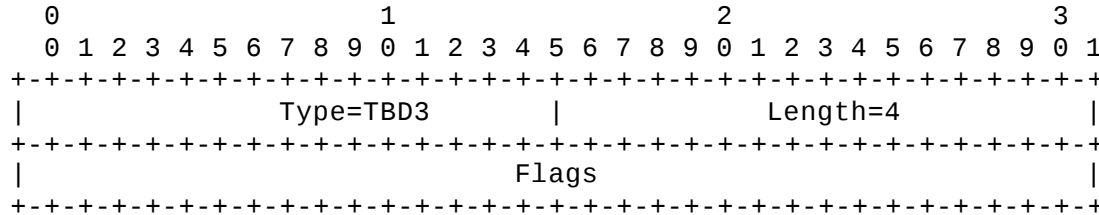


Metric types/units aligned with RFC7471

LOSS-MEASUREMENT Object Body Formats (Tx and Rx)

Object-Types	1	Tx Packets-Lost	24-bit field identifying the packet loss as a percentage of the total packets sent in Tx direction
	2	Rx Packets-Lost	24-bit field identifying the packet loss as a percentage of the total packets received in Rx direction (used for bidirectional LSPs)

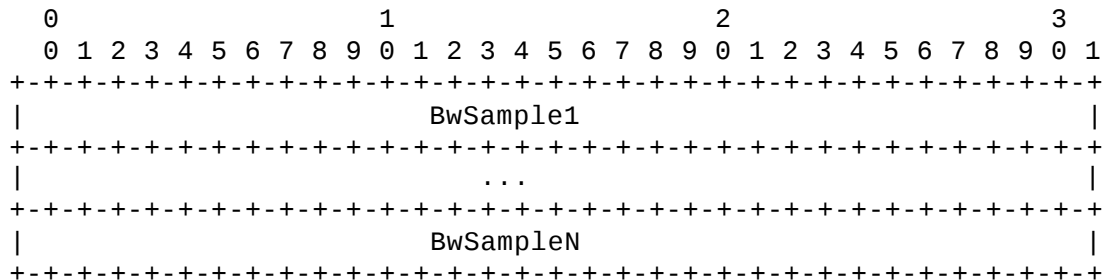
Bandwidth-Utilization Capability TLV



BANDWIDTH-UTILIZATION-CAPABILITY TLV Format

TLV presence
indicates
PCE/PCC BU
capable

Bandwidth-Utilization Report Object



BANDWIDTH-UTILIZATION Object Body Format

- A new object-type (TBD14: BANDWIDTH-UTILIZATION Object) is defined for the BANDWIDTH Object (Class 5) to report the bandwidth-utilization.
- BwSample(i) - The bandwidth sample collected at the end of each sample-interval.
- The number of samples is dependent on the report-interval as well as the report-threshold.

PCEP Notification Message

- If Stateful PCE gets overwhelmed when deploying high LSP scale, it can notify PCC to temporarily suspend the PM reporting.
- PCNtf Message Notification Type = TBD15 (PM Overwhelm State)
 - Notification Value = 1 (Entering PM overwhelm state)
 - Notification Value = 2 (Clearing PM overwhelm state)

Next Steps

- Useful functionality to have?
- Welcome your comments and suggestions
- Request for WG adoption

Thank you.