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RSVP-TE extensions for TCM configuration in MPLS-TP network

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Abstract

This specification describes the requirements of Tandem Connection Monitoring (TCM) configuration via GMPLS control plane in MPLS-TP network and provides the procedure of creating TCM path segment tunnel on a transport path to meet the requirements of TCM configuration.

Conventions used in this document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [[RFC2119](#)].

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[1.](#) Introduction

The MPLS Transport Profile (MPLS-TP) is being developed by ITU-T and IETF. The MPLS-TP data plane framework and requirements are described in [[TP-FRWK](#)] and [[RFC5654](#)], and the [[TP-CP-FRWK](#)] provides the framework to support dynamic provisioning of MPLS-TP transport paths via control plane.

The MPLS-TP Operations, Administration and Maintenance (OAM), which is defined in [[TP-OAM](#)], is one of the most important and fundamental functionalities in MPLS-TP. The OAM functionality is not only applied on a transport path granularity, but also applied on arbitrary parts of the transport path, defined as Tandem Connections. For the latter case, a Tandem Connection Monitoring (TCM) is implemented by creating a path segment tunnel that has a 1:1 association with the path segment of the transport path that is to be uniquely monitored. Therefore, the LSP is nested into the TCM path segment tunnel.

In case of TCM configuration using GMPLS control plane, the TCM path segment tunnel needs to be created on an in-service LSP, which is not

supported in the current GMPLS RSVP-TE signaling.

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This document provides the procedure of creating such outer layer path segment tunnel on a transport path via control plane to meet the requirement of automatic TCM configuration.

2. Terminology

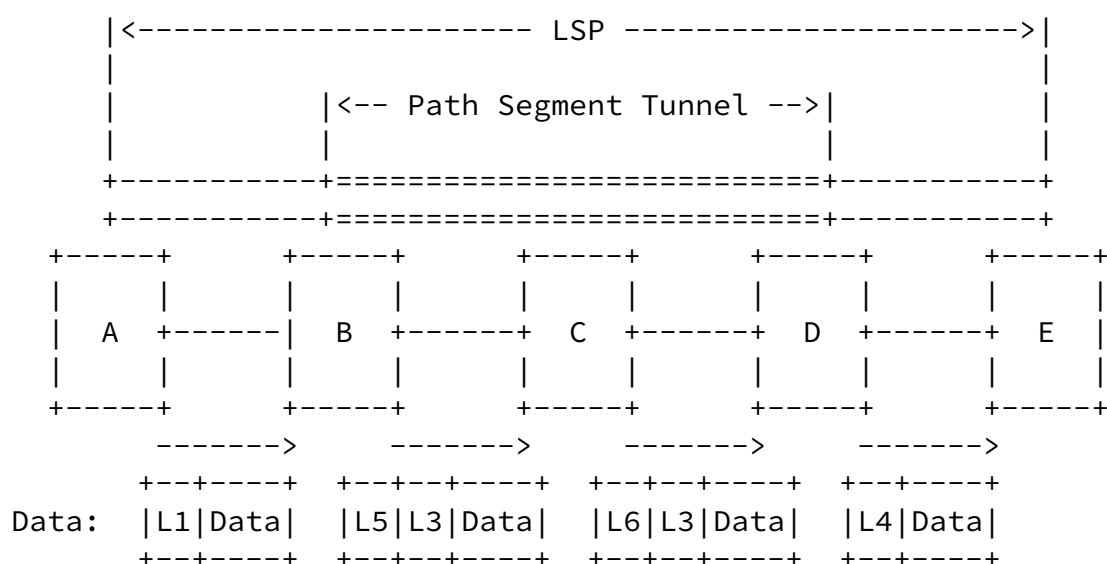
The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

3. Requirements of TCM Configuration

3.1. Introduction of TCM Path Segment Tunnel

This sub-section is informational which introduces the TCM and LSP Path Segment Tunnel Monitoring in the MPLS-TP data plane.

As described in [TP-OAM], TCM is implemented by LSP Path Segment Tunnel Monitoring which can be deployed to monitor the behavior of a part of an LSP.



```

OAM packets:      +---+---+-----+   +---+---+-----+
                   |L5|13|OAM |   |L6|13|OAM |
                   +---+---+-----+   +---+---+-----+

```

Figure 1 - Example of Path Segment Monitoring

Figure 1 shows an example of TCM. Assume that there is an LSP passing through node A, B, C, D and E. A path segment tunnel between node B and D will be created when the operator wants to configure a TCM to

monitor this path segment. The path segment tunnel has a 1:1 association with the LSP which is nested into this tunnel. In other words, the label stacking is performed between B and D, where the inner layer label is corresponded with the LSP and the outer layer label is corresponded with the tunnel.

Since the data packets of the LSP and the OAM packets for path segment monitoring are using the same outer layer labels (i.e., the tunnel labels), the LSP and the OAM session can be associated.

3.2. Requirements of TCM Configuration Using RSVP-TE

In most cases, the path segment tunnel for TCM is created when the LSP is in service. When the network operator wants to monitor a certain part of the LSP, a path segment tunnel needs to be set up by RSVP-TE if the GMPLS control plane is in use.

Figure 2 and 3 show the label forwarding tables on each node that the LSP pass through before and after the creation of the tunnel. In the example shown in Figure 3, in order to create the TCM tunnel, the TCM source node B needs to create a new label forwarding entry with two labels, in which the in-label at the TCM destination node D of the LSP (i.e., the label "L3") is treated as the inner layer out-label. The current RSVP-TE can not support creation of such label forwarding entry and creation of TCM tunnel on an existing LSP, so RSVP-TE needs to be extended.

```

      |<----- LSP ----->|
      |                               |
      +-----+
      +-----+
+-----+   +-----+   +-----+   +-----+   +-----+
|       |   |       |   |       |   |       |   |       |

```

A		B		C		D		E	
in	out	in	out	in	out	in	out	in	out
label	label	label	label	label	label	label	label	label	label
--	L1	L1	L2	L2	L3	L3	L4	L4	POP

Figure 2 - Label Forwarding Tables before Creation of Tunnel

```

|<----- LSP ----->|
|
|          |<-- Path Segment Tunnel -->|
|
+-----+=====+-----+
+-----+=====+-----+
+-----+           +-----+       +-----+           +-----+
|         |         |         |         |         |         |
|   A     +-----|   B     +-----+   C     +-----+   D     +-----+   E     |
|         |         |         |         |         |         |
+-----+           +-----+       +-----+           +-----+

+-----+ +-----+ +-----+ +-----+ +-----+
| Node A | | Node B | | Node C | | Node D | | Node E |
+-----+ +-----+ +-----+ +-----+ +-----+
| in  | out | | in  | out | | in  | out | | in  | out | | in  | out |
|label|label| |label|label| |label|label| |label|label| |label|label|
+-----+ +-----+ +-----+ +-----+ +-----+
| --  | L1  | | L1  |L3+L5| | L5  | L6  | | L6  | POP | | L4  | POP |
+-----+ +-----+ +-----+ +-----+ +-----+
                                     | L3  | L4  |
                                     +-----+

```

Figure 3 - Label Forwarding Tables after Creation of Tunnel

The basic requirements of setting up path segment tunnel on an LSP for TCM by GMPLS RSVP-TE signaling include:

- No Disruption of User Traffic on the LSP.
- The path segment tunnel MUST pass through exactly the same route as the LSP segment to be monitored.
- No extra bandwidth required. Since the tunnel and the LSP segment have a 1:1 relationship, the bandwidth of the tunnel is exactly the same as the LSP. Therefore, when setting up such tunnel, no extra bandwidth is required to be reserved.

[4. Procedure of TCM Configuration](#)

When there is a need to monitor a part of an existing LSP between two nodes (i.e., the TCM source node and the TCM destination node), the

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network operator can instruct the TCM source node to perform the TCM configuration. The GMPLS signaling is used to set up an RSVP-TE session for the TCM tunnel between TCM source node and destination node.

[4.1. Path Segment Tunnel Creation](#)

If the OAM MEP function can be supported, the TCM source node sends a PATH message node by node along the LSP until the TCM destination node. The ERO, which indicates the same route as the LSP segment to be monitored, is necessary to be carried in this PATH message. The tunnel sender address and the tunnel end point address in the PATH message indicate the TCM source node and the TCM destination node.

Additionally, in order to perform bandwidth sharing between the TCM tunnel and the LSP segment to be monitored, the PATH message for the TCM tunnel should indicate using Share Explicit (SE) reservation style and indicate which LSP to be monitored. Therefore, the information of source and destination node IDs and the LSP ID of the LSP to be monitored is needed to be carried in the PATH message.

A new TCM_CONFIGURATION object, as described in Session 5, is introduced into the PATH message to carry this information.

If the OAM MEP function can be supported, the TCM destination node responds a RESV message along the LSP until to the TCM source node. Each node on the TCM tunnel performs a normal label distribution procedure for the TCM tunnel and uses the SE style to share bandwidth resources with the LSP.

Additionally, the TCM source node needs to use the in-label of the LSP at the TCM destination node (i.e., L3 in figure 2 and 3) to create the label forwarding entry for the TCM tunnel. But the TCM source node may not have this label information because the Label recording may not be performed in the LSP (i.e., the Label_Recording flag in the SESSION_ATTRIBUTE object of the LSP is not set). Therefore, the TCM destination node needs to include this in-label in the RESV message. This label will be forwarded to the TCM source node by the RESV messages sent by the intermediate nodes. This label can be also carried in the TCM CONFIGUARIION object. See Session 5 for the detailed format of this object.

In Figure 3, for the TCM source node B, three labels are obtained:

- L3 from the downstream RESV message;

- The label of the TCM tunnel allocate by the downstream node (i.e., L5 in figure 2 and 3) from the downstream RESV message;
- The in-label of the LSP on the TCM source node (i.e., L1 in figure 2 and 3) from the forwarding entry related to the LSP on itself.

Then the TCM source node can creates a new label forwarding entry which indicates that for the received data packet with a label of L1, the label is replaced to two layer label, where the inner layer label is L3 and the outer label is L5.

At last, the TCM source node enables this new created label forwarding entry and disables the old one for the LSP, so that the TCM tunnel is created and is ready for use.

[4.2.](#) LSP Rerouting in control plane


```

+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|               LSP destination node IPv4 address               |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|           MUST be zero           |           LSP ID           |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+

```

C-Type = 2:

```

      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
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|               LSP source node IPv6 address               |
|                                                           |
|                                                           |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|               LSP destination node IPv6 address           |
|                                                           |
|                                                           |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|           MUST be zero           |           LSP ID           |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+

```

The LSP source and destination node and the LSP ID are used to indicate which LSP to be monitored.

5.2. TCM_CONFIGURATION object in RESV message

When the TCM_CONFIGURATION object is carried in the RESV message, the object carries the in-label of the LSP at the TCM destination node.

C-Type = 3:

- [OAM-CFG] A. Takacs et al, "OAM Configuration Framework and Requirements for GMPLS RSVP-TE", [draft-ietf-ccamp-oam-configuration-fwk-03](#), January 28, 2010.
- [RFC3471] Berger, L., Ed., "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description", [RFC 3471](#), January 2003.
- [RFC3473] L. Berger, Ed., "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Resource Reservation Protocol-Traffic Engineering (RSVP-TE) Extensions", [RFC 3473](#), January 2003.

[10](#). Authors' Addresses

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