PCE Working Group
Internet Draft
Intended status: Standard Track
Expires: January 14, 2014

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July 15, 2013

Path Computation Element Communication Protocol (PCEP) Extensions for remote-initiated GMPLS LSP Setup
draft-ali-pce-remote-initiated-gmpls-lsp-01.txt

Status of this Memo

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Abstract

PCEP Extensions for PCE-initiated LSP Setup in a Stateful PCE Model draft [I-D. draft-crabbe-pce-pce-initiated-lsp] specifies procedures that can be used for creation and deletion of PCE-initiated LSPs under the active stateful PCE model. However, this specification is focused on MPLS networks, and does not cover remote instantiation of GMPLS paths. This document complements PCEP Extensions for PCE-initiated LSP Setup in a Stateful PCE Model draft by addressing the extensions required for GMPLS applications, for example for OTN and WSON networks.

When active stateful PCE is used for managing PCE-initiated LSP, PCC may not be aware of the intended usage of the LSP (e.g., in a multi-layer network). PCEP Extensions for PCE-initiated LSP Setup in a Stateful PCE Model draft does not address this requirement. This draft also addresses the requirement to specify on how PCC should use the PCEP initiated LSPs.

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 RFC 2119 [RFC2119].

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1. Introduction

The Path Computation Element communication Protocol (PCEP) provides mechanisms for Path Computation Elements (PCEs) to perform route computations in response to Path Computation Clients (PCCs) requests. PCEP Extensions for PCE-initiated LSP Setup in a Stateful PCE Model draft [I-D. draft-ietf-pce-stateful-pce] describes a set of extensions to PCEP to enable active control of MPLS-TE and GMPLS tunnels.

[I-D. draft-crabbe-pce-pce-initiated-lsp] describes the setup and teardown of PCE-initiated LSPs under the active stateful PCE model, without the need for local configuration on the PCC, thus allowing for a dynamic network that is centrally controlled and deployed. However, this specification is focused on MPLS networks, and does not cover the GMPLS networks (e.g., WSON, OTN, SONET/ SDH, etc. technologies). GMPLS requirements for PCEP initiated LSPs are outlined in Section 3. This document complements [I-D. draft-crabbe-pce-pce-initiated-lsp] by addressing the requirements for remote-initiated GMPLS LSPs. The PCEP extensions for PCEP initiated GMPLS LSPs are specified in Section 5. The mechanism described in this document is applicable not only to active PCEs initiating LSPs, but to any entity that initiates LSPs remotely.

When an active stateful PCE is used for managing remote-initiated LSP, the PCC may not be aware of the intended usage of the remote-initiated LSP. For example, the PCC may not know the target IGP instance in which the remote-initiated LSP is to be used. These requirements are outlined in Section 4. [RFC6107] defines LSP_TUNNEL_INTERFACE_ID Object for communicating target IGP instance and usage of the forwarding and/ or routing adjacency from the ingress node to the egress node. However, current PCEP specifications do not include signaling of the LSP_TUNNEL_INTERFACE_ID TLV in the PCEP message. Furthermore, [I-D. draft-crabbe-pce-pce-initiated-lsp] does not address this requirement. This draft also addresses the requirement to specify on how PCC should use the PCEP initiated LSPs. This is achieved by using LSP_TUNNEL_INTERFACE_ID Object defined in [RFC6107] in PCEP, as detailed in Section 6.

2. Use Cases

2.1. Single-layer provisioning from active stateful PCE

Figure 1 shows a single-layer topology with optical nodes with a GMPLS control plane. In this scenario, the active PCE can dynamically create or delete L0 services between client interfaces. This process can be triggered by the deployment of a new network configuration or a re-optimization process. This operation can be human-driven (e.g. through an NMS) or an automatic process.

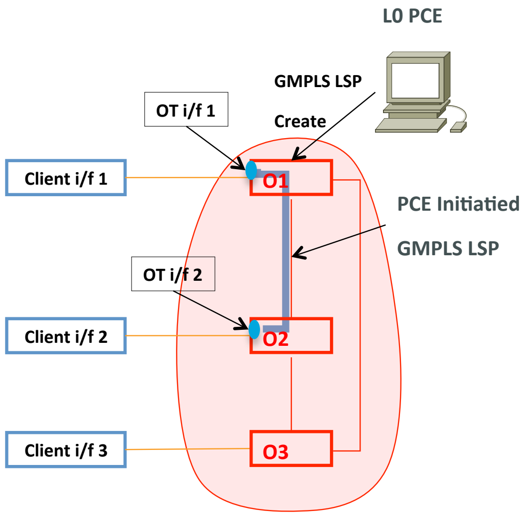


Figure 1. Single-layer provisioning from active stateful PCE.

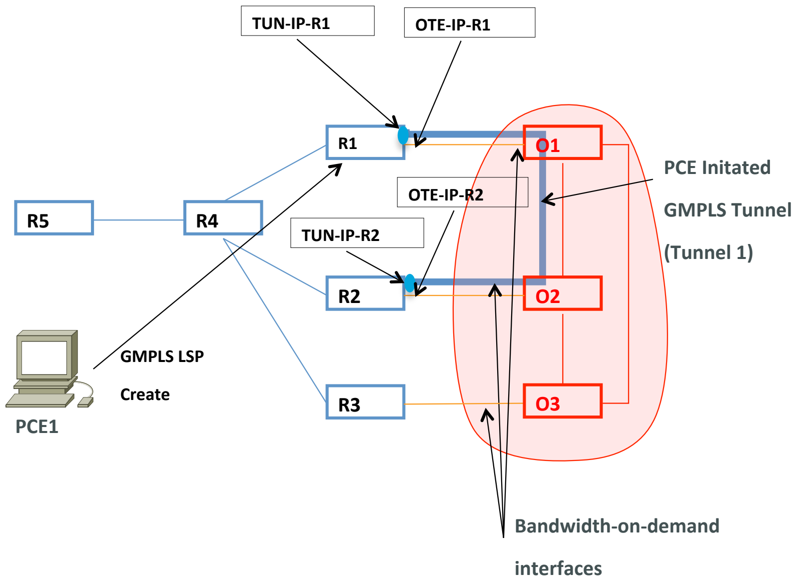
L0 PCE obtains resources information via control plane collecting LSAs messages. The request contains, at least, two optical transport interfaces (OT i/f), so PCE computes the path and sends a message to the optical equipment with ERO path information.

2.2. Bandwidth-on-demand for multi-layer networks

This use case assumes there is a multi-layer network composed by routers and optical equipment. In this scenario, there is an entity, which decides it needs extra bandwidth between two routers. This certain moment a GMPLS LSP connecting both routers via the optical network can be established on-the-fly. This entity can be a router, an active stateful PCE or even the NMS (with or without human intervention).

It is important to note that the bandwidth-on-demand interfaces and spare bandwidth in the optical network could be shared to cover many under capacity scenarios in the L3 network. For example, in this use-case, if we assume all interfaces are 10G and there is 10G of spare bandwidth available in the optical network, the spare bandwidth in the optical network can be used to connect any router, depending on bandwidth demand of the router network. For example, if there are three routers, it is not known a priori if the demand will make bandwidth-on-demand interface at R1 to be connected to bandwidth-on-demand interface at R2 or R3. For this reason, bandwidth-on-demand interfaces cannot be pre-provisioned with the IP services that are expected to carry.

According to [RFC5623], there are four options of Inter-Layer Path Computation and Inter-Layer Path Control Models: (1) PCE-VNTM cooperation, (2) Higher-layer signaling trigger, (3) NMS-VNTM cooperation model (integrated flavor) and (4) NMS-VNTM cooperation model (separated flavor). In all scenarios there is a certain moment when entities are using an interface to request for a path provisioning. In this document we have selected two use cases in a scenario with routers and optical equipment to obtain the requirements for this draft, but it is applicable to the four options.



Inventions:

- Stateful PCE especially stateful PCE in a multilayer environment. Prior art: Stateless PCE including multilayer environments.
- BW on demand addition in the network based on current util (in a multilayer environment).
- Use of GMPLS signaling in establishing connectivity.
- Creaition of circuits
- Boot strapping on the applications
- Try and error in single layer PCE and avoidance of the try and error in a multilayer PCE case.
- PCE can perform multilayer optimization.

Single Layer PCE: Topology with BW avail. Golden links are part of topology.

Figure 2. Use case higher-layer signaling trigger

2.3. Higher-layer signaling trigger

Figure 2 depicts a multi-layer network scenario similar to the presented in section 4.2.2. [RFC5623], with the difference that PCE is an active stateful PCE [I-D. draft-ietf-pce-stateful-pce].

In this example, O1, O2 and O3 are optical nodes that are connected with router nodes R1, R2 and R3, respectively. The network is designed such that the interface between R1-O1, R2-O2 and R3-O3 are setup to provide bandwidth-on-demand via the optical network.

The example assumes that an active stateful PCE is used for setting and tearing down bandwidth-on-demand connectivity. Although the simple use-case assumes a single PCE server (PCE1), the proposed technique is generalized to cover multiple co-operating PCE case. Similarly, although the use case assumes PCE1 only has knowledge of the L3 topology, the proposed technique is generalized to cover multi-layer PCE case.

The PCE server (PCE1) is assumed to be receiving L3 topology data. It is also assumed that PCE learns L0 (optical) addresses associated with bandwidth-on-demand interfaces R1-O1, R2-O2 and R3-O3. These addresses are referred by OTE-IP-R1 (optical TE link R1-O1 address at R1), OTE-IP-R2 (optical TE link R2-O2 address at R2) and OTE-IP-R3 (optical TE link R3-O3 address at R3), respectively. How PCE learns the optical addresses associated with the bandwidth-on-demand interfaces is beyond the scope of this document.

How knowledge of the bandwidth-on-demand interfaces is utilized by the PCE is exemplified in the following. Suppose an application requests 8 Gbps from R1 to R2 (recall all interfaces in Figure 1 are assumed to be 10G). PCE1 satisfies this by establishing a tunnel using R1-R4-R2 path. PCEP initiated LSP using techniques specified in [I-D. draft-crabbe-pce-pce-initiated-lsp] can be used to establish a PSC tunnel using the R1-R4-R2 path. Now assume another application requests 7 Gbps service between R1 and R2. This request cannot be satisfied without establishing a GMPLS tunnel via optical network using bandwidth-on-demand interfaces. In this case, PCE1 initiates a GMPLS tunnel using R1-O1-O2-R2 path (this is referred as GMPLS tunnel1 in the following). The PCEP initiated LSP using techniques specified in document are used for this purpose.

As mentioned earlier, the GMPLS tunnel created on-the-fly to satisfy bandwidth demand of L3 applications cannot be pre-provisioned in IP network, as bandwidth-on-demand interfaces and spare bandwidth in the optical network are shared. Furthermore, in this example, as active stateful PCE is used for managing PCE-initiated LSP, PCC may not be aware of the intended usage of the PCE-initiated LSP. Specifically, when the PCE1 initiated GMPLS tunnel1, PCC does not know the IGP instance whose demand leads to establishment of the GMPLS tunnel1 and hence does not know the IGP instance in which the GMPLS tunnel1 needs to be advertised. Similarly, the PCC does not know IP address that should be assigned to the GMPLS tunnel1. In the above example, this IP address is labeled as TUN-IP-R1 (tunnel IP address at R1). The PCC also does not know if the tunnel needs to be advertised as forwarding and/ or routing adjacency and/or to be locally used by the target IGP instance. Similarly, egress node for GMPLS signaling (R2 node in this example) may not know the intended usage of the tunnel (tunnel1 in this example). For example, the R2 node does not know IP address that should be assigned to the GMPLS tunnel1. In the above example, this IP address is labeled as TUN-IP-R2 (tunnel IP address at R2). Section 6 of this draft addresses the requirement to specify on how PCC and egress node for signaling should use the PCEP initiated LSPs.

2.4. NMS-VNTM cooperation model (separated flavor)

Figure 3 depicts NMS-VNTM cooperation model. This is the separated flavor, because NMS and VNTM are not in the same location.

A new L3 path is requested from NMS, because there is an automated process in the NMS or after human intervention. NMS does not have information about all network information, so it consults L3 PCE. For shake of simplicity L3-PCE is used, but any other multi-layer cooperating PCE model is applicable. In case that there are enough resources in the L3 layer, L3-PCE returns a L3 only path. On the other hand, if there is a lack of resources at the L3 layer, the response does not have any path or may contain a multilayer path with L3 and L0 (optical) information in case of a ML-PCE. In case of there is not a path in L3; NMS sends a message to the VNTM to create a GMPLS LSP in the lower layer. When the VNTM receives this message, based on the local policies, accepts the suggestion and sends a similar message to the router, which can create the lower layer LSP via UNI signaling in the routers, like in use case in section 2.3.1. Similarly, VNTM may talk with L0-PCE to set-up the path in the optical domain (section 2.2). This second option looks more complex, because it requires VNTM configuring inter-layer TE-links.

Requirements for the message from VNTM to the router are the same than in the previous use case (section 2.3.1). Regarding NMS to VNTM message, the requirements here depends on who has all the information. Three different addresses are required in this use case: (1) L3, (2) L0 and (3) inter-layer addressing. In case there is a non-cooperating L3-PCE, information about inter-layer connections have to be stored (or discovered) by VNTM. If there is a ML-PCE and this information is obtained from the network, the message would be the same than in section 2.3.1.

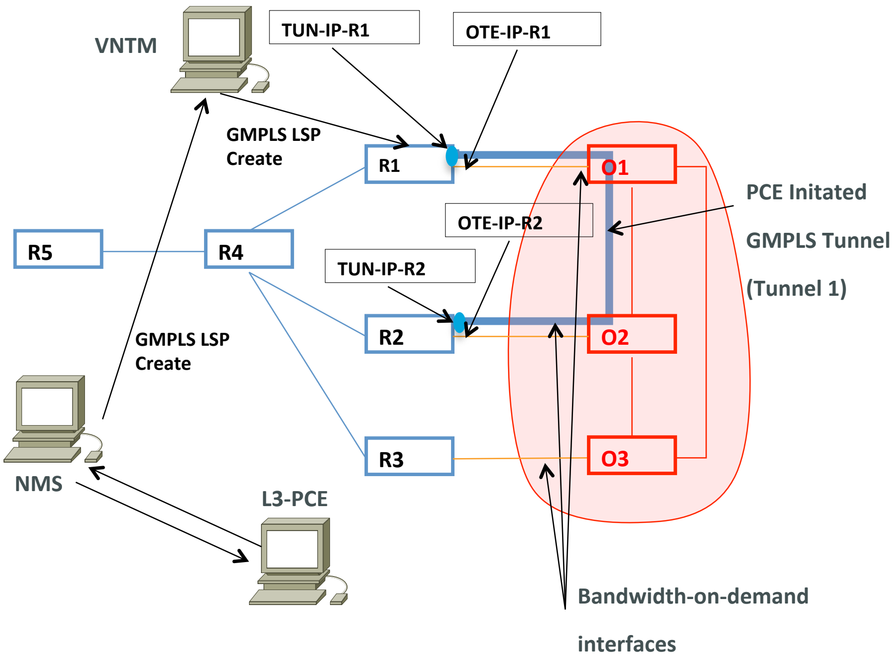


Figure 3. Use case NMS-VNTM cooperation model

3. GMPLS Requirements for Remote-Initiated LSPs

[I-D. draft-crabbe-pce-pce-initiated-lsp] specifies procedures that can be used for creation and deletion of PCE-initiated LSPs under the active stateful PCE model. However, this specification does not address GMPLS requirements outlined in the following:

- GMPLS support multiple switching capabilities on per TE link basis. GMPLS LSP creation requires knowledge of LSP switching capability (e.g., TDM, L2SC, OTN-TDM, LSC, etc.) to be used [RFC3471], [RFC3473].

- GMPLS LSP creation requires knowledge of the encoding type (e.g., lambda photonic, Ethernet, SONET/ SDH, G709 OTN, etc.) to be used by the LSP [RFC3471], [RFC3473].

- GMPLS LSP creation requires information of the generalized payload (G-PID) to be carried by the LSP [RFC3471], [RFC3473].

- GMPLS LSP creation requires specification of data flow specific traffic parameters (also known as Tspec), which are technology specific.

- GMPLS also specifics support for asymmetric bandwidth requests [RFC6387].

- GMPLS extends the addressing to include unnumbered interface identifiers, as defined in [RFC3477].

- In some technologies path calculation is tightly coupled with label selection along the route. For example, path calculation in a WDM network may include lambda continuity and/ or lambda feasibility constraints and hence a path computed by the PCE is associated with a specific lambda (label). Hence, in such networks, the label information needs to be provided to a PCC in order for a PCE to initiate GMPLS LSPs under the active stateful PCE model. I.e., explicit label control may be required.

- GMPLS specifics protection context for the LSP, as defined in [RFC4872] and [RFC4873].

4. Remote Initiated LSP Usage Requirement

The requirement to specify usage of the LSP to the PCC includes but not limited to specification of the following information.

- The target IGP instance for the Remote-initiated LSP needs to be specified.

- In the target IGP instance, should the PCE-initiated LSP be advertised as a forwarding adjacency and/ or routing adjacency and/ or to be used locally by the PCC?

- Should the as Remote-initiated LSP be advertised an IPv4 FA/ RA, IPv6 FA/ RA or as unnumbered FA/ RA.

- If Remote-initiated LSP is to be advertised an IPv4 FA/ RA, IPv6 FA/ RA, what is the local and remote IP address is to be used for the advertisement.

5. PCEP Extensions for Remote-Initiated GMPLS LSPs

Section 3 outlines GMPLS and application requirements that need to be satisfied in order for a PCE to initiate GMPLS LSPs under the active stateful PCE model. The section provides PCEP protocol extensions required to meet these requirements.

LSP create message defined in [I-D. draft-crabbe-pce-pce-initiated-lsp] needs to be extended to include GMPLS specific PCEP objects as follows:

5.1. Generalized Endpoint in LSP Create Message

This document does not modify the usage of END-POINTS object for PCE initiated LSPs as specified in [I-D. draft-crabbe-pce-pce-initiated-lsp]. It augments the usage as specified below.

END-POINTS object has been extended by [I-D. draft-ietf-pcep-gmpls-ext] to include a new object type called “Generalized Endpoint”. PCCreate message sent by a PCE to a PCC to trigger a GMPLS LSP instantiation SHOULD include the END-POINTS with Generalized Endpoint object type. Furthermore, the END-POINTS object MUST contain “label request” TLV. The label request TLV is used to specify the switching type, encoding type and GPID of the LSP being instantiated by the PCE.

As mentioned earlier, the PCE server is assumed to be receiving topology data. In the use case of higher-layer signaling trigger, the addresses associated with bandwidth-on-demand interfaces are included, e.g., OTE-IP-R1, OTE-IP-R2 and OTE-IP-R3, in the use case example. These addresses and R1, R2 and R3 router IDs are used to derive source and destination address of the END-POINT object. As previously mentioned, in the case of NMS-VNMT cooperation model with L3 PCE, VNTM must receive such inter-layer interface association to configure the whole path.

The unnumbered endpoint TLV can be used to specify unnumbered endpoint addresses for the LSP being instantiated by the PCE. The END-POINTS MAY contain other TLVs defined in [I-D. draft-ietf-pcep-gmpls-ext].

If the END-POINTS Object of type Generalized Endpoint is missing the label request TLV, the PCC MUST send a PCErr message with Error-type=6 (Mandatory Object missing) and Error-value= TBA (LSP request TLV missing).

If the PCC does not support the END-POINTS Object of type Generalized Endpoint, the PCC MUST send a PCErr message with Error-type= ???? and Error-value= ???. [??? = already defined values to be looked up].

5.2. GENERALIZED-BANDWIDTH object in LSP Create Message

LSP create message defined in [I-D. draft-crabbe-pce-pce-initiated-lsp] can optionally include the BANDWIDTH object. However, the following possibilities cannot be represented in the BANDWIDTH object:

- Asymmetric bandwidth (different bandwidth in forward and reverse direction), as described in [RFC6387].

- Technology specific GMPLS parameters (e.g., Tspec for SDH/SONET, G.709, ATM, MEF, etc.) are not supported.

GENERALIZED-BANDWIDTH object has been defined in [I-D. draft-ietf-pcep-gmpls-ext] to address the above-mentioned limitation of the BANDWIDTH object.

This document specifies the use of GENERALIZED-BANDWIDTH object in PCCreate message. Specifically, GENERALIZED-BANDWIDTH object MAY be included in the PCCreate message. The GENERALIZED-BANDWIDTH object in PCCreate message is used to specify technology specific Tspec and asymmetrical bandwidth values for the LSP being instantiated by the PCE.

5.3. Protection Attributes in LSP Create Message

This document does not modify the usage of LSPA object for PCE initiated LSPs as specified in [I-D. draft-crabbe-pce-pce-initiated-lsp]. It augments the usage of LSPA object in LSP Create Message to carry the end-to-end protection context this also includes the protection state information.

The LSP Protection Information TLV of LSPA in the PCCreate message can be used to specify protection attributes of the LSP being instantiated by the PCE.

5.4. ERO in LSP Create Object

This document does not modify the usage of ERO object for PCE initiated LSPs as specified in [I-D. draft-crabbe-pce-pce-initiated-lsp]. It augments the usage as specified in the following sections.

5.4.1. ERO with explicit label control

As mentioned earlier, there are technologies and scenarios where active stateful PCE requires explicit label control in order to instantiate an LSP.

Explicit label control (ELC) is a procedure supported by RSVP-TE, where the outgoing label(s) is (are) encoded in the ERO. [I-D. draft-ietf-pcep-gmpls-ext] extends the <ERO> object of PCEP to include explicit label control. The ELC procedure enables the PCE to provide such label(s) directly in the path ERO.

The extended ERO object in PCCreate message can be used to specify label along with ERO to PCC for the LSP being instantiated by the active stateful PCE.

5.4.2. ERO with Path Keys

There are many scenarios in packet and optical networks where the route information of an LSP may not be provided to the PCC for confidentiality reasons. A multi-domain or multi-layer network is an example of such networks. Similarly, a GMPLS User-

Network Interface (UNI) [RFC4208] is also an example of such networks.

In such scenarios, ERO containing the entire route cannot be provided to PCC (by PCE). Instead, PCE provides an ERO with Path Keys to the PCC. For example, in the case UNI interface between the router and the optical nodes, the ERO in the LSP Create Message may be constructed as follows:

- The first hop is a strict hop that provides the egress interface information at PCC. This interface information is used to get to a network node that can extend the rest of the ERO. (Please note that in the cases where the network node is not directly connected with the PCC, this part of ERO may consist of multiple hops and may be loose).
- The following(s) hop in the ERO may provide the network node with the path key [RFC5520] that can be resolved to get the contents of the route towards the destination.
- There may be further hops but these hops may also be encoded with the path keys (if needed).

This document does not change encoding or processing roles for the path keys, which are defined in [RFC5520].

5.4.3. Switch Layer Object

[draft-ietf-pce-inter-layer-ext-07] specifies the SWITCH-LAYER object which defines and specifies the switching layer (or layers) in which a path MUST or MUST NOT be established. A switching layer is expressed as a switching type and encoding type. [I-D. draft-ietf-pcep-gmpls-ext], which defines the GMPLS extensions for PCEP, suggests using the SWITCH-LAYER object. Thus, SWITCH-LAYER object can be used in the PCCreate message to specify the switching layer (or layers) of the LSP being remotely initiated.

6. PCEP extension for PCEP Initiated LSP Usage Specification

The requirement to specify on how PCC should use the PCEP initiated LSPs in outlined in Section 4. This subsection specifies PCEP extension used to satisfy this requirement.

PCEP extensions specified in this section are equally applicable to PCEP initiated MPLS as well as GMPLS LSPs.

6.1. LSP_TUNNEL_INTERFACE_ID Object in LSP Create Message

[RFC6107] defines LSP_TUNNEL_INTERFACE_ID Object for communicating usage of the forwarding or routing adjacency from the ingress node to the egress node. This document extends the LSP Create Message to include LSP_TUNNEL_INTERFACE_ID object defined in [RFC6107]. Object class and type for the LSP_TUNNEL_INTERFACE_ID object are as follows:

Object Name: LSP_TUNNEL_INTERFACE_ID

Object-Class Value: TBA by Iana (suggested value: 40)

Object-type: 1

The contents of this object are identical in encoding to the contents of the RSVP-TE LSP_TUNNEL_INTERFACE_ID object defined in [RFC6107] and [RFC3477]. The following TLVs of RSVP-TE LSP_TUNNEL_INTERFACE_ID object are acceptable in this object. The PCEP LSP_TUNNEL_INTERFACE_ID object's TLV types correspond to RSVP-TE LSP_TUNNEL_INTERFACE_ID object's TLV types. Please note that use of TLV type 1 defined in [RFC3477] is not specified by this document.

TLV Type	TLV Description	Reference
2	IPv4 interface identifier with target IGP instance	[RFC6107]
3	IPv6 interface identifier with target IGP instance	[RFC6107]
4	Unnumbered interface with target IGP instance	[RFC6107]

The meanings of the fields of PCEP LSP_TUNNEL_INTERFACE_ID object are identical to those defined for the RSVP-TE LSP_TUNNEL_INTERFACE_ID object. Similarly, meanings of the fields of PCEP LSP_TUNNEL_INTERFACE_ID object's supported TLV are identical to those defined for the corresponding RSVP-TE LSP_TUNNEL_INTERFACE_ID object's TLVs. The following fields have slightly different usage.

- IPv4 Interface Address field in IPv4 interface identifier with target IGP instance TLV: This field indicates the local IPv4 address to be assigned to the tunnel at the PCC (ingress node for RSVP-TE signaling). In the example use case of Section 2, IP address TUN-IP-R1 (tunnel IP address at R1) is carried in this field (if TUN-IP-R1 is a v4 address).

- IPv6 Interface Address field in IPv4 interface identifier with target IGP instance TLV: This field indicates the local IPv6 address to be assigned to the tunnel at the PCC (ingress node for RSVP-TE signaling). In the example use case of Section 2, IP address TUN-IP-R1 (tunnel IP address at R1) is carried in this field (if TUN-IP-R1 is a v6 address).

- LSR's Router ID field in Unnumbered interface with target IGP instance: The PCC SHOULD use the LSR's Router ID in Unnumbered interface with target IGP instance in advertising the LSP being initiated by the PCE. In the example use case of Section 2, this field carries router-id of R1 in the target IGP instance.

- Interface ID (32 bits) field in unnumbered interface with target IGP instance: All bits of this field MUST be set to 0 by the PCE server and MUST be ignored by PCC. PCC SHOULD allocate an Interface ID that fulfills Interface ID requirements specified in [RFC3477].

When the Ingress PCC receives an LPS Request Message with LSP_TUNNEL_INTERFACE_ID TLV, it uses the information contained in the TLV to drive the IGP instance, treatment of the LSP being initiated in the target IGP instance (e.g., FA, RA or local usage), the local IPv4 or IPv6 address or router-id for unnumbered case to be used for advertisement of the LSP being instantiated.

6.2. Communicating LSP usage to Egress node

PCE does not need to send LSP Create message to egress node (node R2 in the example of section 2) to communicate LSP usage information. Instead PCC (Ingres signaling node) uses RSVP-TE signaling mechanism specified in [RFC6107] to send the LSP usage to Egress node. Specifically, when the Ingress PCC receives an LPS Request Message with LSP_TUNNEL_INTERFACE_ID TLV, it SHOULD add LSP_TUNNEL_INTERFACE_ID object in RSVP TE Path message. For this purpose, it is RECOMMENDED that the ingress PCC uses content of the LSP_TUNNEL_INTERFACE_ID TLV in LSP Create Message in PCEP to drive LSP_TUNNEL_INTERFACE_ID object in RSVP-TE. This document does not modify usage of LSP_TUNNEL_INTERFACE_ID Object in RSVP-TE signaling as specified in [RFC6107].

The egress node uses information contained in the LSP_TUNNEL_INTERFACE_ID object in RSVP-TE Path message to drive the IGP instance, treatment of the LSP being initiated in the target IGP instance (e.g., FA, RA or local usage), the local IPv4 or IPv6 address or router-id for unnumbered case to be used for advertisement of the LSP being instantiated.

6.3. LSP delegation and cleanup

LSP delegation and cleanup procedure specified in [I-D. draft-ietf-pcep-gmpls-ext] are equally applicable to GMPLS LSPs and this document does not modify the associated usage.

7. Security Considerations

To be added in future revision of this document.

8. IANA Considerations

8.1. END-POINT Object

This document extends the LSP Create Message to include LSP_TUNNEL_INTERFACE_ID object defined in [RFC6107]. Object class and type for the LSP_TUNNEL_INTERFACE_ID object are as follows:

Name	Class value	Type
LSP_TUNNEL_INTERFACE_ID	TBA by Iana (Suggested:40)	1

8.2. PCEP-Error Object

This document defines the following new Error-Value:

Error-Type	Error Value
6	Error-value=TBA: LSP Request TLV missing

9. Acknowledgments

The authors would like to thank George Swallow and Jan Medved for their comments.

10. References

10.1. Normative References

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10.2. Informative References

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