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PCE Multi-layer LSP Association
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Abstract

The Path Computation Element Communication Protocol (PCEP) provides mechanisms for Path Computation Elements (PCEs) to perform path computations in response to Path Computation Clients (PCCs) requests. [I-D.ietf-pce-association-group] proposed an association mechanism for a set of LSPs.

This document proposes a set of extensions to PCEP to associate a grouping of multi-layer LSPs. The extensions define a mechanism to create associations between upper-layer LSP and related lower-layer LSPs.

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1. Introduction

[RFC5440] describes the Path Computation Element Protocol (PCEP) which is used between a Path Computation Element (PCE) and a Path Computation Client (PCC) (or other PCE) to enable computation of Multi-protocol Label Switching (MPLS) for Traffic Engineering Label Switched Path (TE LSP). [I-D.ietf-pce-association-group] proposed an association mechanism to create a grouping of LSPs in the context of a PCE.

This document proposes a set of extensions to PCEP to associate a grouping of multi-layer LSPs. The extensions define a mechanism to create associations between upper-layer LSP and related lower-layer LSPs.

2. Requirements Language

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].

2.1. Terminology

The terminology is defined as [RFC5440] ,[I-D.ietf-pce-stateful-pce-app] and [I-D.ietf-pce-association-group].

3. Overview

3.1. Motivation

In GMPLS/MPLS networks, service provider network is divided into several service layers according to the requirements and customer network is the upper layer with the lower layers as the Forwarding Adjacency LSP (FA-LSP) as shown in Figure 1. The service connection is established with the set up of multi-layer LSPs.

```
                 Initiate & Update LSP and related lower LSPs
                                   |
                                   |
                                   V
                              +---+--+
                 +--------------+ PCE  +---------------+
                 |            +---+--+               |
                 |                |                  |
                 |                |                  |
                 |                |                  |
            +---+--+          +---+--+          +---+--+
            | PCC1 +-----------+ PCC2 +-----------+ PCC3 +
            +------+   LSP1->  +------+  LSP2->   +------+
                 |                                   |
                 |<------          LSP3          ----->|
```

Figure 1 Usecase for multi-layer LSPs

As discussed in [I-D.ietf-pce-stateful-pce-app] , it consists of a set of one or more TE LSPs in the lower layer which provides TE links to the upper layer in Multi-Layer Networks (MLN). The requirement is to control of the multi-layer LSPs and related TE links. The establishment or teardown of a lower layer LSP needs to take into consideration the state of existing LSPs or new LSP request in the upper layer.

As discussed in [I-D.ietf-pce-stateful-pce] , the stateful PCE MAY determine to optimize the link and path based on the lower layer of the LSP and its upper TE Link, and in the case of the failure of the lower level LSP, it MAY update the upper network LSP path according to the existing resources and the status of the LSP.

The stateful PCE provides the ability to update the LSP, in the process of bandwidth adjustment, it MAY be necessary to adjust the bandwidth of related lower layer LSPs, which provide the TE link for the upper layer LSP. The association of multi-layer LSPs can reduce the repeated operations and optimize the information interaction between PCC and PCE.

In overlayer multi-domain scenario, the lower-layer LSPs in each domain may be initiated by respective domain's PCE and stitched together to an association group with an end-to-end LSP as its upper-layer LSP.

In these cases, it is necessary to add multi-layer LSPs to an association group.

3.2. Operation Overview

[I-D.ietf-pce-association-group] introduces a generic mechanism to create a grouping of LSPs. This grouping can then be used to define associations between sets of LSPs or between a set of LSPs and a set of attributes.

In order to solve the problem of multi-layer LSP control in PCE network, this document proposes the association if the multi-layer LSPs. The upper LSP is associated with its related lower LSPs by adding them to a multi-layer association group.

One new optional Association Object type is defined carried in the Association object defined in [I-D.ietf-pce-association-group]. This document proposes a new association type called "Layer Association Type" and related TLV called "LAYER-ASSOCIATION TLV".

As defined in [I-D.ietf-pce-association-group], multi-layer LSPs associations could be created dynamically or configured by the operator when operator-configured association is needed.

The handling and policy of multi-layer LSPs Association is similar to the generic association and some processing rules as shown in session 4.2.

4. Extensions to the PCEP

4.1. Association Type and Group

[I-D.ietf-pce-association-group] introduces the ASSOCIATION object and this document proposes a new Association type for multi-layer LSPs association to associate multi-layer LSPs into one group for further operation. An association ID will be used to identify the group and a new Association Type is defined in this document, based on the generic Association object :

Association type = TBD1 ("Multi-Layer Association Type") for Multi-Layer Association Group (MLAG)

MLAG may carry optional TLVs including but not limited to :

MULTI-LAYER-ASSOCIATION-TLV: Used to identify the upper-layer LSP and lower-layer LSP in multi-layer information, described in Section 4.2.

As [I-D.ietf-pce-association-group] specified, the capability advertisement of the association types supported by a PCEP speaker is performed by defining a ASSOC-Type-List TLV to be carried within an OPEN object. The association type which defined in this document should be added in the list and be advertised between the PCEP speakers before the multi-layer association.

This Association-Type is operator-configured and created by the operator manually on the PCEP peers. The LSP belonging to this associations is conveyed via PCEP messages to the PCEP peer. Operator-configured Association Range SHOULD NOT be set for this association-type, and MUST be ignored, so that the full range of association identifier can be utilized.

4.2. MULTI-LAYER-ASSOCIATION TLV

This document proposes LAYER-ASSOCIATION TLV for the association of multi-layer LSPs. The TLV is optional. The format of the new Association TLV is shown in Figure 4:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Type = TBD         |           Length              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Layer Association Flags                    |H|L|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 4: The LAYER-ASSOCIATION TLV format

The type of the TLV is [TBD] which indicates the LAYER ASSOCIATION TLV. The fields in the format are:

Length:16bits,the length of the TLV.

Layer Association Flags-H:1bit, indicates LSP of the upper layer when it is set.

Layer Association Flags-L:1bit, indicates LSP of the lower layer when it is set.

5. PCEP Procedure

Once a group of multilayer LSPs is created, the upper layer LSP is associated with its related lower layer LSPs. Association objects can be carried in PCReq, PCRpt, PCUpd, or PCInit messages.

5.1. Multi-Layer LSPs Associations Creation

As defined in [I-D.ietf-pce-association-group], association groups can be created by both PCC and PCE.

In stateless PCE, the association object with "Layer Association type" is carried in PCReq message from PCC to PCE, indicating that the LSP joins one existing multi-layer LSPs association group or create a new one. If the LSP is belong to upper layer then set the "H" bit in "LAYER-ASSOCIATION TLV", otherwise set the "L" bit when it is lower layer LSP.

In stateful PCE, PCE MAY create a new association group or associate a LSP to an existing association group carried in PCInit message after the LSP delegation from PCC to the PCE as discussed in [I-D.ietf-pce-pce-initiated-lsp]. In state synchronization process between PCC and PCE, PCC also need to report the existing multi-layer LSPs association groups to PCE. If the association group changes, PCC needs to report the relevant group changes to PCE through the PCRpt message.

5.2. Bandwidth Adjustment

The stateful PCE provides the ability to update the LSP, in the process of bandwidth adjustment, for example, enlarge the bandwidth of the upper layer LSP, it MUST be necessary to adjust the bandwidth of related lower layer LSPs, which provide the TE link for it.

Once the multi-layer LSPs associated in a group, the PCE MAY send the PCUpd message to the PCC with the association object to adjust the upper layer LSP. Once receiving the request, PCC will search the

relevant lower layer LSPs and adjust their bandwidth before the adjustment of the upper layer LSP.

5.3. TE Links Optimization

The stateful PCE MAY determine to optimize the link and path based on the lower layer of the LSP and its upper TE Link, and in the case of the failure of the lower level LSP, it MAY update the upper network LSP path and re-optimize resource usage across multi-layers.

When removing the upper layer LSP, PCC or PCE MAY release each of lower layer LSPs which associated in a group and re-use the resources for other upper layer LSP according to the existing resources and the status of the LSP.

6. Security Considerations

TBD

7. IANA Considerations

7.1. Association Object Type

This document defines a new association type in Association object which originally defined in [I-D.ietf-pce-association-group]. IANA is requested to make allocations from the registry, as follows:

Value	Name	Reference
TBD	Layer Association Type	[this document]

Table 1

7.2. LAYER-ASSOCIATION TLV

This document defines the following TLV in Association object which originally defined in [I-D.ietf-pce-association-group]. IANA is requested to make allocations from the registry, as follows:

Value	Name	Reference
TBD	LAYER-ASSOCIATION TLV	[this document]

Table 2

8. Acknowledgements

TBD.

9. References

9.1. Informative References

[I-D.ietf-pce-stateful-pce-app]
Zhang, X. and I. Minei, "Applicability of a Stateful Path Computation Element (PCE)", draft-ietf-pce-stateful-pce-app-08 (work in progress), October 2016.

9.2. Normative References

[I-D.ietf-pce-association-group]
Minei, I., Crabbe, E., Sivabalan, S., Ananthakrishnan, H., Dhody, D., and Y. Tanaka, "PCEP Extensions for Establishing Relationships Between Sets of LSPs", draft-ietf-pce-association-group-06 (work in progress), June 2018.

[I-D.ietf-pce-pce-initiated-lsp]
Crabbe, E., Minei, I., Sivabalan, S., and R. Varga, "PCEP Extensions for PCE-initiated LSP Setup in a Stateful PCE Model", draft-ietf-pce-pce-initiated-lsp-11 (work in progress), October 2017.

[I-D.ietf-pce-stateful-pce]
Crabbe, E., Minei, I., Medved, J., and R. Varga, "PCEP Extensions for Stateful PCE", draft-ietf-pce-stateful-pce-21 (work in progress), June 2017.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

[RFC5440] Vasseur, JP., Ed. and JL. Le Roux, Ed., "Path Computation Element (PCE) Communication Protocol (PCEP)", RFC 5440, DOI 10.17487/RFC5440, March 2009, <https://www.rfc-editor.org/info/rfc5440>.

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