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Path Computation Element Communication Protocol Extensions for Associated Bidirectional Label Switched Paths (LSPs) draft-barth-pce-association-bidir-00

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. The stateful PCE extensions allow stateful control of Multi-Protocol Label Switching (MPLS) Traffic Engineering (TE) Label Switched Paths (LSPs) using PCEP.

This document defines Path Computation Element Communication Protocol (PCEP) extensions for binding two reverse unidirectional RSVP-TE LSPs into an Associated Bidirectional Label Switched Path (LSP).

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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1. Introduction

[RFC5440] describes the Path Computation Element Protocol (PCEP) as a communication mechanism between a Path Computation Client (PCC) and a Path Control Element (PCE), or between PCE and PCC, that enables computation of Multi-Protocol Label Switching (MPLS) Traffic Engineering (TE) Label Switched Paths (LSPs).

[I-D.ietf-pce-stateful-pce] specifies extensions to PCEP to enable stateful control of MPLS TE LSPs. It describes two modes of operation - Passive stateful PCE and Active stateful PCE. In this [I-D.ietf-pce-stateful-pce] document, the focus is on Active stateful PCE where LSPs are can be provisioned on the PCC and control over them is delegated to a PCE. Further [I-D.ietf-pce-pce-initiated-lsp] describes the setup, maintenance and teardown of PCE-initiated LSPs for the stateful PCE model.

[I-D.ietf-pce-association] introduces a generic mechanism to create a grouping of LSPs which can then be used to define associations between a set of LSPs and/or a set of attributes, for example primary and secondary LSP associations, and is equally applicable to the active and passive modes of a stateful PCE [I-D.ietf-pce-stateful-pce] or a stateless PCE [RFC5440].

The MPLS Transport Profile (MPLS-TP) requirements document [RFC5654] specifies that MPLS-TP MUST support associated bidirectional point-to-point LSPs. [RFC7551] specifies RSVP signaling extensions for binding two reverse unidirectional LSPs into an associated bidirectional LSP.

This document specifies PCEP extensions for binding two reverse unidirectional RSVP-TE LSPs into an Associated Bidirectional LSP for both single-sided and double-sided provisioning.

2. Conventions Used in This Document

2.1. Key Word Definitions

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].

2.2. Acronyms and Abbreviations

LSP: Label Switched Path

LSR: Label Switching Router

MPLS: Multi-Protocol Label Switching

PCEP: Path Computation Element Communication Protocol

2.3. Terminology

The following terminology is used in this document.

Active Stateful PCE: PCE that uses tunnel state information learned from PCCs to optimize path computations. Additionally, it actively updates tunnel parameters in those PCCs that delegated control over their tunnels to the PCE.

PCC: Path Computation Client. Any client application requesting a path computation to be performed by a Path Computation Element.

PCE: Path Computation Element. An entity (component, application, or network node) that is capable of computing a network path or route based on a network graph and applying computational constraints.

3. Overview

As shown in Figure 1, two reverse unidirectional LSPs can be associated to form an associated bidirectional LSP. There are two methods of initiating the bidirectional LSP association, single-sided and double-sided as described in the following sections.

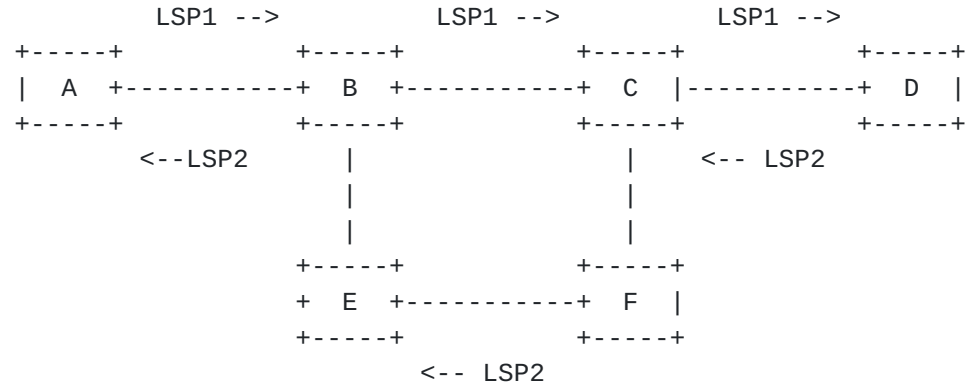

Figure 1: An Example of Associated Bidirectional LSP

3.1. Single-sided Initiation

As specified in [RFC7551], in the single-sided provisioning case, the bidirectional tunnel is signaled only on one ingress LSR of a LSP tunnel. Both forward and reverse LSPs for this tunnel are initiated by the PCE with the Association Type set to "Single-sided

Bidirectional LSP Association" on the originating ingress PCC. The originating PCC identifies the forward and reverse LSPs in the TLV of the Association Objects. The originating endpoint uses the signaled properties for the revere LSP in the RSVP REVERSE_LSP Object [RFC7551] of the forward LSP Path message. The remote endpoint then creates the corresponding reverse tunnel and signals the reverse LSP in response to the received RSVP Path message. The two unidirectional reverse LSPs on the originating endpoint node are bound together using the PCEP signaled Association Objects and on the remote endpoint node by the RSVP signaled Association Objects. As shown in Figure 1, LSP1 and LSP2 are provisioned on the originating endpoint A by the PCE peer. The creation of reverse LSP2 on the remote endpoint D is triggered by the RSVP signaled LSP1.

3.2. Double-sided Initiation

As specified in [RFC7551], in the double-sided provisioning case, the bidirectional tunnel is provisioned on both endpoint nodes(PCCs) of the tunnel. The reverse LSPs for this tunnel are initiated by the PCE peer with Association Type set to "Double-sided Bidirectional LSP Association" on both ingress PCCs. The two reverse unidirectional LSPs on both PCCs are bound together by using the PCEP signaled Association Objects. As shown in Figure 1, LSP1 is provisioned on the endpoint A and LSP2 is provisioned on the endpoint node D, both by the PCEP peer.

3.3. Co-routed Associated Bidirectional LSP

In both single-sided and double-sided initiation cases, forward and reverse LSPs may be co-routed as shown in Figure 2, where both forward and reverse LSPs follow the same congruent path.

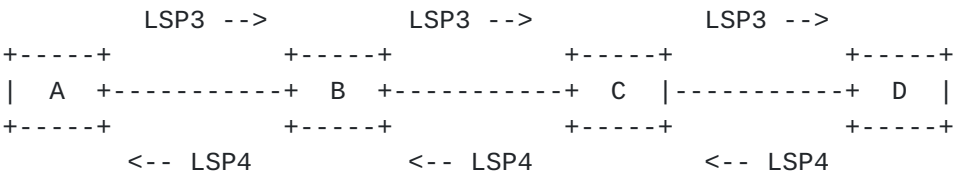

Figure 2: An Example of Co-routed Associated Bidirectional LSP

4. Protocol Extensions

4.1. Association Object

As per [I-D.ietf-pce-association], LSPs are associated by adding them to a common association group.

This document defines two new Association Types for the Association Object as follows:

- Association Type (TBD1) = Single-sided Bidirectional LSP Association

- Association Type (TBD2) = Double-sided Bidirectional LSP Association

The Association ID, Association Source, Global Association Source and Extended Association ID in the Association Object of the bidirectional LSP are provisioned by the PCE using the procedures defined in [RFC7551].

4.2. Bidirectional LSP Association TLV

The Bidirectional LSP Association TLV is an optional TLV for use with the Bidirectional LSP Association Type in the single-sided provisioning case.

- The Bidirectional LSP Association TLV follows the PCEP TLV format from [RFC5440].

- The type (16 bits) of the TLV is TBD3, to be assigned by IANA.

- The length is 4 Bytes.

- The value comprises of a single field, the Bidirectional LSP Association Flags (32 bits), where each bit represents a flag option.

- If the Bidirectional LSP Association TLV is missing, it means the LSP is the forward LSP.

- The Bidirectional LSP Association TLV MUST NOT be present more than once. If it appears more than once, only the first occurrence is processed and any others MUST be ignored.

The format of the Bidirectional LSP Association TLV is shown in Figure 3:

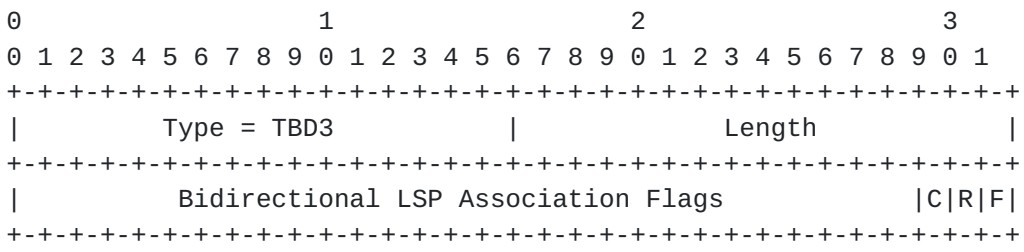

Figure 3: Bidirectional LSP Association TLV format

F (FORWARD-LSP, 1 bit) - Indicates whether the LSP associated is the forward LSP of the bidirectional LSP. If this flag is set, the LSP is a forward LSP.

R (REVERSE-LSP, 1 bit) - Indicates whether the LSP associated is the reverse LSP of the bidirectional LSP. If this flag is set, the LSP is a reverse LSP.

C (Co-ROUTED-LSP, 1 bit) - Indicates whether the bidirectional LSP is co-routed. If this flag is set, the bidirectional LSP is co-routed.

5. Security Considerations

This document introduces two new Association Types for the Association Object, Double-Sided Associated Bidirectional LSP and Single-Sided Associated Bidirectional LSP. These types, by themselves, introduce no additional security concerns beyond those discussed in [RFC5440], [I-D.ietf-pce-stateful-pce] and [I-D.ietf-pce-association].

6. IANA Considerations

6.1. Association Types

This document defines the following Association Types for the Association Object defined [I-D.ietf-pce-association].

Value	Name	Reference
TBD1	Single-sided Bidirectional LSP Association	[This I.D.]
TBD2	Double-sided Bidirectional LSP Association	[This I.D.]

6.2. Bidirectional LSP Association TLV

This document defines a new TLV for carrying additional LSP information for the bidirectional LSP association type as follows:

TLV Type Value	TLV Name	Reference
TBD3	Bidirectional LSP Association TLV	This document

7. Manageability Considerations

7.1. Control of Function and Policy

An operator MUST be allowed to provision the bidirectional LSP association parameters at PCEP peers.

8. Acknowledgments

TBA.

9. References

9.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC5440] Vasseur, JP., Ed. and JL. Le Roux, Ed., "Path Computation Element (PCE) Communication Protocol (PCEP)", RFC 5440.

[RFC7551] Zhang, F., Ed., Jing, R., and Gandhi, R., Ed., "RSVP-TE Extensions for Associated Bidirectional LSPs", RFC 7551, May 2015.

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

[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 (work in progress).

9.2. Informative References

[RFC5654] Niven-Jenkins, B., Ed., Brungard, D., Ed., Betts, M., Ed., Sprecher, N., and S. Ueno, "Requirements of an MPLS Transport Profile", RFC 5654, September 2009.

[RFC7420] Koushik, A., Stephan, E., Zhao, Q., King, D., and J. Hardwick, "Path Computation Element Communication Protocol (PCEP) Management Information Base (MIB) Module", RFC 7420, December 2014.

[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 (work in progress).

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