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PCE Redundancy Extensions in Path Computation Element Communication
Protocol (PCEP)
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Abstract

The Path Computation Element Communication Protocol (PCEP) provides mechanisms for Path Computation Elements (PCEs) to instantiate and manage Label Switched Paths (LSPs) on a Path Computation Client (PCC).

A PCE redundancy case is very important and has no real solution for many cases, like as active-standby, active-active or not concurrent sessions of PCC with different PCEs.

This document proposes extensions to PCEP to allow a PCC and PCEs to support PCE fast and smooth redundancy in case of PCEP session and PCE failure.

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1. Introduction

PCE redundancy case is very important and complicate scenario, as PCEP protocol doesn't support exchange of session information between PCEs.

1.1. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

2. Terminology

This document uses the following terms defined in [RFC5440]: PCC, PCE, PCEP Peer, and PCEP speaker.

The base PCEP specification [RFC4655] originally defined the use of the PCE architecture for MPLS and GMPLS networks with LSPs instantiated using the RSVP-TE signaling protocol. Over time, support for additional path setup types, such as SRv6, has been introduced [RFC9603]. The term "LSP" is used extensively in PCEP specifications and, in the context of this document, refers to a Candidate Path within an SR Policy, which may be an SRv6 path (still represented using the LSP Object as specified in [RFC8231]).

3. PCEP Extensions

Let's consider simple configuration:

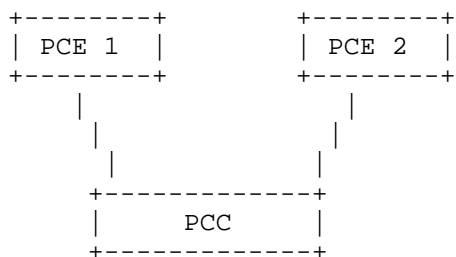
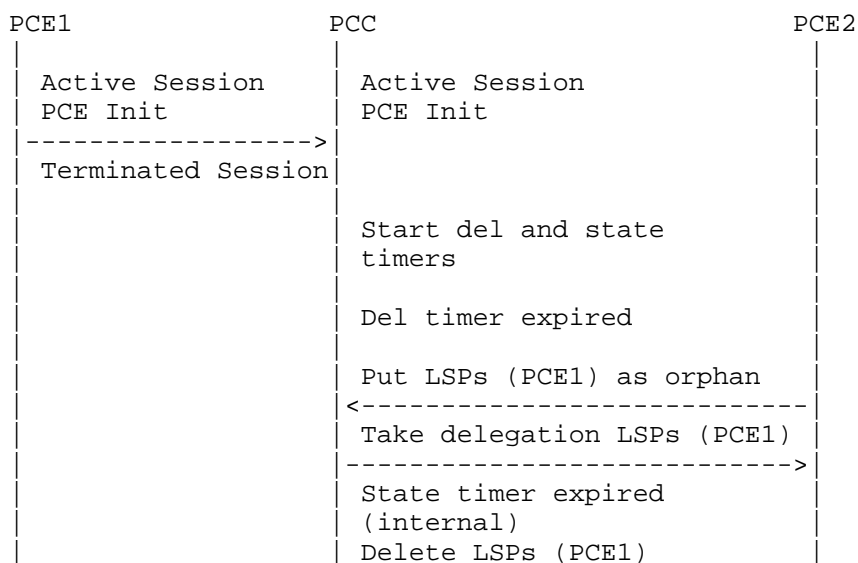


Figure 1: PCE redundancy



Note:

PCE2 session can be created/exist in different states after or in parallel with PCE1 session and others.

Only in the timeslot between expiration of the deletion timer and the state timer, PCE2 can take delegation.

Figure 2: PCE redundancy and take delegation timeslot

A PCE1 can instantiate LSPs on a PCC. When session between PCE1 and PCC is terminated, PCC starts delegation and state timers.

Once delegation timer is expired, all LSPs are changed to orphan. Once state timer is expired, all LSPs in orphan state are deleted by PCC.

PCE2 can take delegation of orphan LSPs only, but doesn't aware about timers of PCE1-PCC session.

This document specifies PCEP extensions to handle this situation in different scenarios:

Multiple parallel sessions in mode active-standby Multiple parallel sessions in mode active-active Sequential sessions (one session is terminated, then another session is established)

3.1. OPEN Object

This document defines one new flag for use in the STATEFUL-PCE-CAPABILITY TLV.

3.1.1. STATEFUL-PCE-CAPABILITY TLV

A new flag is proposed for the STATEFUL-PCE-CAPABILITY TLV, originally defined in Section 5.4 of [RFC8231].

* D (DELEGATION-INFO-CAPABILITY): If set, indicates that the PCEP peer supports LSP delegation info.

3.2. LSP object

New TLV with address of PCE to which LSP is delegated SHALL be added:

```

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

```

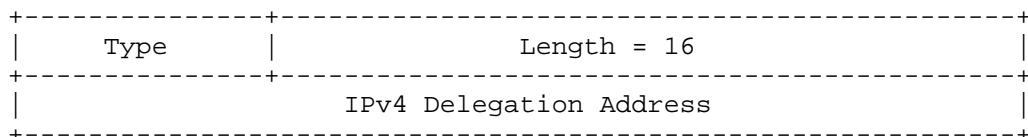


Figure 2: Delegated PCE IPv4 address

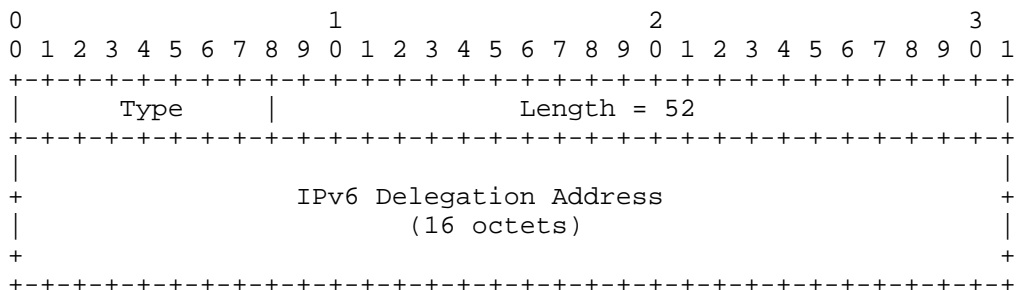


Figure 3: Delegated PCE IPv6 address

PCC SHALL send this TLV for any delegated LSP to all PCEs with active session in PCRpt message.

3.3. DELEGATION-TIMER-EXPIRATION TLV

New NT (notification type) and NV (notification value) are required for

PCNtf:

New NT - Delegation timeout

New NV - TBD

New DELEGATION-TIMER-EXPIRATION TLV is required in Notification (PCNtf)

Message MUST be used for this new NT:

PCE address (was owner) for session with its delegation timer expired.

PCC SHALL send this message to all PCEs with active session.

4. Operation

After receiving the PCNtf message with new NT, the active PCE SHALL/MAY take delegation for all LSPs that were delegated to this PCE (LSP with this IP delegated address)

4.1. Optional extension for take delegation action

Here, maybe, new sub-TLV or new flag in PCInit message will help: get all LSPs were delegated to specific IP (like as PLSP ID = 0 in PCInit with remove flag message means deletion for all PCE initiated LSPs):

New flag in PCInit: D take delegation, PLSP ID = 0, New sub-TLV: Address of the last delegation PCE

PCC SHALL send list of above LSPs with new delegation address and delegation flag

Note: : if there are more than 2 parallel session, the first PCE sent get delegation all, will get it ownership, P CC is responsible to lock other PCEs for it

5. Manageability Considerations

All manageability requirements and considerations listed in [RFC5440], [RFC8231], and [RFC9604] apply to the PCEP extensions defined in this document.

A PCE or PCC implementation MAY allow the capability of supporting PCEP extensions introduced in this document to be enabled/disabled as part of the global configuration. An implementation SHOULD allow the operator to view the advertised and received capabilities.

6. Security Considerations

The security considerations described in [RFC5440], [RFC8231], and [RFC9604] are applicable to this document. No additional security measures are required.

7. IANA Considerations

7.1. STATEFUL-PCE-CAPABILITY TLV Flag

IANA maintains a registry, named "STATEFUL-PCE-CAPABILITY TLV Flag Field", within the "Path Computation Element Protocol (PCEP) Numbers" registry group. IANA is requested to make the following assignment:

| Bit | Description | Reference |
|------|--------------------------------|---------------|
| TBD1 | D (DELEGATION-INFO-CAPABILITY) | This document |

Table 1

7.2. LSP object

IANA maintains a registry, named "TE-PATH-BINDING TLV Flag Field", within the "Path Computation Element Protocol (PCEP) Numbers" registry group. IANA is requested to make the following assignments:

| N | Description | Reference |
|------|-------------------------|---------------|
| TBD2 | IPv4 delegation address | This document |
| TBD3 | IPv6 delegation address | This document |

Table 2

7.3. PCNtf message DELEGATION-TIMER-EXPIRATION TLV

| N | Description | Reference |
|------|------------------------------|---------------|
| TBD4 | PCE address (was owner) IPv4 | This document |
| TBD5 | PCE address (was owner) IPv6 | This document |
| TBD6 | Delegation timeoutr | This document |

Table 3

8. References

8.1. Normative References

- [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>>.
- [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/info/rfc8174>>.
- [RFC8231] Crabbe, E., Minei, I., Medved, J., and R. Varga, "Path Computation Element Communication Protocol (PCEP) Extensions for Stateful PCE", RFC 8231, DOI 10.17487/RFC8231, September 2017, <<https://www.rfc-editor.org/info/rfc8231>>.
- [RFC8664] Sivabalan, S., Filsfils, C., Tantsura, J., Henderickx, W., and J. Hardwick, "Path Computation Element Communication Protocol (PCEP) Extensions for Segment Routing", RFC 8664, DOI 10.17487/RFC8664, December 2019, <<https://www.rfc-editor.org/info/rfc8664>>.
- [RFC9604] Sivabalan, S., Filsfils, C., Tantsura, J., Previdi, S., and C. Li, Ed., "Carrying Binding Label/SID in PCE-Based Networks", RFC 9604, DOI 10.17487/RFC9604, August 2024, <<https://www.rfc-editor.org/info/rfc9604>>.

8.2. Informative References

- [RFC4655] Farrel, A., Vasseur, J.-P., and J. Ash, "A Path Computation Element (PCE)-Based Architecture", RFC 4655, DOI 10.17487/RFC4655, August 2006, <<https://www.rfc-editor.org/info/rfc4655>>.
- [RFC9603] Li, C., Ed., Kaladharan, P., Sivabalan, S., Koldychev, M., and Y. Zhu, "Path Computation Element Communication Protocol (PCEP) Extensions for IPv6 Segment Routing", RFC 9603, DOI 10.17487/RFC9603, July 2024, <<https://www.rfc-editor.org/info/rfc9603>>.

Appendix A. Acknowledgements

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