Path Segment/ID in PCEP

draft-li-pce-controlled-id-space-00
draft-li-pce-sr-path-segment-00
draft-li-pce-sr-bidir-path-00

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Motivation

• Use cases like end-2-end 1+1 path protection, bidirectional path correlation or performance measurement (PM) require the ability to implement “path identification” in SR networks:
  • [draft-cheng-spring-mpls-path-segment] introduces a new segment to uniquely identify an SR path in a specific context that is referred to as Path Segment.
  • [draft-li-spring-passive-pm-for-srv6-np] defines a Path ID to identify an SRv6 path.

• For configuring or allocating “path ID” to an SR path, extensions in PCEP are needed.
  • Path ID allocation and conveying it within PCEP
  • PCE controlled ID Space, where PCC informs the PCE the ID space range from which it should make allocations

• Bidirectional path correlation is required in some scenarios such as mobile backhaul transport network for segment routing.
  • Bidirectional path correlation based on path Segment/ path ID.
• **draft-li-pce-sr-path-segment-00**
  • specifies extensions to the PCEP to support path identifier allocation between PCEP speakers.

• **draft-li-pce-sr-bidir-path-00**
  • defines PCEP extensions for grouping two reverse unidirectional SR Paths into an Associated Bidirectional SR path

• **draft-li-pce-controlled-id-space-00**
  • specifies a mechanism for a PCC to inform the PCE of the identifier space under its control via PCEP.
specifies a mechanism to carry the SR path identification information in PCEP

- The path ID can be allocated by Ingress PCC itself and informed to the PCE. The PCE can then inform the egress PCC.

- The PCC can also request PCE to allocate the path ID, in this case, the PCE would allocate and inform the assigned path ID to the ingress/egress PCC using PCEP messages.

- Also, the PCE can allocate a path ID on its own accord and inform the ingress/egress PCC in case of PCE-initiated LSPs.

- (Next Version) The path ID can be allocated by Egress PCC. The PCE should request the Egress PCC to allocate a Path ID and inform the PCE, which may further inform to the ingress PCC.
Capabilities Advertisement

• For advertising the capability of Path ID allocation, new flags are required:
  • SR-PCE-CAPABILITY TLV [I-D.ietf-pce-segment-routing] in OPEN message:
    • P-flag: Path Identification bit, set to indicate that it has the capability to encode SR path identification.
  • SRv6-PCE-CAPABILITY TLV [I-D.negi-pce-segment-routing-ipv6]
    • P-flag: Path Identification bit, set to indicate that it has the capability to encode SRv6 path identification.

![Figure 1: P-flag in SR-PCE-CAPABILITY TLV](image1)

![Figure 2: P-flag in SRv6-PCE-CAPABILITY TLV](image2)
P-flag in LSP Object

- **P-flag**: Indicating path ID needs to be allocated by PCE for this LSP
  - **LSP.P-flag**: MUST be set in PCReq/PCRpt msg, when PCC requires the path ID allocation.
  - **LSP.P-flag**: MUST be set in PCRep/PCUpd/PCInitiate, when PCE reply the path ID allocation requirement.

![Diagram of P-flag in LSP Object](image)

*Figure 3: P-flag in LSP Object*
Path ID TLV in LSP Object

• **IDT (ID type)** specifies the type of the Path ID field
  - 0: MPLS Path segment, which is an MPLS label as defined in [I-D.cheng-spring-mpls-path-segment].
  - 1: SRv6 Path ID, which is a 4-octet integer as defined in [I-D.li-spring-passive-pm-for-srv6-np].

• **Flags**
  - L: Local/Global bit: set when the path ID has the local significance.
  - C: PCC/PCE bit: set when the Path ID is allocated by the PCC.
  - E: Egress/Ingress bit: set when the Path ID is allocated from the Egress PCC’s ID space.

• **Path ID:**
  - 32bit value of path ID.
  - The path ID type is indicated by the ID Type field.
Inform the Egress PCC: Path FEC Object & CCI

• This document extends the procedures of [I-D.zhao-pce-pcep-extension-pce-controller-sr] by defining a new Path FEC object to inform the Path Identification information to the Egress PCC.

• One or more following TLV(s) are allowed in the Path FEC object:
  • **SYMBOLIC-PATH-NAME TLV**: a human readable string that identifies an LSP in the network [RFC8231].
  • **LSP-IDENTIFIERS TLV**: optional for SR, but could be used to encode the source, destination and other identification information for the path [RFC8231].
  • **SPEAKER-ENTITY-ID TLV**: a unique identifier for the PCEP speaker, used to identify the Ingress PCC [RFC8232].

• The Path ID information is encoded directly in the Central Control Instructions (CCI) SR object. The Path ID TLV MAY also be included in the CCI SR object.

![Figure 2: The path FEC object Format](image-url)
Example: PCE allocated Path ID on its own

Figure 5: PCE allocated Path ID on its own
draft-li-pce-sr-bidir-path-00
PCEP Extension for Segment Routing (SR)
Bi-directional Associated Paths
For associating two SR paths, this document defines a new association group called 'Double-sided Bidirectional SR Path Association Group'

- The SR paths belonging to this association is conveyed via PCEP messages to the PCEP peer.

- A member of the Double-sided Bi-directional SR Path Association Group can take the role of a forward or reverse SR path.

- The TLVs, handling rules, error conditions are same as [I-D.iertf-pce-association-bidir].

- B-flag in RP and SRP object MUST be set.

- The PATH-ID TLV [I-D.li-pce-sr-path-segment] MUST also be included in the LSP object for these SR paths.
Example: PCE-Initiated Bidir Path

- A stateful PCE:
  - Create/update the forward/reverse SR path independently
  - Establish/remove the association relationship on a per SR path basis.
  - Create/update the SR path and the association on a PCC via PCInitiate/PCUpd messages, respectively.

- The Path-ID TLV MUST be included for each SR path in the LSP object.

- The opposite direction SR SHOULD be informed via PCInitiate message with the matching association group.

- Similarly PCC initiated SR Paths are delegated to the PCE which would update with the other direction SR path and the association group information!
• [I-D.zhao-pce-pcep-extension-for-pce-controller] specifies the procedures and PCEP protocol extensions for using the PCE as a central controller, where label forwarding entries (Central Controller’s Instructions (CCI)) are downloaded through extending PCEP.

• [I-D.zhao-pce-pcep-extension-for-pce-controller-sr] specifies the procedures and PCEP protocol extensions for using the PCE as the central controller in SR networks.

• However, these documents assume that label range to be used by a PCE is known and set on both PCEP peers.

• This document specify the extension to support advertisement of the various ID space (Label/ Path ID etc) to the PCE to control.
• For informing the PCE controlled ID space, related ID Space TLV MUST be included in the Open message.

• Each TLV (corresponding to each ID type) SHOULD be included only once in a Open Message.

• The following ID-CONTROL-SPACE TLVs are defined in this document –
  • LABEL-CONTROL-SPACE - for MPLS Labels
  • SRv6-PATH-ID-CONTROL-SPACE - for SRv6 Path ID

• The PCE can then allocate ID from within the controlled ID space.
LABEL-CONTROL-SPACE TLV

• Flags:
  • A: All space flag, set when all the label space is delegated to a PCE.

• Blocks
  • Start(i) (24 bits): indicates the beginning of the label block i.
  • Range(i) (24 bits): indicates the range of the label block i.

• Labels:
  • such as binding SID and path SID can be allocated directly from the PCE controlled space.
Thank you