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PCEP Extension for SR-MPLS Entropy Label Position
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Abstract

This document proposes a set of extensions for PCEP to configure the entropy label position for SR-MPLS networks.

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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). PCEP Extensions for the Stateful PCE Model [RFC8231] describes a set of extensions to PCEP to enable active control of MPLS-TE and Generalized MPLS (GMPLS) tunnels. [RFC8281] 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 dynamic centralized control of a network.

Segment Routing (SR) leverages the source routing paradigm. Segment Routing can be instantiated on MPLS data plane which is referred to as SR-MPLS [RFC8660]. SR-MPLS leverages the MPLS label stack to construct the SR path. PCEP Extensions for Segment Routing [RFC8664] specifies extensions to the PCEP that allow a stateful PCE to compute and initiate TE paths, as well as a PCC to request a path subject to certain constraint(s) and optimization criteria in SR networks.

Entropy label (EL) [RFC6790] is a technique used in the MPLS data plane to improve load-balancing. Entropy Label Indicator (ELI) can be immediately preceding an EL in the MPLS label stack. The idea

behind the EL is that the ingress router computes a hash based on several fields from a given packet and places the result in an additional label, named "entropy label". Then, this entropy label can be used as part of the hash keys used by an LSR. Using the entropy label as part of the hash keys reduces the need for deep packet inspection in the LSR while keeping a good level of entropy in the load-balancing. When the entropy label is used, the keys used in the hashing functions are still a local configuration matter and an LSR may use solely the entropy label or a combination of multiple fields from the incoming packet.

[RFC8662] proposes to use entropy labels for SR-MPLS networks and multiple <ELI, EL> pairs SHOULD be inserted in the SR-MPLS label stack. The ingress node may decide the number and place of the ELI/ELs which need to be inserted into the label stack. But in some cases, the controller (e.g. PCE) could be used to perform the TE path computation as well as the Entropy Label Position (ELP) which is useful for inter-domain scenarios. This document proposes a set of extensions for PCEP to configure the ELP information for SR-MPLS networks.

2. Conventions used in this document

2.1. Terminology

The terminology is defined as [RFC5440], [RFC6790], [RFC8664] and [RFC8662].

2.2. 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.

3. Entropy Labels in SR-MPLS Scenario with PCE

[RFC8662] proposes to use entropy labels for SR-MPLS networks. The Entropy Readable Label Depth (ERLD) is defined as the number of labels which means that the router will perform load-balancing using the ELI/EL. An appropriate algorithm should consider the following criteria:

- o a limited number of <ELI, EL> pairs SHOULD be inserted in the SR-MPLS label stack;

4. PCEP Extensions

4.1. The OPEN Object

As defined in [RFC8664], PCEP speakers use SR PCE Capability sub-TLV to exchange information about their SR capability when PST=1 in the PST List of the PATH-SETUP-TYPE-CAPABILITY TLV carried in Open object. This document defined a new flag (E-flag) for SR PCE Capability sub-TLV as shown in Figure 2.

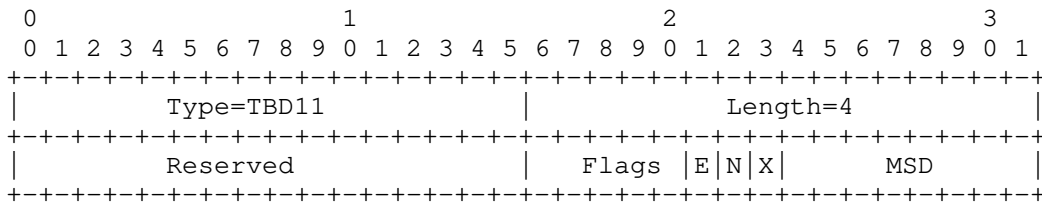


Figure 2: E-flag in SR-PCE-CAPABILITY sub-TLV

E (Entropy Label Configuration is supported) : A PCE sets this flag bit to 1 carried in Open message to indicate that it supports the computation of SR path with ELP information. A PCC sets this flag to 1 to indicate that it supports the capability of inserting multiple ELI/EL pairs and supports the results of SR path with ELP from PCE.

4.2. The LSP-EXTENDED-FLAG TLV

The LSP Object is defined in Section 7.3 of [RFC8231]. This document defiend a new flag (E-flag) for the LSP-EXTENDED-FLAG TLV carried in LSP Object as defined in [I-D.ietf-pce-lsp-extended-flags]. The format is shown as Figure 3:

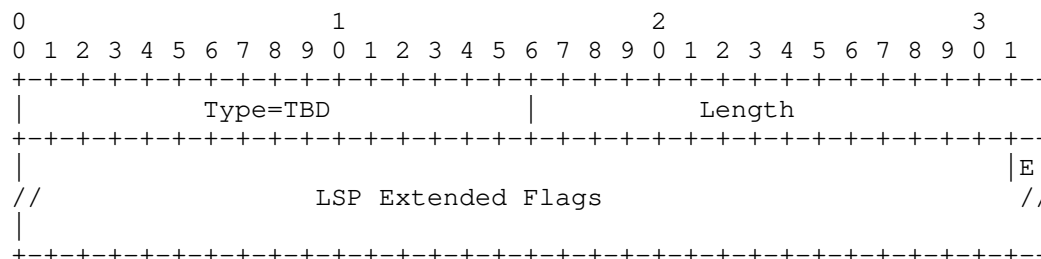


Figure 3: E-flag in LSP-EXTENDED-FLAG TLV

E (Request for ELP Configuration) : If the bit is set to 1, it indicates that the PCC requests PCE to compute the SR path with ELP information. A PCE would also set this bit to 1 to indicate that the ELP information is included by PCE and encoded in the PCRep, PCUpd or PCInitiate message.

4.3. The PATH-MINIMUM-ERLD TLV

The PATH-MINIMUM-ERLD TLV is an optional TLV for use in the LSP Object for the path minimum ERLD configuration. The type of this TLV is to be allocated by IANA. The format is as shown below.

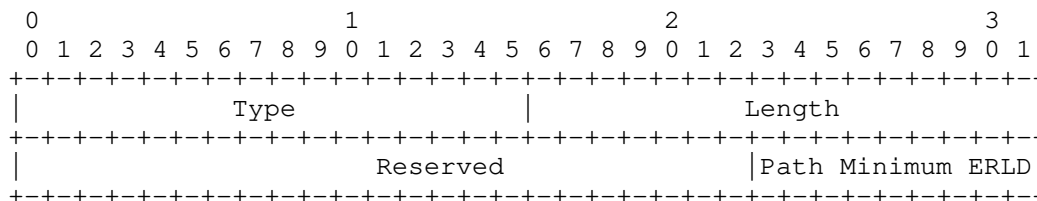


Figure 4: The PATH-MINIMUM-ERLD TLV

Path Minimum ERLD: 8 bits, indicates the minimum ERLD of the nodes along the path.

4.4. The SR-ERO Object

SR-ERO subobject is used for SR-TE path which consists of one or more SIDs as defined in [RFC8664]. This document defiend a new flag (E-flag) for the SR-ERO subobject as Figure 4 shown:

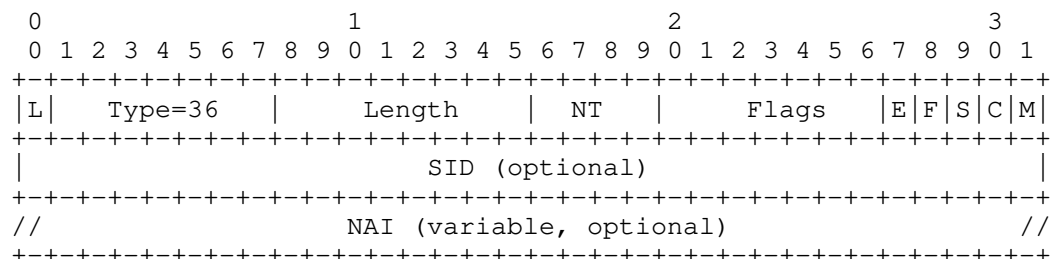


Figure 5: E-flag in SR-ERO subobject

E (ELP Configuration) : If this flag is set, it means that the position after this SR-ERO subobject is the position to insert <ELI, EL>, otherwise it cannot insert <ELI, EL> after this segment.

5. Operations

The SR path is initiated by PCE or PCC with PCReq, PCInitiated or PCUpd messages and the E bit is set to 1 in LSP object to request the ELP configuration. The SR-TE path being received by PCC with SR-ERO segment list, for example, <S1, S2, S3, S4, S5, S6>, especially S3 and S6 with E-flag set. It indicates that two <ELI, EL> pairs MUST be inserted into the label stack of the SR-TE forwarding entry, respectively after the label for S3 and label for S6. With EL information, the label stack for SR-MPLS would be <label1, label2, label3, ELI, EL, label4, label5, label6, ELI, EL>.

6. Security Considerations

TBA

7. Acknowledgements

TBA

8. IANA Considerations

8.1. New SR PCE Capability Flag Registry

SR PCE Capability TLV is defined in [RFC8664], and the registry to manage the Flag field of the SR PCE Capability TLV is requested in [RFC8664]. IANA is requested to make allocations from the registry, as follows:

Value	Name	Reference
TBD11	Entropy Label Configuration is supported (E)	[this document]

Table 1

8.2. New LSP-EXTENDED-FLAG Flag Registry

[I-D.ietf-pce-lsp-extended-flags] defines the LSP-EXTENDED-FLAG TLV. IANA is requested to make allocations from the Flag field registry, as follows:

Value	Name	Reference
TBD	Request for ELP Configuration (E)	[this document]

Table 2

8.3. The PATH-MINIMUM-ERLD TLV

This document requests that a new sub-registry named "PATH-MINIMUM-ERLD TLV" carried in LSP object.

Value	Name	Reference
TBD	PATH-MINIMUM-ERLD TLV	[this document]

Table 3

8.4. New SR-ERO Flag Registry

SR-ERO subobject is defined in [RFC8664], and the registry to manage the Flag field of SR-ERO is requested in [RFC8664]. IANA is requested to make allocations from the registry, as follows:

Value	Name	Reference
36	ELP Configuration (E)	[this document]

Table 4

9. Normative References

- [I-D.ietf-pce-lsp-extended-flags]
Xiong, Q., "LSP Object Flag Extension of Stateful PCE",
draft-ietf-pce-lsp-extended-flags-00 (work in progress),
March 2021.
- [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>>.
- [RFC6790] Kompella, K., Drake, J., Amante, S., Henderickx, W., and
L. Yong, "The Use of Entropy Labels in MPLS Forwarding",
RFC 6790, DOI 10.17487/RFC6790, November 2012,
<<https://www.rfc-editor.org/info/rfc6790>>.
- [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>>.
- [RFC8281] Crabbe, E., Minei, I., Sivabalan, S., and R. Varga, "Path
Computation Element Communication Protocol (PCEP)
Extensions for PCE-Initiated LSP Setup in a Stateful PCE
Model", RFC 8281, DOI 10.17487/RFC8281, December 2017,
<<https://www.rfc-editor.org/info/rfc8281>>.

- [RFC8623] Palle, U., Dhody, D., Tanaka, Y., and V. Beeram, "Stateful Path Computation Element (PCE) Protocol Extensions for Usage with Point-to-Multipoint TE Label Switched Paths (LSPs)", RFC 8623, DOI 10.17487/RFC8623, June 2019, <<https://www.rfc-editor.org/info/rfc8623>>.
- [RFC8660] Bashandy, A., Ed., Filsfils, C., Ed., Previdi, S., Decraene, B., Litkowski, S., and R. Shakir, "Segment Routing with the MPLS Data Plane", RFC 8660, DOI 10.17487/RFC8660, December 2019, <<https://www.rfc-editor.org/info/rfc8660>>.
- [RFC8662] Kini, S., Kompella, K., Sivabalan, S., Litkowski, S., Shakir, R., and J. Tantsura, "Entropy Label for Source Packet Routing in Networking (SPRING) Tunnels", RFC 8662, DOI 10.17487/RFC8662, December 2019, <<https://www.rfc-editor.org/info/rfc8662>>.
- [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>>.

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