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PCEP extensions for Circuit Style Policies

Abstract

This document proposes a set of extensions for Path Computation
Element Communication Protocol (PCEP) for Circuit Style Policies -
Segment-Routing Policy designed to satisfy requirements for
connection-oriented transport services. New TLV is introduced to
control path recomputation and new flag to add ability to request
path with strict hops only.

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.

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1. Introduction

Usage of Segment-routing and PCEP in connection-oriented transport
services require path persistancy and hop-by-hop behavior for PCE
computed paths.

Circuit-Style Policy introduced in
[I-D.schmutzer-spring-cs-sr-policy] requires PCEP extensions, which
are covered in this document.

This document:

   *Introduces possibility to request strict path from the PCE by
    extending LSP-EXTENDED-FLAG TLV

*Adding new TLV to encode information about disabling path
   recomputation for specific path to the PCE, to be carried inside
   the LSPA object, which is defined in [RFC5440].

  *Clarifies usage of existing O-flag from RP object in Segment-
   routing

PCEP extensions described in this document are applicable to RSVP-TE
and SR-TE.

2. Terminology

The following terminologies are used in this document:

ERO: Explicit Route Object

IGP: Interior Gateway Protocol

LSP: Label Switched Path.

LSPA: Label Switched Path Attributes.

OTN: Optical Transport Network.

PCC: Path Computation Client

PCE: Path Computation Element

PCEP: Path Computation Element Protocol.

SDH: Synchronous Digital Hierarchy

SID: Segment Identifier

SONET: Synchronous Optical Network

SR: Segment Routing.

SR-TE: Segment Routing Traffic Engineering.

3. Overview of Extensions to PCEP

3.1. LSP-EXTENDED-FLAG TLV

O-flag is proposed in the LSP-EXTENDED-FLAG TLV, which was
introduced in 5.1.2 of [I-D.ietf-pce-lsp-extended-flags] and
extended with E-flag in [I-D.peng-pce-entropy-label-position]. TLV
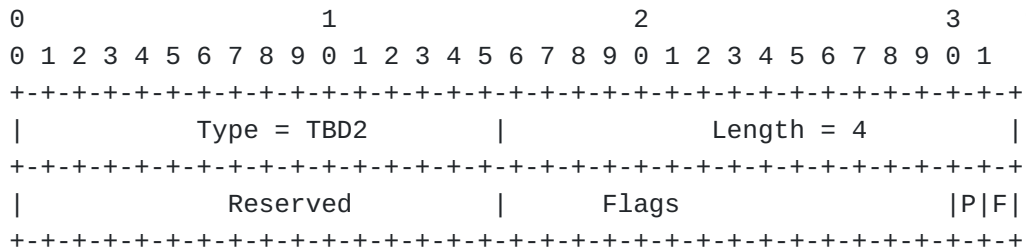format will be added after assigning O flag bit position by IANA.

Type (16 bits): the value is TBD1 by IANA.

Length (16 bits): multiple of 4 octets.

O (Strict-Path): If set to 1, this indicates to the PCE that a path
exclusively made of strict hops is required. Strict hop definition
is described in Section 4.1

3.2. PATH-RECOMPUTATION TLV

This document defines new TLV for the LSPA Object for encoding
information whether path recomputation is allowed for delegated LSP.
The TLV is optional. If the TLV is included in LSPA object, the PCE
MUST NOT recompute path in cases specified by flags in the TLV.

```
 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 = TBD2         |            Length = 4         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Reserved          |       Flags            |P|F|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Type (16 bits): the value is TBD2 by IANA.

Length (16 bits): 4 octets

Reserved: MUST be set to zero by the sender and MUST be ignored by
   the receiver.

Flags: This document defines the following flag bits. The other
   bits MUST be set to zero by the sender and MUST be ignored by the
   receiver.

      *P (Permanent): If set to 1, the PCE MUST NOT recompute path
       even if current path is not satisfying path computation
       constraints. Otherwise, if this flag is cleared, then the
       PCE MAY recompute path if original path is invalidated.

      *F (Force): If set to 1, the PCE MUST NOT update path. If
       flag is cleared, the PCE MAY update path based on explicit
       request from operator.

4. Operation

4.1. Strict path enforcement

PCC MAY set the O flag in LSP-EXTENDED-FLAG TLV in PCRpt message to
the PCE to indicate that a path exclusively made of strict hops is
required.

O flag cleared or LSP-EXTENDED-FLAG TLV not included indicates that a loose path is acceptable.

In PCUpdate or PCInitiate messages, PCE MAY set O bit if strict path is provided.

The flag is applicable only for stateful messages. Existing O flag in RP object MAY be used to indicate similar behavior in PCReq and PCRep messages as described in as described in Section 7.4.1 of [RFC5440].

If O flag is set to 1 for both stateful and stateless messages for SR paths introduced in [RFC8664], PCE MUST use only SIDs, which will use explicitly specified adjacencies for packet forwarding. For example Adjacency SIDs MAY be used, but Prefix SIDs MUST NOT be used (even if there is only one adjacency). the PCE MUST use Adjacency SIDs only.

4.2. Path recomputation

PCC MAY set flags in PATH-RECOMPUTATION TLV to control path computation behavior on PCE side. If TLV is not included, then the PCE MAY use local policy to trigger path-computation or LSP path update.

The presence of the TLV is blocking path recomputation based on various triggers like topology update, any periodic update or changed state of other LSPs in the network. LSP path MAY be modified if forwarded packets will still use same path - for example if same path can be encoded using Adjacency and Prefix SIDs, then PCE MAY switch between various representations of same path.

If P flag is cleared, the PCE MAY recompute if current path is not considered valid, for example after topology update resulting in path not satisfying LSP's path constraints, but it MUST NOT recompute path if current path is not optimal.

If P flag is set, the PCE MUST NOT recompute path during LSP lifetime even if path is invalidated. Only exception is explicit request from operator to recompute path

If F flag is cleared, path update triggered manually by operator or any northbound interface of PCE MAY be done. If flag is set the PCE CAN update path only to tear down LSP by sending PCUpdate message with empty ERO.

TLV MAY be included in PCInitiate and PCUpdate messages to indicate, which triggers will be disabled on the PCE. PCC should reflect flag values in PCRpt messages to forward requirement to other PCEs in the network.

5. Security Considerations

No additional security measure is required.

6. IANA Considerations

6.1. LSP-EXTENDED-FLAG TLV

[I-D.ietf-pce-lsp-extended-flags] defines the LSP-EXTENDED-FLAG TLV.
IANA is requested to make the following assignment from the "LSP-
EXTENDED-FLAG TLV Flag Field" registry:

Bit	Description	Reference
TBD1	Strict-Path Flag (O)	This document

Table 1

6.2. PATH-RECOMPUTATION TLV

IANA is requested to make the assignment of a new value for the
existing "PCEP TLV Type Indicators" registry as follows:

TLV Type	TLV Name	Reference
TBD2	PATH-RECOMPUTATION TLV	This document

Table 2

7. References

7.1. Normative References

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