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                    Conveying path setup type in PCEP messages
                         draft-ietf-pce-lsp-setup-type-07

Abstract

   A Path Computation Element can compute Traffic Engineering paths (TE
   paths) through a network that are subject to various constraints.
   Currently, TE paths are Label Switched Paths (LSPs) which are set up
   using the RSVP-TE signaling protocol. However, other TE path setup
   methods are possible within the PCE architecture. This document
   proposes an extension to PCEP to allow support for different path
   setup methods over a given PCEP session.

Requirements Language

   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].

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1. Introduction

   [RFC5440] describes the Path Computation Element communication
   Protocol (PCEP) for communication between a Path Computation Client
   (PCC) and a Path Computation Element (PCE), or between a PCE and a
   PCE. A PCC requests a path subject to various constraints and
   optimization criteria from a PCE. The PCE responds to the PCC with a
   hop-by-hop path in an Explicit Route Object (ERO). The PCC uses the
   ERO to set up the path in the network.

   [RFC8231] specifies extensions to PCEP that allow a PCC to delegate
   its LSPs to a PCE. The PCE can then update the state of LSPs
   delegated to it. In particular, the PCE may modify the path of an
   LSP by sending a new ERO. The PCC uses this ERO to re-route the LSP

in a make-before-break fashion. [I-D.ietf-pce-pce-initiated-lsp]
specifies a mechanism allowing a PCE to dynamically instantiate an
LSP on a PCC by sending the ERO and characteristics of the LSP. The
PCC creates the LSP using the ERO and other attributes sent by the
PCE.

So far, PCEP and its extensions have assumed that the TE paths are
label switched and are established via the RSVP-TE protocol.
However, other methods of LSP setup are possible in the PCE
architecture (see [RFC4655] and [RFC4657]). This document introduces
a TLV called "PATH-SETUP-TYPE-CAPABILITY" which allows a PCEP speaker
to announce the path setup types it supports when the PCEP session is
established. When a new path setup type (other than RSVP-TE) is
introduced for setting up a path, a path setup type code and,
optionally, a sub-TLV pertaining to the new path setup type will be
defined by the document that specifies the new path setup type.

When multiple path setup types are deployed in a network, a given
PCEP session may have to simultaneously support more than one path
setup type. In this case, the intended path setup type needs to be
explicitly indicated in the appropriate PCEP messages, unless the
path setup type is RSVP-TE (which is assumed to be the path setup
type if no other setup type is indicated). This is so that both the
PCC and the PCE can take the necessary steps to set up the path.
This document introduces a generic TLV called "PATH-SETUP-TYPE TLV"
and specifies the base procedures to facilitate this operational
model.

2. Terminology

The following terminologies are used in this document:

ERO: Explicit Route Object.

LSR: Label Switching Router.

PCC: Path Computation Client.

PCE: Path Computation Element.

PCEP: Path Computation Element Protocol.

PST: Path Setup Type.

TLV: Type, Length, and Value.

3. **Path Setup Type Capability TLV**

   A PCEP speaker indicates which PSTs it supports during the PCEP
   initialization phase, as follows. When the PCEP session is created,
   it sends an Open message with an OPEN object containing the PATH-
   SETUP-TYPE-CAPABILITY TLV. The format of this TLV is as follows.

```
     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 (TBD1)         |             Length            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                           Reserved             | PST length    |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    //     List of PSTs padded to 4-byte alignment (variable)      //
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    //                Optional sub-TLVs (variable)                 //
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
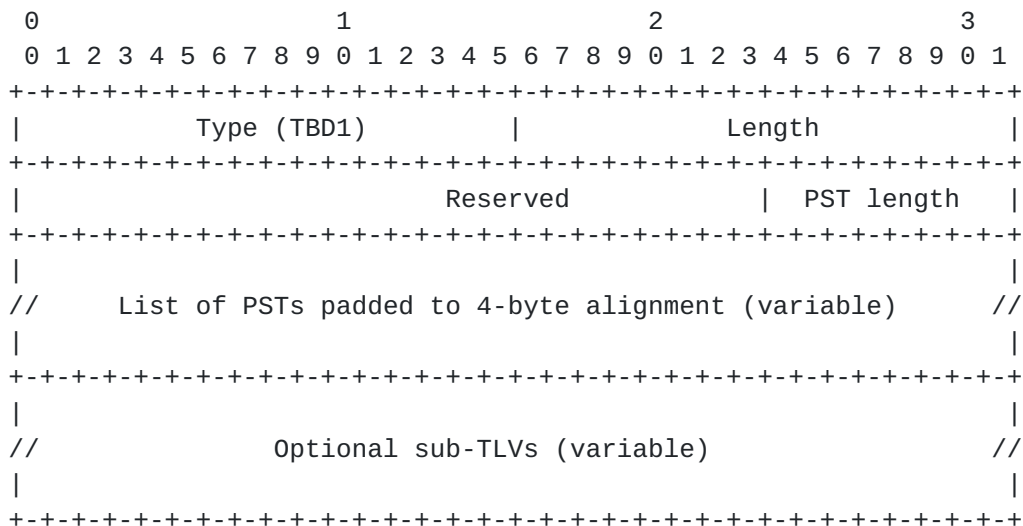
                Figure 1: PATH-SETUP-TYPE-CAPABILITY TLV

   The TLV type is TBD1 (to be assigned by IANA). Its reserved field
   MUST be set to zero. The other fields in the TLV are as follows.

   PST length: The length of the list of supported PSTs, in bytes,
      excluding padding.

   List of PSTs: A list of the PSTs that the PCEP speaker supports.
      Each PST is a single byte in length. Duplicate entries in this
      list MUST be ignored. The PCEP speaker MUST pad the list with
      zeros so that it is a muliple of four bytes in length.

   Optional sub-TLVs: A list of sub-TLVs associated with the supported
      PSTs. Each sub-TLV MUST obey the rules for TLV formatting defined
      in ([RFC5440]). That is, each sub-TLV MUST be padded to a four
      byte alignment, and the length field of each sub-TLV MUST NOT
      include the padding bytes. This document does not define any sub-
      TLVs.

   This document defines the following PST value:

   o PST = 0: Path is setup using the RSVP-TE signaling protocol.

The overall TLV length MUST be equal to the size of the appended sub-
TLVs plus the PST length (rounded up to the nearest multiple of four)
plus four bytes for the reserved field and PST length field. The PST
length field MUST be greater than zero. If a PCEP speaker receives a
PATH-SETUP-TYPE-CAPABILITY TLV which violates these rules, then the
PCEP speaker MUST send a PCErr message with Error-Type = 10
(Reception of an invalid object) and Error-Value = 11 (Malformed
object) and MUST close the PCEP session. The PCEP speaker MAY
include the malformed OPEN object in the PCErr message as well.

If a PCEP speaker receives an OPEN object with more than one PATH-
SETUP-TYPE-CAPABILITY TLV then it MUST ignore all but the first
instance of this TLV.

The absence of the PATH-SETUP-TYPE-CAPABILITY TLV from the OPEN
object is equivalent to a PATH-SETUP-TYPE-CAPABILITY TLV containing a
single PST of 0 (RSVP-TE signaling protocol) and no sub-TLVs. A PCEP
speaker MAY omit the PATH-SETUP-TYPE-CAPABILITY TLV if the only PST
it supports is RSVP-TE. If a PCEP speaker supports other PSTs
besides RSVP-TE, then it SHOULD include the PATH-SETUP-TYPE-
CAPABILITY TLV in its OPEN object.

If a PCEP speaker does not recognize the PATH-SETUP-TYPE-CAPABILITY
TLV, it MUST ignore the TLV in accordance with ([RFC5440]).

4. Path Setup Type TLV

When a PCEP session is used to set up TE paths using different
methods, the corresponding PCE and PCC must be aware of the path
setup method used. That means, a PCE must be able to specify paths
in the correct format and a PCC must be able take control plane and
forwarding plane actions appropriate to the PST.

```
   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 (28)            |           Length (4)          |
  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
  |                        Reserved               |      PST      |
  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
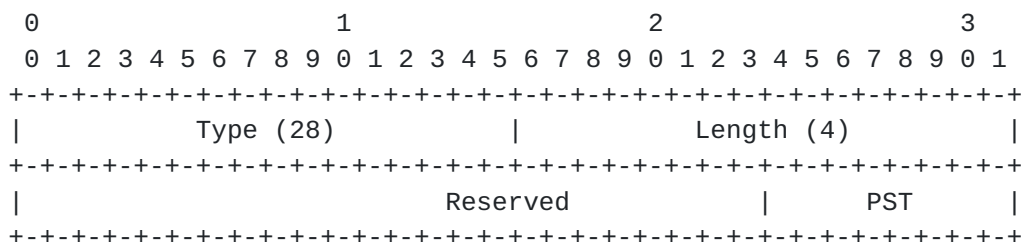
Figure 2: PATH-SETUP-TYPE TLV

PATH-SETUP-TYPE TLV is an optional TLV associated with the RP
([RFC5440]) and the SRP ([RFC8231]) objects. Its format is shown in
the above figure. The TLV type is 28. Its reserved field MUST be
set to zero. The one byte value contains the PST as defined for the
PATH-SETUP-TYPE-CAPABILITY TLV.

The absence of the PATH-SETUP-TYPE TLV is equivalent to a PATH-SETUP-
TYPE TLV with a PST value of 0 (RSVP-TE). A PCEP speaker MAY omit
the TLV if the PST is RSVP-TE. If the RP or SRP object contains more
than one PATH-SETUP-TYPE TLV, only the first TLV MUST be processed
and the rest MUST be ignored.

If a PCEP speaker does not recognize the PATH-SETUP-TYPE TLV, it MUST
ignore the TLV in accordance with ([RFC5440]).

5. Operation

During the PCEP initialization phase, if a PCEP speaker receives a
PATH-SETUP-TYPE-CAPABILITY TLV from its peer, it MUST consider that
the peer suports only the PSTs listed in the TLV. If the PCEP
speaker and its peer have no PSTs in common, then the PCEP speaker
MUST send a PCErr message with Error-Type = 21 (Invalid traffic
engineering path setup type) and Error-Value = 2 (Mismatched path
setup type) and close the PCEP session.

If the peer has sent no PATH-SETUP-TYPE-CAPABILITY TLV, then the PCEP
speaker MUST infer that the peer supports path setup using at least
RSVP-TE. The PCEP speaker MAY also infer that the peer supports
other path setup types, but the means of inference are outside the
scope of this document.

When a PCC sends a PCReq message to a PCE ([RFC5440]), it MUST
include the PATH-SETUP-TYPE TLV in the RP object, unless the intended
PST is RSVP-TE, in which case it MAY omit the PATH-SETUP-TYPE TLV.
If the PCE is capable of expressing the path in a format appropriate
to the intended PST, it MUST use the appropriate ERO format in the
PCRep message.

When a PCE sends a PCRep message to a PCC ([RFC5440]), it MUST
include the PATH-SETUP-TYPE TLV in the RP object, unless the PST is
RSVP-TE, in which case it MAY omit the PATH-SETUP-TYPE TLV. If the
PCE does not support the intended PST, it MUST send a PCErr message
with Error-Type = 21 (Invalid traffic engineering path setup type)
and Error-Value = 1 (Unsupported path setup type) and close the PCEP
session. If the PSTs corresponding to the PCReq and PCRep messages
do not match, the PCC MUST send a PCErr message with Error-Type = 21
(Invalid traffic engineering path setup type) and Error-Value = 2
(Mismatched path setup type) and close the PCEP session.

When a stateful PCE sends a PCUpd message ([RFC8231]) or a PCInitiate
message ([I-D.ietf-pce-pce-initiated-lsp]) to a PCC, it MUST include
the PATH-SETUP-TYPE TLV in the SRP object, unless the intended PST is
RSVP-TE, in which case it MAY omit the PATH-SETUP-TYPE TLV. If the
PCC does not support the PST associated with the PCUpd or PCInitiate

message, it MUST send a PCErr message with Error-Type = 21 (Invalid
traffic engineering path setup type) and Error-Value = 1 (Unsupported
path setup type) and close the PCEP session.

When a PCC sends a PCRpt message to a stateful PCE ([RFC8231]), it
MUST include the PATH-SETUP-TYPE TLV in the SRP object, unless the
PST is RSVP-TE, in which case it MAY omit the PATH-SETUP-TYPE TLV.
The PCC MUST include the SRP object in the PCRpt message if the PST
is not RSVP-TE, even when the SRP-ID-number is the reserved value of
0x00000000. If the PCRpt message is triggered by a PCUpd or
PCInitiate message, then the PST that the PCC indicates in the PCRpt
MUST match the PST that the stateful PCE intended in the PCUpd or
PCInitiate. If it does not, then the PCE MUST send a PCErr message
with Error-Type = 21 (Invalid traffic engineering path setup type)
and Error-Value = 2 (Mismatched path setup type) and close the PCEP
session.

6. Security Considerations

The security considerations described in [RFC5440] and
[I-D.ietf-pce-pce-initiated-lsp] are applicable to this
specification. No additional security measure is required.

7. IANA Considerations

7.1. PCEP TLV Type Indicators

IANA is requested to confirm the early allocation of the following
code point in the PCEP TLV Type Indicators registry.

Value	Description	Reference
28	PATH-SETUP-TYPE	This document

IANA is requested to allocate a new code point for the following TLV
in the PCEP TLV Type Indicators registry.

Value	Description	Reference
TBD1	PATH-SETUP-TYPE-CAPABILITY	This document

Note to IANA: The above TLV type was not part of the early code point
allocation that was done for this draft. It was added to the draft
after the early code point allocation had taken place. Please assign
a code point from the indicated registry and replace each instance of
"TBD1" in this document with the allocated code point.

7.2. New Path Setup Type Registry

   IANA is requested to create a new sub-registry within the "Path
   Computation Element Protocol (PCEP) Numbers" registry called "PCEP
   Path Setup Types". The allocation policy for this new registry
   should be by IETF Consensus. The new registry should contain the
   following value:

Value	Description	Reference
0	Path is setup using the RSVP-TE signaling protocol.	This document

7.3. PCEP-Error Object

   IANA is requested to confirm the early allocation of the following
   code-points in the PCEP-ERROR Object Error Types and Values registry.

Error-Type	Meaning
10	Reception of an invalid object
	Error-value=11: Malformed object

Error-Type	Meaning
21	Invalid traffic engineering path setup type
	Error-value=0: Unassigned
	Error-value=1: Unsupported path setup type
	Error-value=2: Mismatched path setup type

   Note to IANA: the early allocation for Error-Type=10, Error-value=11
   was originally done by draft-ietf-pce-segment-routing. However, we
   have since moved its definition into this document. Therefore,
   please update the reference for this Error-value in the indicated
   registry to point to RFC.ietf-pce-lsp-setup-type.

8. Contributors

   The following people contributed to this document:

      - Jan Medved
      - Edward Crabbe

9. Acknowledgements

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10. References

10.1. Normative References

[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-11 (work in
          progress), October 2017.

[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>.

[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>.

10.2. Informative References

[RFC4655] Farrel, A., Vasseur, J., 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>.

[RFC4657] Ash, J., Ed. and J. Le Roux, Ed., "Path Computation
          Element (PCE) Communication Protocol Generic
          Requirements", RFC 4657, DOI 10.17487/RFC4657, September
          2006, <https://www.rfc-editor.org/info/rfc4657>.

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