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PCEP Extensions to support BFD parameters

Abstract

This document proposes extension to PCEP to configure LSP
parameters. Some of LSP parameters are needed to configure S-BFD for
candidate paths. Each candidate path is identified in PCEP by its
uniquely assigned PLSP-ID. The mechanism proposed in this document
is applicable to to all path setup types. The need for these
definitions first appeared for Segment Routing path setup type, both
MPLS and IPv6 data planes of SR.

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.

Status of This Memo

Table of Contents

1. Introduction

   Path Computation Element (PCE) Communication Protocol (PCEP)
   [RFC5440] enables the communication between a Path Computation
   Client (PCC) and a Path Computation Element (PCE), or between two
   PCEs based on the PCE architecture [RFC4655].

   PCEP Extensions for the Stateful PCE Model [RFC8231] describes a set
   of extensions to PCEP to enable active control of Multiprotocol
   Label Switching Traffic Engineering (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.

PCEP Extensions for Segment Routing [RFC8664] specifies extensions to the Path Computation Element Protocol (PCEP) that allow a stateful PCE to compute and initiate Traffic Engineering (TE) paths, as well as a PCC to request a path subject to certain constraint(s) and optimization criteria in SR networks.

PCEP Extensions for Establishing Relationships Between Sets of LSPs [RFC8697] introduces a generic mechanism to create a grouping of LSPs which can then be used to define associations between a set of LSPs and a set of attributes (such as configuration parameters or behaviors) and is equally applicable to stateful PCE (active and passive modes) and stateless PCE.

This document specifies PCEP extensions to signal additional information to configure LSP attributes. This is accomplished via the use of the existing LSPA object, by defining a new capability and new TLVs.

2. Terminology

The following terminologies are used in this document:

   *PCC: Path Computation Client. Any client application requesting a path computation to be performed by a Path Computation Element.

   *PCE: Path Computation Element. An entity (component, application, or network node) that is capable of computing a network path or route based on a network graph and applying computational constraints.

   *PCEP: Path Computation Element Protocol. PCEP Tunnel: The entity identified by the PLSP-ID, as per [I-D.koldychev-pce-operational].

3. Motivation

S-BFD protocol is used for detecting failures in different tunnels path setup types. There are several protocol parameters that need to be configured and exchanged between PCEP speakers. As the parameters are associated to LSPs or tunnels, they are exchanged via PCEP. The LSPS-BFD-Capability TLV, the LSP-SBFD TLV and its sub-TLVs, defined in this document, allow PCEP speakers to exchange additional information about S-BFD.

4. Overview of Protocol Extensions

4.1. Overview

A new option to define S-BFD parameters is defined in this document.
The S-BFD parameters are only meant to be used for SR LSPs and with
PCEP peers which advertise SR capability.

A PCEP speaker indicates its ability to support S-BFD parameters
during the PCEP initialization phase, as follows. When the PCEP
session is created, it sends an Open message with an OPEN object
that contains the LSP-SBFD-Capability TLV (see [Section 4.3.1](#)).

If a PCEP speaker receives the PCEP LSP-SBFD-Capability TLV with B
flag = 1 in the Open object, then it means its peer is capable to
receive and to send S-BFD TLVs towards that peer.

If a PCEP speaker has not received this TLV in the Open object, or
if it receives it with B flag set to 0, then it MUST NOT send any S-
BFD TLVs in LSPA object towards that peer.

4.2. Processing

If a PCEP speaker is capable of S-BFD and its peer is capable of S-
BFD, then the PCEP speaker MAY send LSP-SBFD TLV towards that peer,
to report the S-BFD state (Enabled/Disabled) for the configured LSP.
The LSP-SBFD TLV shall be sent as an optional TLV in the LSPA
object. A PCC shall send it in the PCRpt message.

A PCE shall send it in the PCInit or in the PCUpd message. If the
LSP-SBFD TLV is received from a PCEP peer with the B flag set to 1,
then S-BFD shall be applied for specified LSP. If PCC received this
TLV via PCUpd with B=0 and there is no S-BFD applied for the LSP,
then the PCC shall IGNORE the TLV.

If PCE received this TLV with B=0 and there is no S-BFD applied for
the LSP (editing a PCC-initiated LSP) then it may IGNORE it. If B=0
and LSP-BFD-Parameters sub-TLV is received, then the PCEP speaker
shall IGNORE the sub-TLV. Ignoring or saving the S-BFD configuration
is implementation decision.

In some implementations there is limitation that LSPs in the same
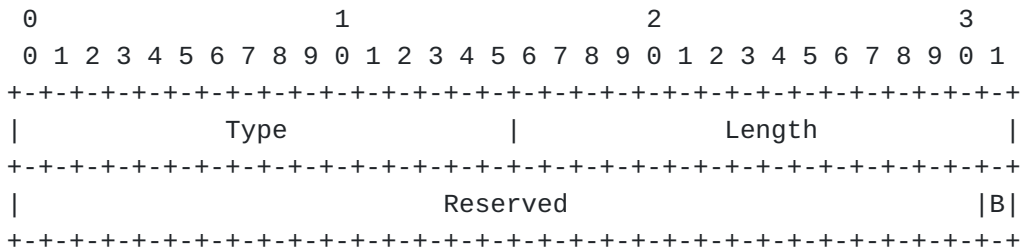association group must have same S-BFD parameter values.

Editor note: Alternatively, it can be defined implicitly as follows:
If the LSP-SBFD TLV is not received from PCEP peer but there is S-
BFD for that LSP then S-BFD shall be removed for specified LSP.

4.3. Objects and TLVs

4.3.1. LSP S-BFD Capability

The LSP-SBFD-Capability TLV is an optional TLV. It MAY be carried
within an OPEN object sent by PCEP speaker in an Open message to a
PCEP peer to indicate it supports SBFD capability.

The LSP-SBFD-Capability TLV has the following format:

```
 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              |             Length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          Reserved                           |B|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
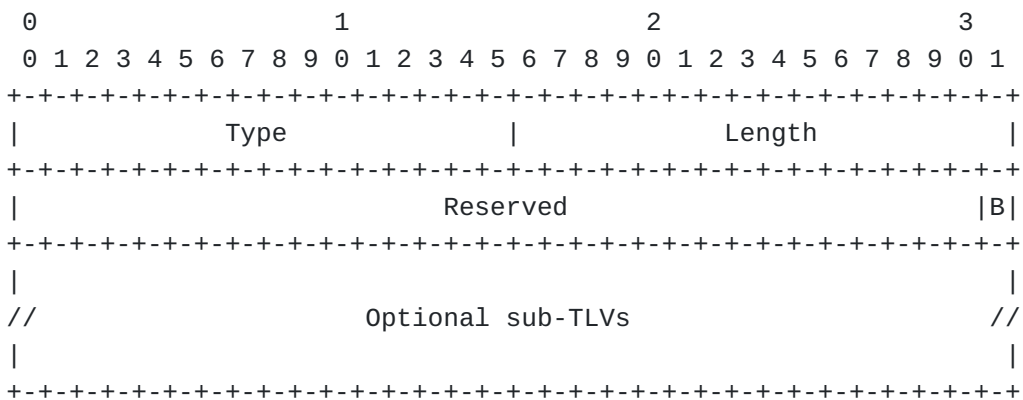
Type: TBD1
Length: 4
B flag: A PCEP speaker sets this bit to 1 to indicate that it is capable
of S-BFD, and it supports configuring the S-BFD via PCEP

4.3.2. S-BFD parameters

4.3.2.1. LSP S-BFD TLV

The PCEP LSP-SBFD TLV is an optional TLV. It MAY be carried within
the LSPA object.

The PCEP LSP-SBFD TLV has the following format:

```
 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              |             Length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          Reserved                           |B|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
//                    Optional sub-TLVs                       //
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
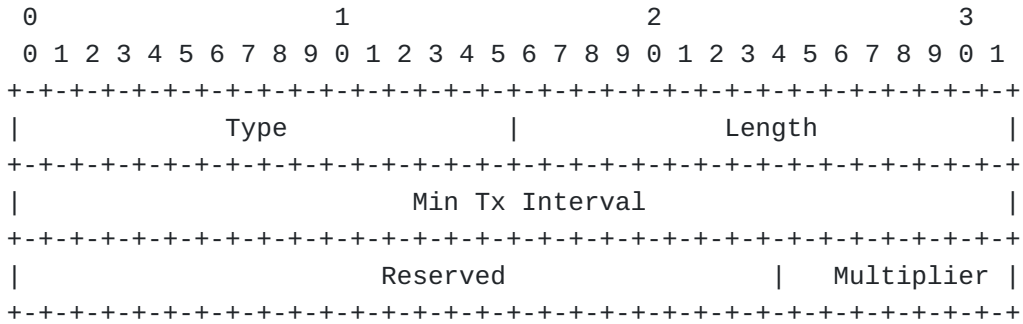
Type: TBD2

Length: The total length in bytes of the remainder of the TLV, that
is, excluding the Type and Length fields.

B flag: Enable/Disable S-BFD for this LSP. If B=1 then S-BFD will be
enabled. If B=0 then S-BFD will be disabled for that LSP. If the
PCEP speaker received LSP-SBFD TLV from PCEP peer with B flag is set
to 0, then S-BFD shall be removed (in case of PCE update) or shall
not be applied (in case of PCE initiated message) for specified LSP

4.3.2.2. LSP-SBFD Parameters sub-TLV

The PCEP LSP-SBFD-Parameters sub-TLV is optional. It MAY be carried
within the LSP-SBFD TLV. The PCEP LSP-SBFD-Parameters sub-TLV has
the following format:

```
 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              |             Length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Min Tx Interval                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Reserved                | Multiplier |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Type: TBD3
Length: 8
Min Tx Interval: 32 bits - Specify the Minimal Transmit Interval
(milliseconds).
Note: for YANG implementation of the S-BFD information model the value
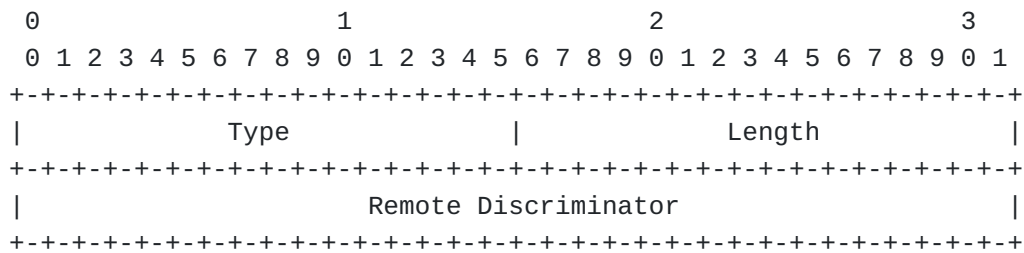needs to be converted to microseconds
Multiplier: 1..255

Procedure

If B=0 and LSP-SBFD-Parameters sub-TLV is received, then the PCEP
speaker shall IGNORE the sub-TLV.

4.3.2.3. LSP-SBFD-Discriminator sub-TLV

The PCEP LSP-SBFD-Discriminator sub-TLV and is optional TLV. It MAY
be carried within the LSP-SBFD TLV. The PCEP LSP-SBFD-Discriminator
sub-TLV has the following format:

```
      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              |            Length             |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |                     Remote Discriminator                      |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Type: TBD4
Length: 4
Remote Discriminator: 32 bits

Procedure

If B=0 and LSP-SBFD-Discriminator sub-TLV is received, then the PCEP
speaker shall IGNORE the LSP-SBFD-Discriminator sub-TLV.

5. Error Handling

If a PCEP speaker has not received S-BFD-Capability TLV from a peer
in the Open object, and it received an LSP S-BFD TLV (see
Section 4.3.2.1) from that peer, then it MUST ignore the content of
the LSP S-BFD TLV, and it MUST return a PCErr message with Error-
Type=19 "Invalid Operation" with Error-value = TBD5 "SBFD capability
is not negotiated".

If Multiplier value in the LSP-SBFD-Parameters sub-TLV is not in the
legal range (1..255), then the PCEP Speaker MUST return a PCErr
message with Error-Type=23 "Bad parameter value" and Error-value =
TBD6 "Multiplier is out of range".

If Remote Discriminator value in the PCEP LSP-SBFD-Discriminator
sub-TLV is not in the legal range (i.e., it is zero), then the PCEP
Speaker MUST return a PCErr message with Error-Type=23 "Bad
parameter value" and Error-value = TBD8 "Remote Discriminator is out
of range".

6. Implementation Note

In some implementations there is limitation that LSPs in the same
association group must have same S-BFD parameter values. If either
the Min Tx Interval, the Multiplier or the Remote Discriminator
values received in the LSP-BFD Parameters sub-TLVs for LSPs that are
members in the same Association Group are not identical, then the
PCEP Speaker SHOULD return a PCErr message with Error-Type=26
"Association Error" with Error-value TBD7 "Invalid S-BFD parameter
value"

7. IANA Considerations

7.1. PCEP TLV Type Indicators

This document defines new TLVs and sub-TLVs for carrying additional
information about S-BFD. IANA is requested to make the assignment of
new values for the existing "PCEP TLV Type Indicators" registry as
follows:

Value	Description	Reference
TBD1	LSP-SBFD-Capability TLV	This document
TBD2	LSP-SBFD TLV	This document
TBD3	LSP-BFD-Parameters sub-TLV	This document
TBD4	LSP-SBFD-DISCRIMINATOR sub-TLV	This document

Figure 1

7.2. PCEP Errors

This document defines new Error-Values within the different Error-Types.
IANA is requested to allocate new types:</t>
        <figure anchor="ure-2">
          <artwork name="" type="" align="left" alt=""><![CDATA[

Error Type	Error Value	Meaning	Reference
19	TBD5	SBFD capability is not negotiated	This document
23	TBD6	Multiplier is out of range	This document
26	TBD7	Invalid S-BFD parameter value	This document
26	TBD8	Remote Discriminator is out of range	This document

Figure 2

8. Security Considerations

This document defines one new type for association, which does not
add any new security concerns beyond those discussed in [RFC5440],
[RFC8231], [RFC8664], [RFC5880] and [RFC8697] in itself.

9. Acknowledgement

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