PCEP Extensions for LSP scheduling with stateful PCE

draft-zhuang-pce-stateful-pce-lsp-scheduling-00.txt

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PCEP Extensions for LSP bandwidth scheduling with stateful PCE

- Objective
  - Extensions to PCEP to schedule LSP according to actual usage requirements from customers for LSPs, so as to improve the usage of network resources in path computation.

- Motivation
  - LSP scheduling allows network operators to reserve resources in advance according to the agreements with their customers, and allow them to transmit data with specified starting time and duration, for example for a scheduled bulk data replication between data centers.
  - The requirement was introduced in section 5.3 [draft-ietf-pce-stateful-pce-app-03] and section 23 [rfc7399], but not completely solved yet in PCE group.
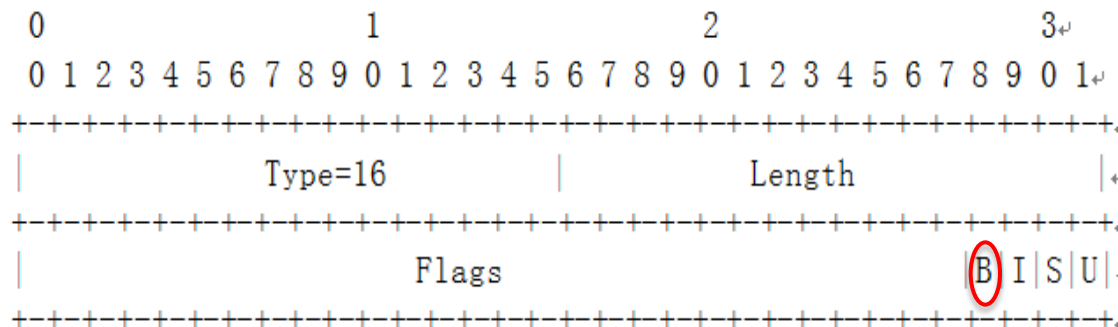
Brief Introduction of new flags in existing TLVs and SCHED-LSP-ATTRIBUTE TLV

- By reusing existing objects and TLVs defined in [I-D. ietf-pce-stateful-pce] and [I-D. ietf-pce-pce-initiated-lsp], this draft defines two new flags while reusing existing TLVs:

  - A new LSP-SCHEDULING-CAPABILITY Flag placed in STATEFUL-PCE-CAPABILITY TLV carried on an open message to advertise the ability of LSP scheduling to PECP peers during the establishing of a PCEP session.

  - A new ACTIVATING-LSP Flag in SRP object to activate a LSP with scheduled bandwidth at its starting time.

- This draft also defines a new SCHED-LSP-ATTRIBUTE TLV as an optional TLV within the LSP object to indicate the detailed LSP scheduling information, such as the starting time, duration and status of the LSP for the user traffic.

Advertise LSP scheduling Capability STATEFUL-PCE-CAPABILITY

- LSP-SCHEDULING-CAPABILITY Flag is used to indicate PCEP peers' LSP scheduling capability.

- The PCE and the PCC can exchange an Open Message with the LSP-SCHEDULING-CAPABILITY(B) Flag in STATEFUL-PCE-CAPABLITY TLV set to 1 to indicate it supports bandwidth scheduling to its peer.

- The B bit must be set by both PECP peers in order to provide scheduling LSP for path computation.

```
 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=16             |            Length             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                      Flags                          |B|I|S|U|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Carry the scheduled lsp information LSP Object with Sched-LSP-Attribute TLV

- The SCHED-LSP-ATTRIBUTE TLV can be included as an optional TLV within the LSP to carry the LSP scheduling information for the path computation.

- The TLV in the LSP object body is carried on a PCRpt message, PCUpd message and PCInitiate message. The TLV can also work along with the BANDWIDTH Object to indicate the required bandwidth source at the scheduled time.

- The values in the TLV Indicate the Starting Time and duration to activate the scheduled LSP with required network resources.

```
 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=[TBD]           |             Length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         Starting Time                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                           Duration                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
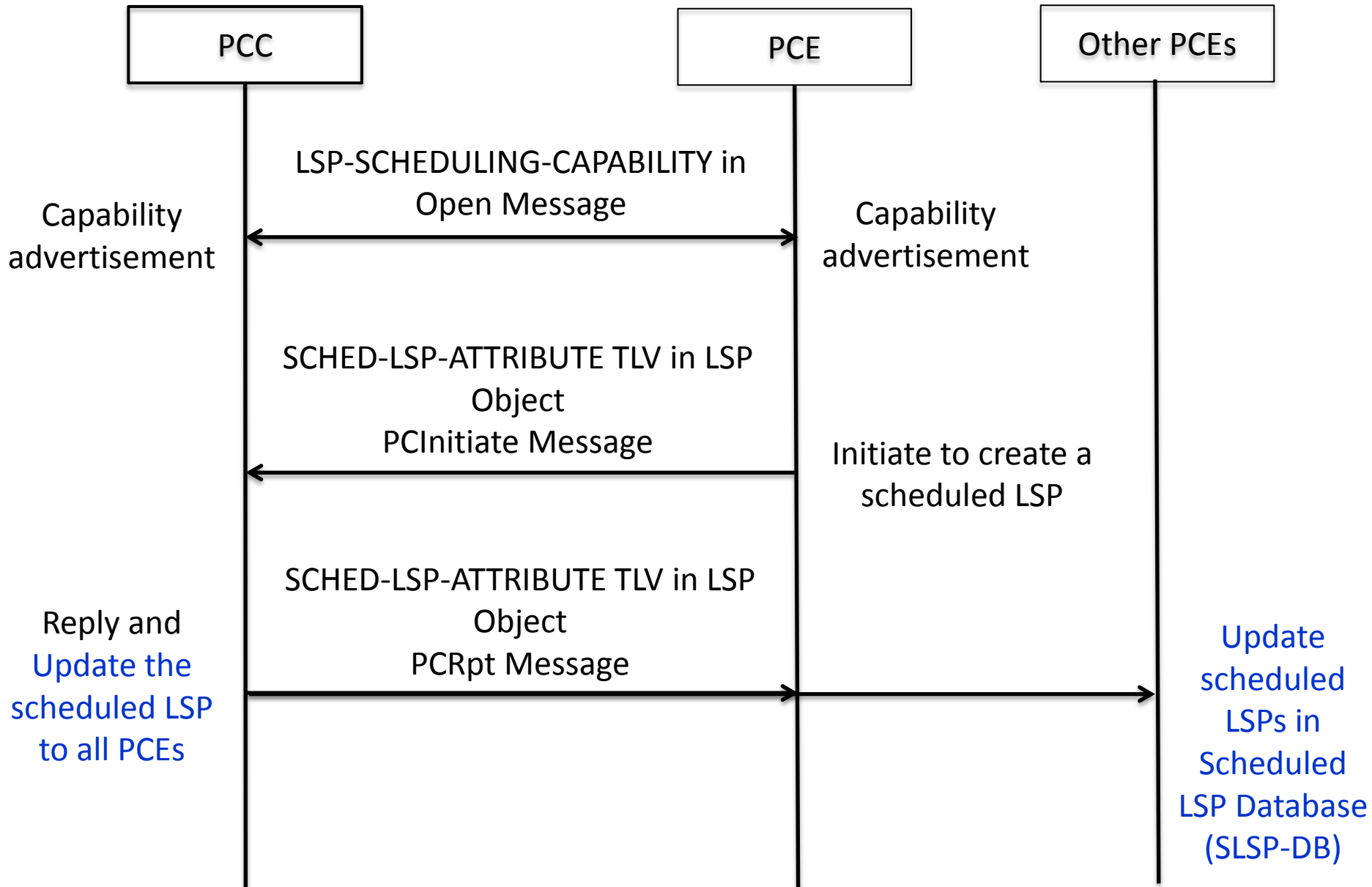
PCC Initiated scheduled LSP creation
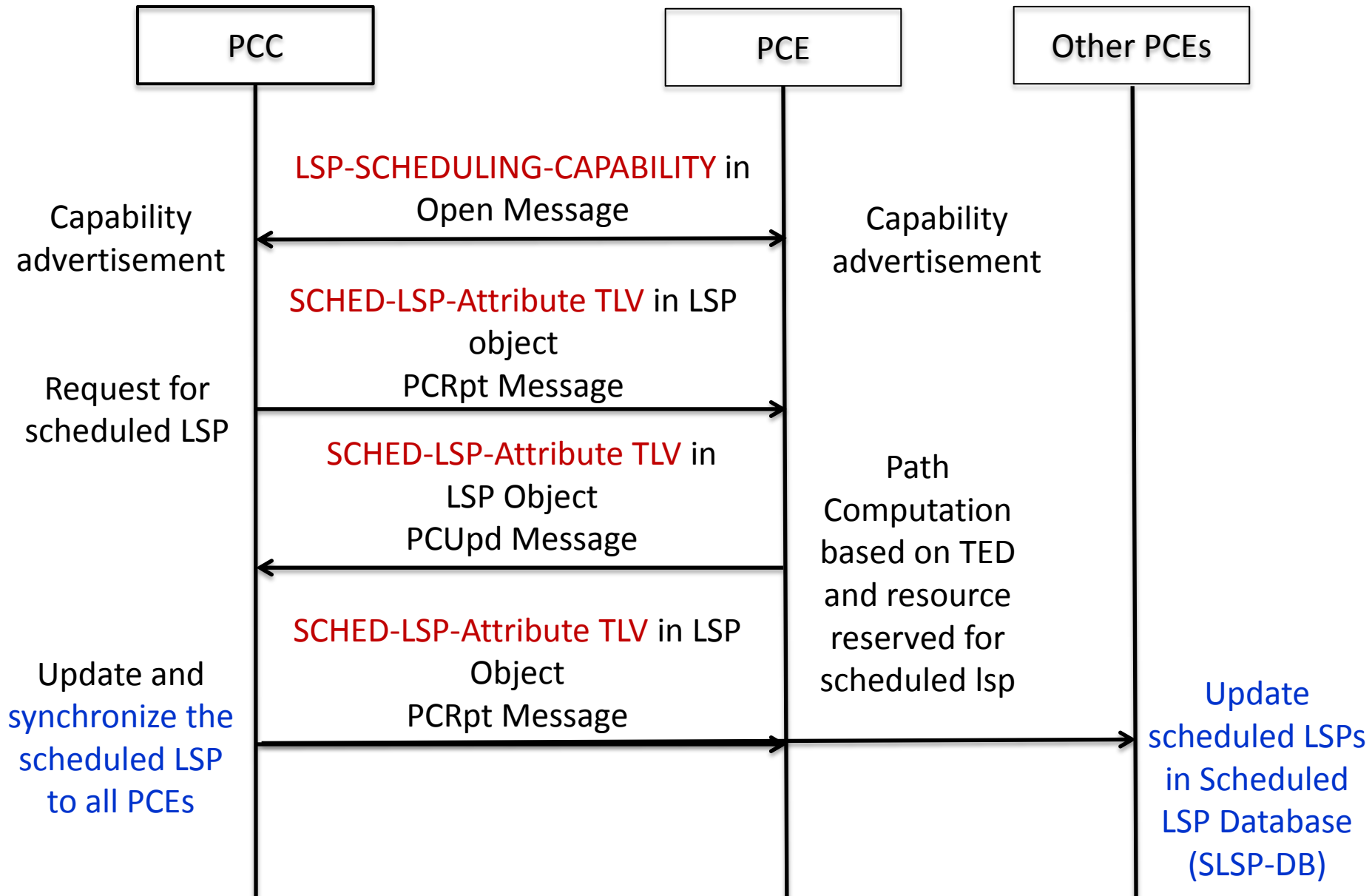
PCE Initiated scheduled LSP creation

Activation/Change/Deletion of the scheduled LSP

- Activation of the scheduled LSP means to signal the LSP onto its traversed LSRs over the path.

- Activation can be done by PCC/PCE:

  - For PCC, it can activate the LSP at the starting time according to the SCHED-LSP-ATTRIBUTE-TLV in PCUpd or PCInitiate message.
  - For PCE, it can use the extended SRP object in the PCUpd to notify the PCC to signal the LSP at the starting time.

- At any time, stateful PCE may change the attribute of a scheduled LSP by sending the PCUpd message.

- Deletion of a scheduled lsp is notified onto PCC by the delegated PCE when the usage time expires by reusing the Removal bit in SRP object.

Activating/removing a scheduled LSP by an active PCE: The SRP Object

- The ACTIVATING-LSP Flag is used to activate a scheduled LSP at its starting time in the case of active stateful PCE control.

- The Removal Flag defined in [I-D. ietf-pce-pce-initiated-lsp]can be used to remove the scheduled LSP when its usage duration expires.

- It is carried on a PCUpd message from active stateful PCE to the PCC to notify triggering signaling for the LSP creation and deletion at the correct time.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                           Flags                           |A|R|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        SRP-ID-number                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                       Optional TLVs                         //
|                                                              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Questions?