PCE for BIER-TE Path

draft-chen-pce-bier-te-path-00

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A flow for creating a BIER-TE path
1. PCEa gets reports about egresses in PCRpt
2. PCEa requests PCEb to find Ingress by PCReq
3. PCEb finds ingress, and sends it to PCEa in PCRep
4. PCEa computes path, sends it to Ingress using PCInitiate
5. Ingress creates path, sends PCEa report in PCRpt
6. PCEa gets report about path creation, records it
More on BIER-TE Path

A flow for updating a BIER-TE path
1. PCEa gets reports about existing egress leave in PCRpt
2. PCEa computes a new path, sends it to Ingress using PCUdp
3. Ingress replaces old path with new one, sends PCEa report in PCRpt
4. PCEa gets report about path update in PCRpt, records it

Another flow for creating a BIER-TE path
1. PCEa gets a request from a user for a path from ingress to egresses
2. PCEa computes a path, sends it to Ingress using PCInitiate
3. Ingress creates path, sends PCEa report in PCRpt
4. PCEa gets report about path creation in PCRpt, records it
Extensions to PCE

Extensions to PCEP Objects
1. BIER-TE Path Capability
2. Extensions to SRP
3. Ingress Node Object
4. Objective Functions
5. BIER-TE Path Subobject

Extensions to PCEP Messages
1. PCRpt Message
2. PCUpd Message
3. PCIInitiate Message
4. PCReq Message
5. PCRep Message

Procedures
1. BIER-TE Path Creation
2. BIER-TE Path Update
3. BIER-TE Path Deletion
Capability for BIER-TE Path

PCC and PCE exchange capabilities of BIER-TE path

PATH_SETUP_TYPE_CAPABILITY TLV with PST = TBD1 + sub-TLV in Open

* PST = TBD1: Path is setup using BIER-TE.

```
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                        | SILen | BitStrLen |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

- **SILen (SI Length)** - 5 bits: The length in bits of the SI field

- **BitStrLen (Bit String Length)** - 8 bits: The length in bits of the BitString field according to RFC8296. If \( k \) is the length of the BitString, the value of BitStrLen is \( \log_2(k) - 5 \). For example, BitStrLen = 1 indicates \( k = 64 \), BitStrLen = 7 indicates \( k = 4096 \).
For BIER-TE path, SRP MUST include:
• PATH-SETUP-TYPE TLV with PST = TBD1 for path setup using BIER-TE

Three contiguous bits (bit 27-29) in SRP Flag Field are defined as AOP (Assistant Operation).

Multicast Traffic TLV

<table>
<thead>
<tr>
<th>AOP Value</th>
<th>Meaning (Assistant Operation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x001 (J)</td>
<td>Join with Multicast Group and Source</td>
</tr>
<tr>
<td>0x010 (L)</td>
<td>Leave from Multicast Group and Source</td>
</tr>
<tr>
<td>0x011 (I)</td>
<td>Ingress node computation</td>
</tr>
</tbody>
</table>

• When the PCC running on an edge node of a BIER-TE domain sends the PCE for the domain a PCEP message such as PCRpt to report that the edge node receives a multicast join, the message MUST include a SRP object with AOP == 0x001 (J).

• When the PCC running on an edge node of a BIER-TE domain sends the PCE for the domain a PCEP message such as PCRpt to report that the edge node receives a multicast leave, the message MUST include a SRP object with AOP == 0x010 (L).

• When the PCE for the domain sends a PCEP message such as PCReq to another PCE for requesting to find an ingress node for a BIER-TE path, the message MUST include a SRP object with AOP == 0x011 (I).
Multicast Traffic TLV
- For a PCE-Initiated BIER-TE path, when a PCE sends a PCC a PCInitiate message to create a BIER-TE path in a BIER-TE domain, the message MUST contain the Multicast Traffic Information TLV in SRP.
- When PCC on an edge node of a BIER-TE domain sends PCE for the domain a message to report that the edge node receives a multicast join or leave with a multicast group/address and source, the message MUST contain the Multicast Traffic Information TLV in SRP.
- When the PCE for a BIER-TE domain sends another PCE a message to request for finding an ingress node of a BIER-TE path, the message MUST contain the Multicast Traffic Information TLV in SRP.

Two groups of sub-TLVs for IPv4/IPv6:
- IPv4/IPv6 multicast group address prefix sub-TLV and
- IPv4/IPv6 multicast source address prefix sub-TLV.
Extensions to SRP (3/4)

IPv4 Multicast Group Address Prefix sub-TLV

IPv6 Multicast Group Address Prefix sub-TLV
Extensions to SRP (4/4)

IPv4 Multicast Source Address Prefix sub-TLV

IPv6 Multicast Source Address Prefix sub-TLV
Ingress Node Object

Ingress node object to represent ingress node

```
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
|ObjectClass=TBD| OT=1 |Res|P|I|   Object Length (bytes)   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
| Ingress Node IPv4 address |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
| Cost to Ingress Node |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
~
Optional TLVs
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
```

Ingress Node Object for IPv4

```
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
|ObjectClass=TBD| OT=2 |Res|P|I|   Object Length (bytes)   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
| Ingress Node IPv6 address (16 bytes) |
~
Optional TLVs
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
```

Ingress Node Object for IPv6
Objective Functions

New OF defined for BIER-TE path

OF Code: TBD8
Name: Minimum Bit Sets (MBS)
Description: Find a path represented by BitPositions that has the minimum number of bit sets.

OF Code: TBD9
Name: Minimum Bits (MB)
Description: Find a path represented by BitPositions that has the minimum bit distance. The bit distance of BitPositions is the distance from the lowest bit to the highest bit in BitPositions.
BIER-TE Path Subobject

New subobject, called BIER-TE Path subobject (or BIER-TE-ERO subobject), is defined to contain the information about one or more BitPositions.

<table>
<thead>
<tr>
<th>L</th>
<th>Type = TBDa</th>
<th>Length</th>
<th>sub-domain-id</th>
<th>MT-ID</th>
<th>BitPositions</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>TBDa</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>0 0 0 0 0 0 0 1 0</td>
<td>7</td>
<td>1 0 0 0 0 0 0 0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0 0 1 0 1 0 1 0</td>
<td>0</td>
<td>0 0 0 0 1 0 1 0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

BIER-TE Path Subobject for Path \{18', 16', 6', 4', 2', 4, 2\}

\{18'\(8:00000010\), 16'\(7:10000000\), 6'\(6:00100000\), 4'\(6:00001000\), 2'\(6:00000010\), 4 \(0:00001000\), 2 \(0:00000010\)}.
BIER-TE Path Subobject in RRO

BIER-TE Path Subobject in RRO (Record Route Object) has the same format as BIER-TE Path subobject in ERO except for L flag.

```
<table>
<thead>
<tr>
<th>Type = TBDa</th>
<th>Length</th>
<th>sub-domain-id</th>
<th>MT-ID</th>
</tr>
</thead>
</table>
```

BitPositions

```
|                                                               |
|---------------|---------------|---------------|---------------|
```

BIER-TE Path Subobject in RRO
Extensions to PCEP Messages

Every PCEP message for BIER-TE path MUST include
• SRP containing PATH-SETUP-TYPE TLV with PST = TBD1 for path setup using BIER-TE

PCRpt includes
• BIER-TE path represented by a BIER-TE path subobject or
• Multicast Traffic TLV in SRP
• Flags in SRP set for egress join or leave

PCUpd includes
• BIER-TE path represented by a BIER-TE path subobject

PCInitiate includes
• BIER-TE path represented by a BIER-TE path subobject
• Multicast Traffic TLV in SRP

PCReq includes
• Multicast Traffic TLV in SRP
• OF for BIER-TE path or
• Flags in SRP set for computing ingress

PCRep includes
• BIER-TE path represented by a BIER-TE path subobject or
• Ingress nodes represented by ingress node objects
Next Step

Comments