PCEP Extensions for BIER
draft-chen-pce-bier-02

Abstract

   Bit Index Explicit Replication (BIER)-TE shares architecture and
   packet formats with BIER as described in
   [I-D.ietf-bier-architecture]. BIER-TE forwards and replicates
   packets based on a BitString in the packet header, but every
   BitPosition of the BitString of a BIER-TE packet indicates one or
   more adjacencies.BIER-TE Path can be derived from a Path Computation
   Element (PCE).

   This document specifies extensions to the Path Computation Element
   Protocol (PCEP) to handle requests and responses for the computation
   of paths for BIER-TE.

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1. Introduction

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packet formats with BIER as described in
[I-D.ietf-bier-architecture]. BIER-TE forwards and replicates
packets based on a BitString in the packet header, but every
BitPosition of the BitString of a BIER-TE packet indicates one or
more adjacencies.BIER-TE Path can be derived from a Path Computation
Element (PCE).

This document specifies extensions to the Path Computation Element
Protocol (PCEP) to handle requests and responses for the computation
of paths for BIER-TE.

2. Conventions used in this document

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.

3. Overview of PCEP Operation in BIER Networks

BIER-TE forwards and replicates packets based on a BitString in the packet header. In a PCEP session, An ERO object specified in [RFC5440] can be extended to carry a BIER-TE path consists of one or more BIER-ERO subobject(s). BIER-TE computed by a PCE can be represented in the following forms:

o An ordered set of adjacencies BitString(s) in which each bit represents that the adjacencies to which the BFR should replicate packets to in the domain.

In this document, we define a set of PCEP protocol extensions, including a new PCEP capability,a new Path Setup Type (PST) ,a new BIER END-POINT Object, new ERO subobjects, new RRO subobjects, new PCEP error codes and procedures.

4. BIER PCEP Message Extensions

The following section describes the protocol extensions required to support BIER-TE path.

4.1. BIER Capability Advertisement

4.1.1. The OPEN Object

This document defines a new optional TLV for use in the OPEN Object.

4.1.1.1. The BIER PCE Capability TLV

The BIER-PCE-CAPABILITY TLV is an optional TLV associated with the OPEN Object to exchange BIER capability of PCEP speakers. The format of the BIER-PCE-CAPABILITY TLV is shown in the following figure:

```
 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           |             Flags             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
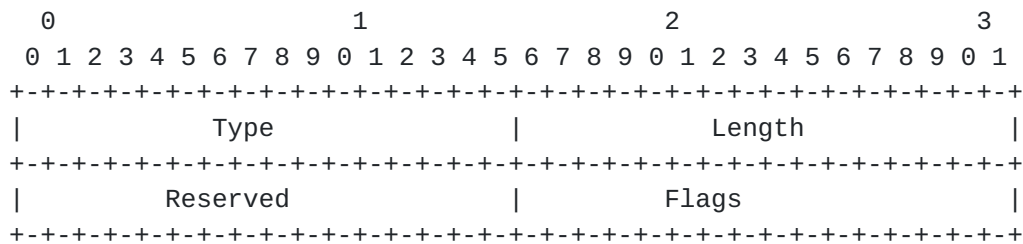
Figure 1

The code point for the TLV type is to be defined by IANA.

Length: 4 bytes.

The "Reserved" (2 octet) and "Flags" (2 octet) fields are currently
unused, and MUST be set to zero on transmission and ignored on
reception.

4.1.1.1.1. Exchanging BIER Capability

This document defines a new optional BIER-PCE-CAPABILITY TLV for use
in the OPEN object to negotiate the BIER capability. The inclusion
of this TLV in the OPEN message destined to a PCC indicates the PCE's
capability to perform BIER-TE path computations, and the inclusion of
this TLV in the OPEN message destined to a PCE indicates the PCC's
capability to support BIER-TE Path.

A PCE that is able to support the BIER extensions defined in this
document SHOULD include the BIER-PCE-CAPABILITY TLV on the OPEN
message. If the PCE does not include the BIER-PCE-CAPABILITY TLV in
the OPEN message and PCC does include the TLV, it is RECOMMENDED that
the PCC indicates a mismatch of capabilities.

4.2. Path Computation Request/Reply Message Extensions

4.2.1. The RP/SPR Object

In order to setup an BIER-TE, a new PATH-SETUP-TYPE
TLV[I-D.ietf-pce-lsp-setup-type] MUST be contained in RP or SRP
object. This document defines a new Path Setup Type (PST) for BIER
as follows:

o   PST = 2: Path is setup using BIER Traffic Engineering technique.

If a PCEP speaker does not recognize the PATH-SETUP-TYPE TLV, it MUST
ignore the TLV in accordance with [RFC5440]. If a PCEP speaker
recognizes the TLV but does not support the TLV, it MUST send PCErr
with Error-Type = 2 (Capability not supported).

4.2.2. The New BIER END-POINT Object

The END-POINTS object is used in a PCReq message to specify the BIER
information of the path for which a path computation is requested.
To represent the end points for a BIER path efficiently, we define a
new END-POINT Object for the BIER path:

The format of the new END-POINTS Object is as follows:

```
    0                       1
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |Subdomain-ID   |  BS Length    |        Source BFR-id          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |   Destination  BFR-id         ~        ...                    ~
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    ~       ...                     ~     Destination BFR-id        |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
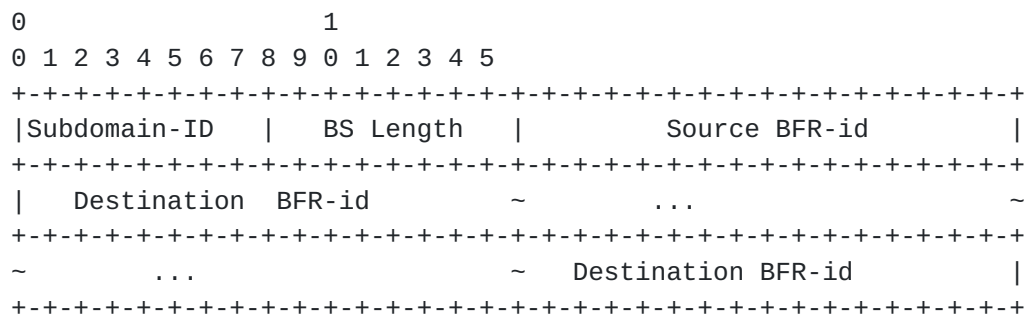
Figure 2

Subdomain-id: Unique value identifying the BIER sub-domain. 1 octet

BS Length: A 1 octet field encoding the supported BitString length.

Source BFR-id:A 2 octet field encoding the source BFR-id.

Destniation BFR-id:A 2 octet field encoding the destniation BFR-id.

4.2.3. ERO Object

BIER-TE consists of one or more adjacencies BitStrings where every
BitPosition of the BitString indicates one or more adjacencies, as
described in([I-D.eckert-bier-te-arch]).

The ERO object specified in [RFC5440] is used to encode the path of a
TE LSP through the network.The ERO is carried within a PCRep message
to provide the computed TE LSP if the path computation was
successful.In order to carry BIER-TE explicit paths, this document
defines a new ERO subobjects referred to as "BIER-ERO subobjects"
whose formats are specified in the following section. An BIER-ERO
subobjects carrying a adjacencies BitStrings consists of one or more
BIER-ERO subobject(s).

4.2.3.1. **BIER-ERO Subobject**

```
      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           |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |     BS Length |    Reserved    |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |                       Adjacency BitString                     |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
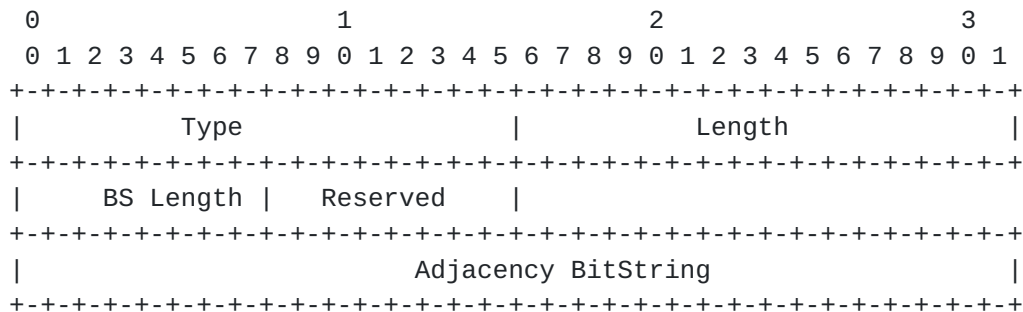
                             Figure 3

   Type: TBD

   Length: 4 bytes

   BS Length: A 1 octet field encoding the supported BitString length.

   The "Reserved" (1 octets) fields are currently unused, and MUST be
   set to zero on transmission and ignored on reception.

   Adjacency BitString: A 4 octet field encoding the Adjacency BitString
   where every BitPosition of the BitString indicates one or more
   adjacencies.

4.2.3.1.1. **BIER-ERO Processing**

   If a PCC finds a non-recognize the BIER-ERO subobject, the PCC MUST
   respond with a PCErr message with Error-Type=3 ("Unknown Object") and
   Error-Value=2 ("Unrecognized object Type") or Error-Type=4 ("Not
   supported object") and Error-Value=2 ("Not supported object Type") as
   described in [RFC5440] .

   If a PCC receives an BIER-ERO subobject in which either
   BitStringLength or Adjacency BitString is absent, it MUST consider
   the entire BIER-ERO subobject invalid and send a PCErr message with
   Error-Type = 10 ("Reception of an invalid object") and Error-Value =
   TBD ("BitStringLength is absent ") and Error-Value = TBD ("Adjacency
   BitString is absent ")

   If a PCC detects that all subobjects of BIER-ERO are not identical,
   it MUST send a PCErr message with Error-Type = 10 ("Reception of an
   invalid object") and Error-Value = TBD ("Non-identical BIER-ERO
   subobjects").

If a PCC receives an BIER-ERO subobject in which BitStringLength
values are not chosen from: 64, 128, 256, 512, 1024, 2048, and 4096,
as it described in ([I-D.ietf-bier-architecture]). The PCC MUST send
a PCErr message with Error-Type = 10 ("Reception of an invalid
object") and Error-Value = TBD ("Invalid BitStringLength").

4.2.4. RRO Object

A PCC can record BIER-ERO explicit paths and report the paths to a
PCE via RRO. An RRO object contains one or more subobjects called
"BIER-RRO subobjects" whose formats are the same as that of BIER-ERO
subobject.

4.2.4.1. RRO Processing

Processing rules of BIER-RRO subobject are identical to those of
BIER-ERO subobject defined in section 4.2.3.1 in this document.

5. Security Considerations

TBD.

6. IANA Considerations

6.1. PCEP Objects

As discussed in Section 4.2.2, a new END-POINTS Object-Type is
defined. IANA has made the following Object-Type allocations from
the "PCEP Objects" sub-registry:

```
        Object                        Object-Class Value
    --------------------          --------------------------
      BIER END-POINT Object                 TBD
```

As discussed in Section 4.2.3 and 4.2.4, a new sub-object type for
the PCEP explicit route object (ERO), and a new sub-object type for
the PCEP record route object (RRO) are defined.

IANA has made the following sub-objects allocation from the RSVP
Parameters registry:

Object	Sub-Object	Sub-Object Type
EXPLICIT_ROUTE	BIER-ERO (PCEP-specific)	TBD
ROUTE_RECORD	BIER-RRO (PCEP-specific)	TBD

6.2. PCEP-Error Objects and Types

As described in Section 4.2.3.1.1, a number of new PCEP-ERROR Object
Error Values have been defined.

Error-Type	Meaning	Reference
10	Reception of an invalid object.	RFC5540
	Error-value = TBD: BitStringLength is absent	This document
	Error-value = TBD: BitString is absent	This document
	Error-value = TBD: Invalid BitStringLength	This document

6.3. PCEP TLV Type Indicators

IANA is requested to allocate a new code point in the PCEP TLV Type
Indicators registry, as follows:

Value	Meaning	Reference
TBD	BIER-PCE-CAPABILITY TLV	This document

6.4. New Path Setup Type

IANA is requested to allocate a new code point in the PCEP
PATH_SETUP_TYPE TLV PST field registry, as follows:

Value	Description	Reference

	2	Path is setup using BIER Traffic	This document
		Engineering technique	

[7](#). References

7.1. Normative references

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7.2. Informative references

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