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                        OSPF Extensions for BIER
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Abstract

   Bit Index Explicit Replication (BIER) is an architecture that
   provides multicast forwarding through a "BIER domain" without
   requiring intermediate routers to maintain multicast related per-flow
   state. Neither does BIER require an explicit tree-building protocol
   for its operation. A multicast data packet enters a BIER domain at a
   "Bit-Forwarding Ingress Router" (BFIR), and leaves the BIER domain at
   one or more "Bit-Forwarding Egress Routers" (BFERs). The BFIR router
   adds a BIER header to the packet. Such header contains a bit-string
   in which each bit represents exactly one BFER to forward the packet
   to. The set of BFERs to which the multicast packet needs to be
   forwarded is expressed by the according set of bits switched on in
   BIER packet header.

   This document describes the OSPF protocol extension required for BIER
   with MPLS encapsulation.

Status of This Memo

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1. Introduction

Bit Index Explicit Replication (BIER) is an architecture that
provides optimal multicast forwarding through a "BIER domain" without
requiring intermediate routers to maintain any multicast related per-
flow state. Neither does BIER explicitly require a tree-building
protocol for its operation. A multicast data packet enters a BIER
domain at a "Bit-Forwarding Ingress Router" (BFIR), and leaves the
BIER domain at one or more "Bit-Forwarding Egress Routers" (BFERs).
The BFIR router adds a BIER header to the packet. The BIER header
contains a bit-string in which each bit represents exactly one BFER
to forward the packet to. The set of BFERs to which the multicast
packet needs to be forwarded is expressed by setting the bits that
correspond to those routers in the BIER header.

BIER architecture requires routers participating in BIER to exchange
BIER related information within a given domain. BIER architecture
permits link-state routing protocols to perform distribution of such
information. This document describes extensions to OSPF necessary to
carry BIER specific information in the case where BIER uses MPLS
encapsulation as described in [I-D.wijnands-mpls-bier-encapsulation].

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].

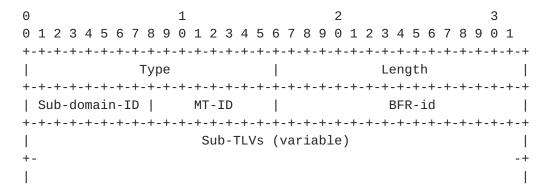## 2. Flooding of the BIER Information in OSPF

All BIER specific information that a BFR needs to advertise to other
BFRs is associated with a BFR-Prefix. BFR prefix is a unique (within
a given BIER domain), routable IP address that is assigned to each
BFR as described in more detail in section 2 of
[I-D.wijnands-bier-architecture].

Given that BIER information must be associated with a BFR prefix, the
OSPF Extended Prefix Opaque LSA [I-D.ietf-ospf-prefix-link-attr] has
been chosen to flood it.

2.1. The BIER Sub-TLV

A new Sub-TLV of the Extended Prefix TLV (defined in
[I-D.ietf-ospf-prefix-link-attr]) is defined for distributing BIER
information. The new Sub-TLV is called BIER Sub-TLV. Multiple BIER
Sub-TLVs may be included in the Extended Prefix TLV.

BIER 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             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Sub-domain-ID |     MT-ID     |            BFR-id             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Sub-TLVs (variable)                     |
+-                                                             -+
|                                                               |
```

Type: TBD

Length: variable

   Sub-domain-ID: Unique value identifying the BIER sub-domain within
   the BIER domain, as described in section 1 of
   [I-D.wijnands-bier-architecture].

   MT-ID: Multi-Topology ID (as defined in [RFC4915]) that identifies
   the topology that is associated with the BIER sub-domain.

   BFR-id: A 2 octet field encoding the BFR-id, as documented in
   section 2 [I-D.wijnands-bier-architecture]. If the BFR is not
   locally configured with a valid BFR-id, the value of this field is
   set to invalid BFR-id per [I-D.wijnands-bier-architecture].

Each BFR sub-domain MUST be associated with one and only one OSPF
topology that is identified by the MT-ID. If the association between
BIER sub-domain and OSPF topology advertised in the BIER sub-TLV by
other BFRs is in conflict with the association locally configured on
the receiving router, whole BIER sub-TLV of the advertising routers
MUST be ignored.

If a BFR advertises the same Sub-domain-ID in multiple BIER sub-TLVs,
the BRF MUST be treated as if it did not advertise a BIER sub-TLV for
such sub-domain.

All BFRs MUST detect advertisement of duplicate valid BFR-IDs for a
given MT-ID and Sub-domain-ID. When such duplication is detected all
BFRs advertising duplicates MUST be treated as if they did not
advertise a valid BFR-id.

2.2. The BIER MPLS Encapsulation Sub-TLV

   BIER MPLS Encapsulation Sub-TLV is a sub-TLV of the BIER Sub-TLV.
   BIER MPLS Encapsulation Sub-TLV is used in order to advertise MPLS
   specific information used for BIER. It MAY appear multiple times in
   the BIER Sub-TLV.

   BIER MPLS Encapsulation 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            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Lbl Range Size |              Label Range Base                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| BS Length |                  Reserved                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

      Type: TBD

    Length: 4 bytes

    Label Range Size: A 1 octet field encoding the label range size of
    the label range. It MUST be greater then 0, otherwise the
    advertising router MUST be treated as if it did not advertise a
    BIER sub-TLV.

    Label Range Base: A 3 octet field, where the 20 rightmost bits
    represent the first label in the label range.

    BS Length: A 1 octet field encoding the supported BitString length
    associated with this BFR-prefix. The values allowed in this field
    are specified in section 3 of
    [I-D.wijnands-mpls-bier-encapsulation].

    The "label range" is the set of labels beginning with the label
    range base and ending with (label range base)+(label range size)-
    1. A unique label range is allocated for each BitStream length
    and Sub-domain-ID. These labels are used for BIER forwarding as
    described in [I-D.wijnands-bier-architecture] and
    [I-D.wijnands-mpls-bier-encapsulation].

    The size of the label range is determined by the number of Set
    Identifiers (SI) (section 2 of [I-D.wijnands-bier-architecture])
    that are used in the network. Each SI maps to a single label in
    the label range. The first label is for SI=0, the second label is
    for SI=1, etc.

If same BS length is repeated in multiple BIER MPLS Encapsulation
Sub-TLV inside the same BIER Sub-TLV, the advertising router MUST be
treated as if it did not advertise a BIER sub-TLV.

Label ranges within all BIER MPLS Encapsulation Sub-TLV inside the
same BIER Sub-TLV MUST NOT overlap. If the overlap is detected, the
advertising router MUST be treated as if it did not advertise a BIER
sub-TLV.

All advertised labels MUST be valid, otherwise the advertising router
MUST be treated as if it did not advertise a BIER sub-TLV.

2.3. Optional BIER Tree Type Sub-TLV

This Sub-TLV carries the information associated with the supported
BIER tree type for a subdomain. This Sub-TLV is optional and its
absence has the same semantics as its presence with Tree Type value 0
(SPF). When Tree Type 0 is used it is recommended that this Sub-TLV
is omitted in order to reduce the space consumed in the parent TLV.

This Sub-TLV MAY occur no more than once in a BIER sub-TLV. If
multiple occurences of this Sub-TLV are present in a single BIER Sub-
TLV the advertising router MUST be treated as if it did not advertise
a BIER sub-TLV.

If the tree type (implied or explicitly advertised) does not match
the locally configured tree type associated with the matching
subdomain the advertising router MUST be treated as if it did not
advertise a BIER sub-TLV.

```
  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     |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 | Tree Type     |
 +-+-+-+-+-+-+-+-+
```

   Type: value of 1 indicating BIER Tree Type.

   Length: 1 octet.

   Tree Type: 1 octet

2.4. Flooding scope of BIER Information

Flooding scope of the OSPF Extended Prefix Opaque LSA
[I-D.ietf-ospf-prefix-link-attr] that is used for advertising BIER
Sub TLV is set to area. To allow BIER deployment in a multi-area
environment, OSPF must propagate BIER information between areas. The
following procedure is used in order to propagate BIER related
information between areas:

   When an OSPF ABR advertises a Type-3 Summary LSA from an intra-
   area or inter-area prefix to all its connected areas, it will also
   originate an Extended Prefix Opaque LSA, as described in
   [I-D.ietf-ospf-prefix-link-attr]. The flooding scope of the
   Extended Prefix Opaque LSA type will be set to area-scope. The
   route-type in the OSPF Extended Prefix TLV is set to inter-area.
   When determining whether a BIER Sub-TLV should be included in this
   LSA ABR will:

      - look at its best path to the prefix in the source area and
      find the advertising router associated with the best path to
      that prefix.

      - determine if such advertising router advertised a BIER Sub-
      TLV for the prefix. If yes, ABR will copy the information from

such BIER MPLS Sub-TLV when advertising BIER MPLS Sub-TLV to
each connected area.

3. Security Considerations

Implementations must assure that malformed TLV and Sub-TLV
permutations do not result in errors which cause hard OSPF failures.

4. IANA Considerations

The document requests three new allocations from the OSPF Extended
Prefix sub-TLV registry as defined in
[I-D.ietf-ospf-prefix-link-attr].

   BIER Sub-TLV: TBD

   BIER MPLS Encapsulation Sub-TLV: TBD

   BIER Tree Type Sub-TLV: TBD

5. Acknowledgments

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