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OSPF Extensions for BIER draft-ietf-bier-ospf-bier-extensions-08.txt

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 set 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 perflow 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 advertise BIER specific information in the case where BIER uses MPLS encapsulation as described in [I-D.ietf-bier-mpls-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 Bit-Forwarding Router (BFR) needs to advertise to other BFRs is associated with a BFR-Prefix. A 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.ietf-bier-architecture].

Given that BIER information must be associated with a BFR prefix, the OSPF Extended Prefix Opaque LSA [RFC7684] has been chosen for advertisement.

2.1. BIER Sub-TLV

A Sub-TLV of the Extended Prefix TLV (defined in [RFC7684]) is defined for distributing BIER information. The Sub-TLV is called the BIER Sub-TLV. Multiple BIER Sub-TLVs may be included in the Extended Prefix TLV.

The BIER Sub-TLV has the following format:

Type: TBD1

Length: Variable, dependent on sub-TLVs.

Sub-domain-ID: Unique value identifying the BIER sub-domain within the BIER domain, as described in section 1 of [I-D.ietf-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 of $[\underline{\text{I-D.ietf-bier-architecture}}]$. If the BFR is not locally configured with a valid BFR-id, the value of this field is set to invalid BFR-id per $[\underline{\text{I-D.ietf-bier-architecture}}]$.

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, the BIER Sub-TLV 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. BIER MPLS Encapsulation Sub-TLV

The BIER MPLS Encapsulation Sub-TLV is a Sub-TLV of the BIER Sub-TLV. The 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.

The BIER MPLS Encapsulation Sub-TLV has the following format:

0									1	1								2	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	
+-+	-+-	-+-	-+-	- + -	+-	+-	- + -	-+-	+-	-+-	- + -	- + -	+-	- + -	+-	+-	+-	+-	-+-	- + -	+-	+-	+-	+	-+-	-+-	-+-	+-	+-	- + -	- +
	Туре															Length															
+-+	+-															- +															
Lbl Range Size													Label Range Base																		
+-+	-+-	-+-	-+-	-+-	+-	+-	+-	+-	+-	-+-	+-	+-	+-	-+-	+-	+-	+-	+-	+-	+-	+-	+-	+-	+	-+-	-+-	-+-	+	+-	+-	- +
BS	BS Len F														Reserved														-		
+-+	-+-	-+-	-+-	- + -	+-	+-	+-	+-	+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-														+-	+-	- +						

Type: TBD2

Length: 4 octets

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. The 4 leftmost bits MUST be ignored.

Bit String Length: A 4 bits field encoding the supported BitString length associated with this BFR-prefix. The values allowed in this field are specified in section 2 of [I-D.ietf-bier-mpls-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.ietf-bier-architecture] and [I-D.ietf-bier-mpls-encapsulation].

The size of the label range is determined by the number of Set Identifiers (SI) (section 1 of [I-D.ietf-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 BIER sub-TLV MUST be ignored.

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 BIER sub-TLV MUST be ignored.

2.3. Optional BIER Tree Type Sub-TLV

The BIER Tree Type Sub-TLV is a Sub-TLV of the BIER Sub-TLV. This Sub-TLV carries the information associated with the supported BIER tree type for a sub-domain. 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 BIER sub-TLV MUST be ignored.

If the tree type (implied or explicitly advertised) does not match the locally configured tree type associated with the matching subdomain, the BIER sub-TLV MUST be ignored.

 $\begin{smallmatrix} 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 0 & 1 \\ \end{smallmatrix}$ Type | Length | Tree Type | +-+-+-+-+-+-+-+

Type: TBD3.

Length: 1 octet.

Tree Type: 1 octet field describing the Tree Type. The following value is defined by this document:

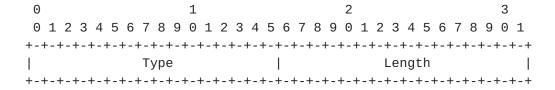
0: Shortest Path First (SPF) algorithm based on IGP link metric. This is the standard shortest path algorithm as computed by the OSPF protocol.

2.4. Optional BIER sub-domain BSL conversion Sub-TLV

The BIER sub-domain BSL conversion Sub-TLV is a Sub-TLV of the BIER Sub-TLV. This sub-TLV indicates whether the BFR is capable of imposing a different Bit String Length (BSL) than the one it received in a BIER encapsulated packet. Such a capability may allow future, advanced tree types which ensure simple migration procedures from one BSL to another in a given MT-ID and Sub-domain-ID or prevent stable blackholes in scenarios where not all routers support the same set of BSLs in a given MT-ID and Sub-domain-ID.

The BIER sub-domain BSL conversion Sub-TLV is optional and its absence indicates that the router is NOT capable of imposing different BSLs but will always forward the packet with the BSL unchanged. This sub-TLV MAY occur at most once in a given BIER sub-TLV. If multiple occurrences of this sub-TLV are received in a given BIER sub-TLV, the BIER sub-TLV MUST be ignored.

The BIER sub-domain BSL conversion Sub-TLV has following format:



Type: TBD4.

Length: 0 octets.

2.5. Flooding scope of BIER Information

The flooding scope of the OSPF Extended Prefix Opaque LSA [RFC7684] that is used for advertising the BIER Sub-TLV is set to area-local. To allow BIER deployment in a multi-area environment, OSPF must propagate BIER information between areas.

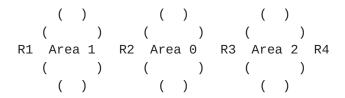


Figure 1: BIER propagation between areas

The following procedure is used in order to propagate BIER related information between areas:

When an OSPF Area Border Router (ABR) advertises a Type-3 Summary LSA from an intra-area or inter-area prefix to all its attached areas, it will also originate an Extended Prefix Opaque LSA, as described in [RFC7684]. The flooding scope of the Extended Prefix Opaque LSA type will be set to area-local. 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, an OSPF ABR will:

- Examine 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, the ABR will copy the information

In the Figure 1, R1 advertises a prefix 192.0.0.1/32 in Area 1. It also advertises Extended Prefix Opaque LSA for prefix 192.0.0.1/32 and includes BIER Sub-TLV in it. Area Border Router (ABR) R2 calculates the reachability for prefix 192.0.0.1/32 inside Area 1 and propagates it to Area 0. When doing so, it copies the entire BIER Sub-TLV (including all its Sub-TLVs) it received from R1 in Area 1 and includes it in the Extended Prefix Opaque LSA it generates for 192.0.0.1/32 in Area 0. ABR R3 calculates the reachability for prefix 192.0.0.1/32 inside Area 0 and propagates it to Area 2. When doing so, it copies the entire BIER Sub-TLV (including all its Sub-TLVs) it received from R2 in Area 0 and includes it in the Extended Prefix Opaque LSA it generates for 192.0.0.1/32 in Area 2.

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 [RFC7684].

BIER Sub-TLV: TBD1

BIER MPLS Encapsulation Sub-TLV: TBD2

BIER Tree Type Sub-TLV: TBD3

BIER sub-domain BSL conversion Sub-TLV

4.1. BIER Tree Type Registry

IANA is requested to set up a registry called "BIER Tree Type". The registration policy for this registry is "Standards Action" ([RFC8126]] and [RFC7120]).

Values in this registry must come from the range 0-255.

The initial value in the BIER Tree Type registry is:

0: Shortest Path First (SPF) algorithm based on standard IGP link metric.

5. Acknowledgments

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6. Normative References

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