OSPF
Internet-Draft
Intended status: Standards Track
Expires: August 18, 2018

P. Psenak, Ed.
N. Kumar
IJ. Wijnands
Cisco
A. Dolganow
Nokia
T. Przygienda
J. Zhang
Juniper Networks, Inc.
S. Aldrin
Google, Inc.
February 14, 2018

OSPF Extensions for BIER
draft-ietf-bier-ospf-bier-extensions-12.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 [RFC2328] protocol extension required for BIER with MPLS encapsulation.

Table of Contents

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 advertise BIER specific information in the case where BIER uses MPLS encapsulation as described in [RFC8296].

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 [RFC8279].

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:

```
 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           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    BAR        |                  Reserved                     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                      Sub-TLVs (variable)                      |
+-                                                             -+
|                                                               |
```

Type: 9

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 [RFC8279].

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 [RFC8279]. If the BFR is not locally configured with a valid BFR-id, the value of this field is set to invalid BFR-id per [RFC8279].

BAR: Single octet BIER Algorithm. 0 is the only supported value defined in this document and represents Shortest Path First (SPF) algorithm based on IGP link metric. This is the standard shortest path algorithm as computed by the OSPF protocol. Other values may be defined in the future.

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.

The supported algorithm MUST be consistent for all routers supporting a given BFR sub-domain. A router receiving BIER Sub-TLV advertisement with a BAR which does not match the locally configured value MUST report a misconfiguration for the given BIER sub-domain and MUST ignore such BIER sub-TLV.

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                   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            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Max SI    |                     Label                     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|BS Len |                     Reserved                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Type: 10

Length: 4 octets

Max SI : A 1 octet field encoding the Maximum Set Identifier (section 1 of [RFC8296]), used in the encapsulation for this BIER sub-domain for this bitstring length.

Label: 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 [RFC8296].

The "label range" is the set of labels beginning with the Label and ending with (Label + (Max SI)). A unique label range is allocated for each BitStream length and Sub-domain-ID. These labels are used for BIER forwarding as described in [RFC8279] and [RFC8296].

The size of the label range is determined by the number of Set Identifiers (SI) (section 1 of [RFC8279]) 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-TLVs advertised by the same BFR MUST NOT overlap. If the overlap is detected, the advertising router MUST be treated as if it did not advertise any BIER sub-TLVs.

All advertised labels MUST be valid, otherwise the BIER sub-TLV MUST be ignored.

2.3. 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.

```
              (  )          (  )          (  )
            (      )      (      )      (      )
         R1  Area 1   R2  Area 0   R3  Area 2  R4
            (      )      (      )      (      )
              (  )          (  )          (  )
```

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 from such BIER Sub-TLV when advertising BIER Sub-TLV to each attached area.

In the Figure 1, R1 advertises a prefix 192.0.2.1/32 in Area 1. It also advertises Extended Prefix Opaque LSA for prefix 192.0.2.1/32 and includes BIER Sub-TLV in it. Area Border Router (ABR) R2 calculates the reachability for prefix 192.0.2.1/32 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 192.0.2.1/32 in Area 0. ABR R3 calculates the reachability for prefix 192.0.2.1/32 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 192.0.2.1/32 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: 9

BIER MPLS Encapsulation Sub-TLV: 10

5. Acknowledgments

The authors would like to thank Rajiv Asati, Christian Martin, Greg Shepherd and Eric Rosen for their contribution.

6. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

[RFC2328] Moy, J., "OSPF Version 2", STD 54, RFC 2328, DOI 10.17487/RFC2328, April 1998, <https://www.rfc-editor.org/info/rfc2328>.

[RFC4915] Psenak, P., Mirtorabi, S., Roy, A., Nguyen, L., and P. Pillay-Esnault, "Multi-Topology (MT) Routing in OSPF", RFC 4915, DOI 10.17487/RFC4915, June 2007, <https://www.rfc-editor.org/info/rfc4915>.

[RFC7684] Psenak, P., Gredler, H., Shakir, R., Henderickx, W., Tantsura, J., and A. Lindem, "OSPFv2 Prefix/Link Attribute Advertisement", RFC 7684, DOI 10.17487/RFC7684, November 2015, <https://www.rfc-editor.org/info/rfc7684>.

[RFC8279] Wijnands, IJ., Ed., Rosen, E., Ed., Dolganow, A., Przygienda, T., and S. Aldrin, "Multicast Using Bit Index Explicit Replication (BIER)", RFC 8279, DOI 10.17487/RFC8279, November 2017, <https://www.rfc-editor.org/info/rfc8279>.

[RFC8296] Wijnands, IJ., Ed., Rosen, E., Ed., Dolganow, A., Tantsura, J., Aldrin, S., and I. Meilik, "Encapsulation for Bit Index Explicit Replication (BIER) in MPLS and Non-MPLS Networks", RFC 8296, DOI 10.17487/RFC8296, January 2018, <https://www.rfc-editor.org/info/rfc8296>.

Authors' Addresses

Peter Psenak (editor)
Cisco
Apollo Business Center
Mlynske nivy 43
Bratislava 821 09
Slovakia

Email: ppsenak@cisco.com

Nagendra Kumar
Cisco
7200 Kit Creek Road
Research Triangle Park, NC 27709
US

Email: naikumar@cisco.com

IJsbrand Wijnands
Cisco
De Kleetlaan 6a
Diegem 1831
Belgium

Email: ice@cisco.com

Andrew Dolganow
Nokia
750 Chai Chee Rd
06-06 Viva Business Park
Singapore 469004

Email: andrew.dolganow@nokia.com

Tony Przygienda
Juniper Networks, Inc.
10 Technology Park Drive
Westford, MA 01886
USA

Email: prz@juniper.net

Jeffrey Zhang
Juniper Networks, Inc.
10 Technology Park Drive
Westford, MA 01886
USA

Email: zzhang@juniper.net

Sam Aldrin
Google, Inc.
1600 Amphitheatre Parkway
Mountain View, CA
USA

Email: aldrin.ietf@gmail.com