

Internet Engineering Task Force
Internet-Draft
Intended status: Standards Track
Expires: August 26, 2018

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February 22, 2018

BIER support via ISIS
draft-ietf-bier-isis-extensions-08

Abstract

This document defines ISIS extensions to support multicast forwarding using the Bit Index Explicit Replication (BIER) architecture.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [BCP 14](#) [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

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[1.](#) Introduction

Bit Index Explicit Replication (BIER) [[RFC8279](#)] defines an architecture where all intended multicast receivers are encoded as bitmask in the Multicast packet header within different encapsulations such as [[RFC8296](#)]. A router that receives such a packet will forward the packet based on the Bit Position in the packet header towards the receiver(s), following a precomputed tree

for each of the bits in the packet. Each receiver is represented by a unique bit in the bitmask.

This document presents necessary extensions to the currently deployed ISIS for IP [[RFC1195](#)] protocol to support distribution of information necessary for operation of BIER domains and sub-domains. This document defines a new TLV to be advertised by every router participating in BIER signaling.

This document defines support for MPLS encapsulation as specified in [[RFC8296](#)]. Support for other encapsulation types is outside the scope of this document. The use of multiple encapsulation types is outside the scope of this document.

2. Terminology

Some of the terminology specified in [[RFC8279](#)] is replicated here and extended by necessary definitions:

BIER: Bit Index Explicit Replication (The overall architecture of forwarding multicast using a Bit Position).

BIER-OL: BIER Overlay Signaling. (The method for the BFIR to learn about BFER's).

BFR: Bit Forwarding Router (A router that participates in Bit Index Multipoint Forwarding). A BFR is identified by a unique BFR-prefix in a BIER domain.

BFIR: Bit Forwarding Ingress Router (The ingress border router that inserts the BM into the packet). Each BFIR must have a valid BFR-id assigned.

BFER: Bit Forwarding Egress Router. A router that participates in Bit Index Forwarding as leaf. Each BFER must be a BFR. Each BFER must have a valid BFR-id assigned.

BFT: Bit Forwarding Tree used to reach all BFERs in a domain.

BIER sub-domain: A further distinction within a BIER domain identified by its unique sub-domain identifier. A BIER sub-domain can support multiple BitString Lengths.

BFR-id: An optional, unique identifier for a BFR within a BIER sub-domain.

Invalid BFR-id: Unassigned BFR-id. The special value 0 is reserved for this purpose.

BAR BIER Algorithm. Used to calculate underlay next hops.

IPA IGP Algorithm. May be used to modify, enhance or replace the calculation of underlay paths as defined by the BAR value

SPF Shortest Path First routing calculation based on IGP link metric

3. IANA Considerations

This document adds the following new sub-TLV to the registry of Sub-TLVs for TLVs 135, 235, 236, and 237.

Value: 32 (suggested - to be assigned by IANA)

Name: BIER Info

This document also introduces a new registry for sub-sub-TLVs for the BIER Info sub-TLV added above. The registration policy is Expert Review as defined in [\[RFC8126\]](#). This registry is part of the "IS-IS TLV Codepoints" registry. The name of the registry is "sub-sub-TLVs for BIER Info sub-TLV". The defined values are:

Type	Name
----	----
1	BIER MPLS Encapsulation

IANA is requested to set up a registry called "BIER Algorithm Registry" under category "Bit Index Explicit Replication". The registration policies [\[RFC8126\]](#) for this registry are:

"Standards Action" for values 0-127

"Specification Required" for values 128-240

"Experimental Use" for values 240-254"

The initial values in the BIER Algorithm Registry are:

0: No BIER specific algorithm is used

1-254: Unassigned

255: Reserved

4. Concepts

4.1. BIER Domains and Sub-Domains

An ISIS signalled BIER domain is aligned with the scope of distribution of BFR-prefixes that identify the BFRs within ISIS. ISIS acts in such a case as the supporting BIER underlay.

Within such a domain, the extensions defined in this document advertise BIER information for one or more BIER sub-domains. Each sub-domain is uniquely identified by a subdomain-id (SD). Each subdomain is associated with a single ISIS topology (MT) [[RFC5120](#)], which may be any of the topologies supported by ISIS. Local configuration controls which <MT,SD> pairs are supported by a router. The mapping of sub-domains to topologies MUST be consistent within the IS-IS flooding domain used to advertise BIER information.

Each BIER sub-domain has as its unique attributes the encapsulation used and the type of tree it is using to forward BIER frames (currently always SPF). Additionally, per supported bitstring length in the sub-domain, each router will advertise the necessary label ranges to support it.

4.2. Advertising BIER Information

BIER information advertisements are associated with a new sub-TLV in the extended reachability TLVs. BIER information is always associated with a host prefix which MUST be a node address for the advertising node. The following restrictions apply:

- o Prefix length MUST be 32 for an IPv4 prefix or 128 for an IPv6 prefix
- o When the Prefix Attributes Flags sub-TLV is present N flag MUST be set. [[RFC7794](#)]
- o BIER sub-TLVs MUST be included when a prefix reachability advertisement is leaked between levels.

5. Procedures

5.1. Multi Topology and Sub-Domain

A given sub-domain is supported within one and only one topology. All routers in the flooding scope of the BIER sub-TLVs MUST advertise the same sub-domain within the same multi-topology. A router receiving an <MT,SD> advertisement which does not match the locally configured pair MUST report a misconfiguration of the received

<MT,SD> pair. All received BIER advertisements associated with the conflicting <MT,SD> pair MUST be ignored.

Example:

The following combination of advertisements are valid: <0,0> <0,1> <2,2>.

The following combination of advertisements are invalid: <0,0> <0,1> <2,0>. Advertisements associated with <0,0> and <2,0> MUST be ignored.

[5.2.](#) Label advertisements for MPLS Encapsulation

A router that desires to participate in <MT,SD> MUST advertise for each bitstring length it supports in <MT,SD> a Maximum Set ID that guarantees to cover the maximum BFR-id injected into <MT,SD> (which implies a certain maximum set id per bitstring length as described in [[RFC8279](#)]). Any router that violates this condition MUST be excluded from BIER BFTs for <MT,SD>.

[5.3.](#) BFR-id Advertisements

Each BFER/BFIR MAY advertise with its TLV<MT,SD> the BFR-id that it has administratively chosen. A valid BFR-id MUST be unique within the flooding scope of the BIER advertisements. All BFERs/BFIRs MUST detect advertisement of duplicate valid BFR-IDs for a given <MT, SD>. When such duplication is detected all of the routers advertising duplicates MUST be treated as if they did not advertise a valid BFR-id. This implies they cannot act as BFER or BFIR in that <MT,SD>.

[5.4.](#) Logging Misconfiguration

Whenever an advertisement is received which violates any of the constraints defined in this document the receiving router MUST support logging this occurrence. Logging SHOULD be dampened to avoid excessive output.

[5.5.](#) Flooding Reduction

BIER domain information SHOULD change infrequently. Frequent changes will increase the number of Link State PDU (LSP) updates and negatively impact performance in the network.

6. Packet Formats

All ISIS BIER information is carried within the TLVs 235, 237 [RFC5120] or TLVs 135 [RFC5305], or TLV 236 [RFC5308].

6.1. BIER Info sub-TLV

This sub-TLV carries the information for the BIER sub-domains that the router participates in as BFR. This sub-TLV MAY appear multiple times in a given prefix-reachability TLV - once for each sub-domain supported in the associated topology.

The sub-TLV advertises a single <MT,SD> combination followed by optional sub-sub-TLVs as described in the following sections.

```

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   |                                     |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|   BAR    |   IPA      | subdomain-id |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|   BFR-id |                                     |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
| sub-sub-TLVs (variable) |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+

```

Type: as indicated in IANA section.

Length: variable

BAR BIER Algorithm. Specifies a BIER specific algorithm used to calculate underlay paths to reach BFERs. Values are allocated from the BIER Algorithm Registry. 1 octet

IPA IGP algorithm. Specifies an IGP Algorithm to either modify, enhance or replace the calculation of underlay paths to reach BFERs as defined by the BAR value. Values are from the IGP Algorithm registry. 1 octet

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

BFR-id: A 2 octet field encoding the BFR-id, as documented in [RFC8279]. If no BFR-id has been assigned this field is set to the invalid BFR-id.

The use of non-zero values in either the BAR field or the IPA field is outside the scope of this document. If an implementation does not support the use of non-zero values in these fields, but receives a BIER Info sub-TLV containing non-zero values in these fields, it SHOULD treat the advertising router as incapable of supporting BIER (one way of handling incapable routers is documented in [section 6.9 of \[RFC8279\]](#) and additional methods may be defined in the future).

6.2. BIER MPLS Encapsulation sub-sub-TLV

This sub-sub-TLV carries the information for the BIER MPLS encapsulation including the label range for a specific bitstring length for a certain <MT,SD>. It is advertised within the BIER Info sub-TLV ([Section 6.1](#)). This sub-sub-TLV MAY appear multiple times within a single BIER info sub-TLV.

On violation of any of the following conditions, the receiving router MUST ignore the encapsulating BIER Info sub-TLV.

- o Label ranges in multiple sub-sub-TLVs MUST NOT overlap.
- o Bitstring lengths in multiple sub-sub-TLVs MUST NOT be identical.
- o The sub-sub-TLV MUST include the required bitstring lengths encoded in precisely the same way as in [\[RFC8296\]](#).
- o All labels in the range MUST represent valid label values

[illegible]

Type: value of 1 indicating MPLS encapsulation.

Length: 4

Local BitString Length (BS Len): Encoded bitstring length as per [RFC8296]. 4 bits.

Max SI Maximum Set Identifier ([section 1 of \[RFC8279\]](#)) used in the encapsulation for this BIER sub-domain for this bitstring length.

1 octet. 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.

Label: First label of the range, 20 bits. The labels are as defined in [\[RFC8296\]](#).

7. Security Considerations

Security concerns for IS-IS are addressed in [\[RFC5304\]](#) and [\[RFC5310\]](#). Advertisement of the additional information defined in this document introduces no new security concerns.

BIER specific security considerations are discussed in [\[RFC8279\]](#).

8. Acknowledgements

The RFC is aligned with the [\[I-D.draft-ietf-bier-ospf-bier-extensions-14\]](#) draft as far as the protocol mechanisms overlap.

Many thanks for comments from (in no particular order) Hannes Gredler, Ijsbrand Wijnands, Peter Psenak and Chris Bowers.

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