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BIER support via ISIS
draft-przygienda-bier-isis-ranges-02

Abstract

Specification of an ISIS extension to support BIER domains and sub-domains.

Requirements Language

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 RFC 2119 [RFC2119] .

Status of This Memo

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1. Introduction

Bit Index Explicit Replication (BIER) [I-D.draft-wijnands-bier-architecture-02] defines an architecture where all intended multicast receivers are encoded as bitmask in the Multicast packet header within different encapsulations such as [I-D.draft-wijnands-mpls-bier-encapsulation-02]. 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.

2. Terminology

Some of the terminology specified in [I-D.draft-wijnands-bier-architecture-02] 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).

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.

BIFT: Bit Index Forwarding Table.

BMS: Bit Mask Set. Set containing bit positions of all BFER participating in a set.

BMP: Bit Mask Position, a given bit in a BMS.

Invalid BMP: Unassigned Bit Mask Position, consisting of all 0s.

IGP signalled BIER domain: A BIER underlay where the BIER synchronization information is carried in IGP. Observe that a multi-topology is NOT a separate BIER domain in IGP.

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, consisting of all 0s.

3. IANA Considerations

This document adds the following new sub-TLVs to the registry of sub-TLVs for TLVs 235, 237 [RFC5120] and TLVs 135,236 [RFC5305],[RFC5308].

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

Name: BIER Info

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 according BIER underlay.

Within such a domain, ISIS extensions are capable of carrying BIER information for multiple BIER sub-domains. Each sub-domain is uniquely identified by its subdomain-id and each subdomain can reside in any of the ISIS topologies [RFC5120]. The mapping of sub-domains to topologies is a local decision of each BFR currently but is advertised throughout the domain to ensure routing consistency.

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.

This RFC introduces a sub-TLV in the extended reachability TLVs to distribute such information about BIER sub-domains. To satisfy the requirements for BIER prefixes per [I-D.draft-wijnands-bier-architecture-02] additional information will be carried in [I-D.draft-ginsberg-isis-prefix-attributes].

5. Procedures

5.1. Enabling a BIER Sub-Domain

A given sub-domain with identifier BS with supported bitstring lengths MLs in a multi-topology MT [RFC5120] is denoted further as <MT,SD,MLs> and is normally not advertised to preserve the scaling of the protocol (i.e. ISIS carries no TLVs containing any of the elements related to <MT,SD>) and is enabled by a first BIER sub-TLV (Section 6.1) containing <MT,SD> being advertised into the area. The trigger itself is outside the scope of this RFC but can be for example a VPN desiring to initiate a BIER sub-domain as MI-PMSI [RFC6513] tree. It is outside the scope of this document to describe what trigger for a router capable of participating in <MT,SD> is used to start the origination of the necessary information to join into it.

5.2. Multi Topology and Sub-Domain

All routers in the flooding scope of the BIER TLVs MUST advertise a sub-domain within the same multi-topology. A router discovering a sub-domain advertised within a topology that is different from its own MUST report a misconfiguration of a specific sub-domain. Each router MUST compute BFTs for a sub-domain using only routers advertising it in the same topology.

5.3. Encapsulation

All routers in the flooding scope of the BIER TLVs MUST advertise the same encapsulation for a given <MT,SD>. A router discovering encapsulation advertised that is different from its own MUST report a misconfiguration of a specific <MT,SD>. Each router MUST compute BFTs for <MT,SD> using only routers having the same encapsulation as its own advertised encapsulation in BIER sub-TLV for <MT,SD>.

5.4. Tree Type

All routers in the flooding scope of the BIER TLVs MUST advertise the same tree type for a given <MT,SD>. In case of mismatch the behavior is analogous to Section 5.3.

5.5. Label Advertisements for MPLS encapsulated BIER sub-domains

Each router MAY advertise within the BIER MPLS Encapsulation sub-sub-TLV (Section 6.2) of a BIER Info sub-TLV (Section 6.1, denoted as TLV<MT,SD>) for <MT,SD> for every supported bitstring length a valid starting label value and a non-zero range length. It MUST advertise at least one valid label value and a non-zero range length for the required bitstring lengths per [I-D.draft-wijnands-bier-architecture-02] in case it has computed

itself as being on the BFT rooted at any of the BFRs with valid BFR-ids (except itself if it does NOT have a valid BFR-id) participating in <MT,SD>.

A router MAY decide to not advertise the BIER Info sub-TLV (Section 6.1) for <MT,SD> if it does not want to participate in the sub-domain due to resource constraints, label space optimization, administrative configuration or any other reasons.

5.5.1. Special Consideration

A router MUST advertise for each bitstring length it supports in <MT,SD> a label range size 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 [I-D.draft-wijnands-bier-architecture-02]). Any router that violates this condition MUST be excluded from BIER BFTs for <MT,SD>.

5.6. BFR-id Advertisements

Each BFER MAY advertise with its TLV<MT,SD> the BFR-id that it has administratively chosen.

If a router discovers that two BFRs it can reach advertise the same value for BFR-id for <MT,SD>, it MUST report a misconfiguration and disregard those routers for all BIER calculations and procedures for <MT,SD> to align with [I-D.draft-wijnands-bier-architecture-02]. It is worth observing that based on this procedure routers with colliding BFR-id assignments in <MT,SD> MAY still act as BFIRs in <MT,SD> but will be never able to receive traffic from other BFRs in <MT,SD>.

5.7. Flooding

BIER domain information SHOULD change and force flooding infrequently. Especially, the router SHOULD make every possible attempt to bundle all the changes necessary to sub-domains and ranges advertised with those into least possible updates.

5.8. Version

This RFC specifies Version 0 of the BIER extension encodings. Packet encoding supports introduction of future, higher versions with e.g. new sub-sub-TLVs or redefining reserved bits that can maintain the compatiblity to Version 0 or choose to indicate that the compatibility cannot be maintained anymore (changes that cannot work with the provided encoding would necessitate obviously introduction of completely new sub-TLV for BIER).

This kind of 'versioning' allows to introduce e.g. backwards-compatible automatic assignment of unique BFR-ids within sub-domains or addition of optional sub-sub-TLVs that can be ignored by version 0 BIER routers without the danger of incompatiblity.

This is a quite common technique in software development today to maintain and extend backwards compatible APIs.

6. Packet Formats

All ISIS BIER information is carried within the TLVs 235, 237 [RFC5120] and TLVs 135,236 [RFC5305], [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. It can repeat multiple times for different sub-domain <MT,SD> combinations.

The sub-TLV carries a single <MT,SD> combination followed by optional sub-sub-TLVs specified within its context such as e.g. BIER MPLS Encapsulation per Section 6.2.

On violation of any of the following conditions, the receiving router SHOULD signal a misconfiguration condition. Further results are unspecified unless described in the according section of this RFC:

o The subdomain-id MUST be included only within a single topology.

```
 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      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Ver|C| Reserved| subdomain-id  |   BFR-id                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Type: as indicated in IANA section.

Length: 1 octet.

Version: Version of the BIER TLV advertised, must be 0 on transmission by router implementing this RFC. Behavior on reception depends on the 'C' bit. 2 bits

C-BIT: Compatibility bit indicating that the TLV can be interpreted by routers implementing lower than the advertised version. Router implementing this version of the RFC MUST set it to 1. On reception, IF the version of the protocol is higher than 0 AND the bit is set (i.e. its value is 1), the TLV MUST be processed normally, IF the bit is clear (i.e. its value is 0), the TLV MUST be ignored for further processing completely independent of the advertised version. When processing this sub-TLV with compatibility bit set, all sub-sub-TLV of unknown type MUST and CAN be safely ignored. 1 bit

Reserved: reserved, must be 0 on transmission, ignored on reception. May be used in future versions. 5 bits

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

BFR-id: A 2 octet field encoding the BFR-id, as documented in [I-D.draft-wijnands-bier-architecture-02]. If set to the invalid BFR-id advertising router is not owning a BFR-id in the sub-domain.

6.2. BIER MPLS Encapsulation sub-sub-TLV

This sub-sub-TLV carries the information for the BIER MPLS encapsulation and the necessary label ranges per bitstring length for a certain <MT,SD> and is carried within the BIER Info sub-TLV (Section 6.1) that the router participates in as BFR.

On violation of any of the following conditions, the receiving router SHOULD signal a misconfiguration condition. Further results are unspecified:

- The sub-sub-TLV MUST be included once AND ONLY once within the sub-TLV.

- Label ranges within the sub-sub-TLV MUST NOT overlap. A receiving BFR MAY additionally check whether any of the ranges in all the sub-sub-TLVs advertised by another BFR overlap and apply the same treatement on violations.

- Bitstring lengths within the sub-sub-TLV MUST NOT repeat.

- The sub-sub-TLV MUST include the required bitstring lengths per [I-D.draft-wijnands-bier-architecture-02].

o All label range sizes MUST be greater than 0.

o All labels MUST represent valid label values.

```
 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|BS Len |                     Label             |   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+   |
        ~~ (number repetitions derived from TLV length) ~~         ~~~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+   |
| Lbl Range Size|BS Len |                     Label             |   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+ <-+
```

Type: value of 0 indicating MPLS encapsulation.

Length: 1 octet.

Local BitString Length (BS Len): Bitstring length for the label range that this router is advertising per [I-D.draft-wijnands-mpls-bier-encapsulation-02]. 4 bits.

Label Range Size: Number of labels in the range used on encapsulation for this BIER sub-domain for this bitstring length, 1 octet. This MUST never be advertised as 0 (zero) and otherwise, this sub-sub-TLV must be treated as if not present for BFT calculations and a misconfiguration SHOULD be reported by the receiving router.

Label: First label of the range used on encapsulation for this BIER sub-domain for this bitstring length, 20 bits. The label is used for example by [I-D.draft-wijnands-mpls-bier-encapsulation-02] to forward traffic to sets of BFERs.

6.3. Optional BIER sub-domain Tree Type sub-sub-TLV

This sub-sub-TLV carries the information of the BIER tree type for a certain <MT,SD>. It is carried within the BIER Info sub-TLV (Section 6.1) that the router participates in as BFR. This sub-sub-TLV is optional and its absence indicates the same as its presence

with Tree Type value 0 (SPF). BIER implementation following this version of the RFC SHOULD NOT advertise this TLV.

On violation of any of the following conditions, the receiving router implementing this RFC SHOULD signal a misconfiguration condition. Further results are unspecified unless described further:

o The sub-sub-TLV MUST be included once AND ONLY once.

o The advertised BIER TLV version is 0 and the value of Tree Type MUST be 0 (SPF).

```
 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     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Tree Type specific opaque data|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   ~~ up to TLV Length ~~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Tree Type specific opaque data|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Type: value of 1 indicating BIER Tree Type.

Length: 1 octet.

Tree Type: The only supported value today is 0 and indicates that BIER uses normal SPF computed reachability to construct BIFT. BIER implementation following this RFC MUST ignore the node for purposes of the sub-domain <MT,SD> if this field has any value except 0.

Tree type specific opaque data: Opaque data up to the length of the TLV carrying tree type specific parameters. For Tree Type 0 (SPF) no such data is included and therefore TLV Length is 1.

7. Security Considerations

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

8. Acknowledgements

The RFC is aligned with the [I-D.draft-psenak-ospf-bier-extension-01] draft as far as the protocol mechanisms overlap.

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

9. Normative References

[I-D.draft-ginsberg-isis-prefix-attributes]
Ginsberg et al., U., "IS-IS Prefix Attributes for Extended IP and IPv6 Reachability", internet-draft draft-ginsberg-isis-prefix-attributes-00.txt, October 2014.

[I-D.draft-psenak-ospf-bier-extension-01]
Psenak, P. and IJ. Wijnands, "OSPF Extension for Bit Index Explicit Replication", internet-draft draft-ietf-ospf-prefix-link-attr-01.txt, October 2014.

[I-D.draft-wijnands-bier-architecture-02]
Wijnands, IJ., "Stateless Multicast using Bit Index Explicit Replication Architecture", internet-draft draft-wijnands-bier-architecture-02.txt, February 2014.

[I-D.draft-wijnands-mpls-bier-encapsulation-02]
Wijnands et al., IJ., "Bit Index Explicit Replication using MPLS encapsulation", internet-draft draft-wijnands-mpls-bier-encapsulation-02.txt, February 2014.

[RFC1195] Callon, R., "Use of OSI IS-IS for routing in TCP/IP and dual environments", RFC 1195, December 1990.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC4971] Vasseur, JP., Shen, N., and R. Aggarwal, "Intermediate System to Intermediate System (IS-IS) Extensions for Advertising Router Information", RFC 4971, July 2007.

[RFC5120] Przygienda, T., Shen, N., and N. Sheth, "M-ISIS: Multi Topology (MT) Routing in Intermediate System to Intermediate Systems (IS-ISs)", RFC 5120, February 2008.

[RFC5305] Li, T. and H. Smit, "IS-IS Extensions for Traffic Engineering", RFC 5305, October 2008.

[RFC5308] Hopps, C., "Routing IPv6 with IS-IS", RFC 5308, October 2008.

[RFC6513] Rosen, E. and R. Aggarwal, "Multicast in MPLS/BGP IP VPNs", RFC 6513, February 2012.

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