

This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents (<https://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Revised BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Revised BSD License.

Table of Contents

- [1. Introduction](#)
- [2. IGP Extensions/Re-uses for Proxy Forwarding](#)
 - [2.1. OSPF Extensions/Re-uses](#)
 - [2.1.1. Advertising Binding Segment](#)
 - [2.1.2. Advertising Proxy Forwarding](#)
 - [2.2. IS-IS Extensions/Re-uses](#)
 - [2.2.1. Advertising Binding Segment](#)
 - [2.2.2. Advertising Proxy Forwarding](#)
- [3. Security Considerations](#)
- [4. IANA Considerations](#)
 - [4.1. OSPFv2](#)
 - [4.2. OSPFv3](#)
 - [4.3. IS-IS](#)
- [5. Acknowledgements](#)
- [6. References](#)
 - [6.1. Normative References](#)
 - [6.2. Informative References](#)
- [Authors' Addresses](#)

1. Introduction

[[I-D.hu-spring-segment-routing-proxy-forwarding](#)] describes a SR proxy forwarding for protection. Each neighbor of a possible failed node advertises its SR proxy forwarding capability when it has the capability. This capability indicates that the neighbor (the Proxy Forwarder) will forward traffic on behalf of the failed node. A router receiving the capability from the neighbors of a failed node will send traffic using the node-SID of the failed node to the nearest Proxy Forwarder after the IGP converges on the failure.

Once the affected traffic reaches a Proxy Forwarder, it sends the traffic on the post-failure shortest path to the node immediately following the failed node in the segment list.

For a binding segment of a possible failed node, the node advertises the information about the binding segment, including the binding SID and the list of SIDs associated with the binding SID, to its direct

neighbors only. Note that the information is not advertised in the network domain.

After the node fails and the IGP converges on the failure, the traffic with the binding SID of the failed node will reach its neighbor having SR Proxy Forwarding capability. Once receiving the traffic, the neighbor swaps the binding SID with the list of SIDs/segments associated with the binding SID and sends the traffic along the post-failure shortest path to the first node in the segment list.

2. IGP Extensions/Re-uses for Proxy Forwarding

This section defines IGP extensions for advertising the information about each binding segment (including its binding SID and the list of SIDs/segments associated with the binding SID) of a node to its direct neighbors. It describes IGP re-uses/extensions for advertising the SR proxy forwarding capability of a node in a network domain.

2.1. OSPF Extensions/Re-uses

2.1.1. Advertising Binding Segment

For a binding segment (or binding for short) on a node A, which consists of a binding SID and a list of segments, node A advertises an LSA containing the binding (i.e., the binding SID and the list of the segments). The LSA is advertised only to each of the node A's neighboring nodes. For OSPFv2, the LSA is a opaque LSA of LS type 9 (i.e., a link local scope LSA).

A binding segment is represented by binding segment TLV of the format as shown in [Figure 1](#).

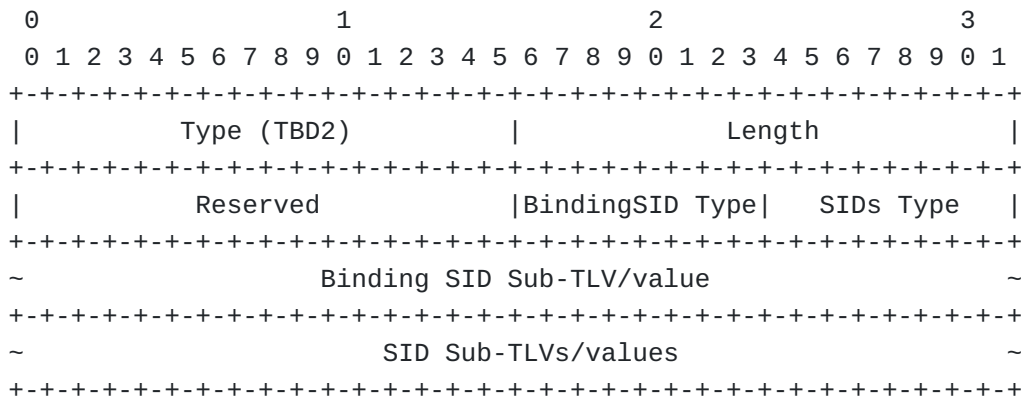


Figure 1: OSPF Binding Segment TLV

It comprises a binding SID and a list of segments (SIDs). The fields of this TLV are defined as follows:

Type: 2 octets, its value (TBD2) is to be assigned by IANA.

Length: 2 octets, its value is (4 + length of Sub-TLVs/values).

Binding SID Type (BT): 1 octet indicates whether the binding SID is represented by a Sub-TLV or a value included in the TLV. For the binding SID represented by a value, it indicates the type of binding SID. The following BT values are defined:

- o BT = 0: The binding SID is represented by a Sub-TLV (i.e., Binding SID Sub-TLV) in the TLV. A binding SID Sub-TLV is a SID/Label Sub-TLV defined in [[RFC8665](#)]. BT != 0 indicates that the binding SID is represented by a value.

- o BT = 1: The binding SID value is a label, which is represented by the 20 rightmost bits. The length of the value is 3 octets.

- o BT = 2: The binding SID value is a 32-bit SID. The length of the value is 4 octets.

SIDs Type (ST): 1 octet indicates whether the list of segments (SIDs) are represented by Sub-TLVs or values included in the TLV. For the SIDs represented by values, it indicates the type of SIDs. The following ST values are defined:

- o ST = 0: The SIDs are represented by Sub-TLVs (i.e., SID Sub-TLVs) in the TLV. A SID Sub-TLV is an Adj-SID Sub-TLV, a Prefix-SID Sub-TLV or a SID/Label Sub-TLV defined in [[RFC8665](#)]. ST != 0 indicates that the SIDs are represented by values.

- o ST = 1: Each of the SID values is a label, which is represented by the 20 rightmost bits. The length of the value is 3 octets.

- o ST = 2: Each of the SID values is a 32-bit SID. The length of the value is 4 octets.

The opaque LSA of LS Type 9 containing the binding segment (i.e., the binding SID and the list of the segments) has the format as shown in [Figure 2](#). It may have Opaque Type of x (the exact type is to be assigned by IANA) for Binding Segment Opaque LSA.

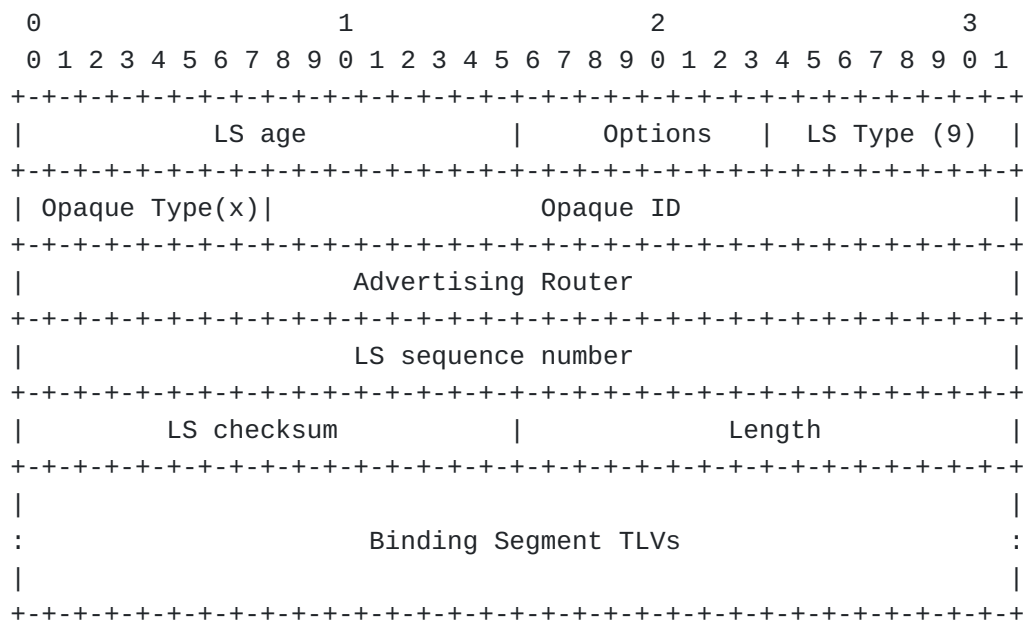


Figure 2: OSPFv2 Binding Segment Opaque LSA

For every binding on a node A, the LSA originated by A contains a binding segment TLV for it.

For node A running OSPFv3, it originates a link-local scoping LSA of a new LSA function code (TBD3) containing binding segment TLVs for the bindings on it. The format of the LSA is illustrated in [Figure 3](#).

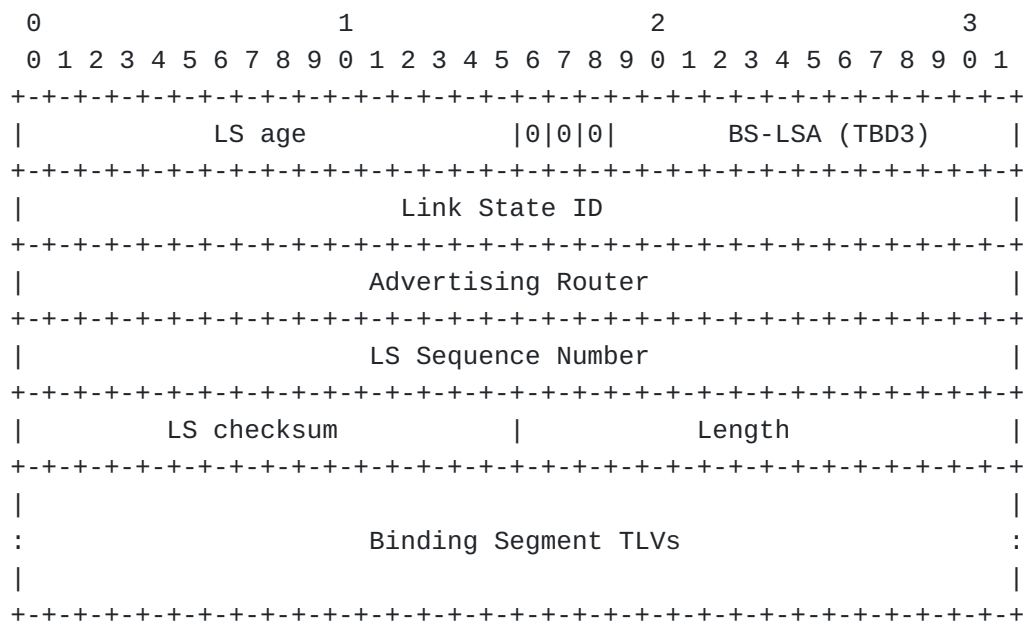


Figure 3: OSPFv3 Binding Segment Opaque LSA

The U-bit is set to 0, and the scope is set to 00 for link-local scoping.

2.1.2. Advertising Proxy Forwarding

When a node P has the capability to do a SR proxy forwarding for its neighboring nodes for protecting the failures of these nodes, P advertises its capability for these nodes. The mirror SID [[RFC8402](#)] [[RFC8667](#)] for a node N (Neighbor of P) advertised by P indicates the capability of P for N.

Alternatively, P advertises its capability in its router information opaque LSA with Router Functional Capabilities TLV [[RFC7770](#)]. One bit (called PF bit) in the Functional Capabilities field of the TLV is used to indicate node P's capability. When this bit is set to one by node P, it indicates that node P is capable of doing a SR proxy forwarding for its neighboring nodes.

For a node X in the network, it learns the prefix/node SID of node N, which is originated and advertised by node N. It creates a proxy prefix/node SID of node N for node P if node P is capable of doing SR proxy forwarding for node N. The proxy prefix/node SID of node N for node P is a copy of the prefix/node SID of node N originated by node N, but stored under (or say, associated with) node P. The route to the proxy prefix/node SID is through proxy forwarding capable nodes.

In normal operations, node X prefers to use the prefix/node SID of node N. When node N fails, node X prefers to use the proxy prefix/node SID of node N. Thus node X will forward the traffic targeting to the prefix/node SID of node N to node P when node N fails, and node P will do a SR proxy forwarding for node N and forward the traffic towards its final destination without going through node N.

Note that the behaviors of normal IP forwarding and routing convergences in a network are not changed at all by the SR proxy forwarding. For example, the next hop used by BGP is an IP address (or prefix). The IGP and BGP converge in normal ways for changes in the network. The packet with its IP destination to this next hop is forwarded according to the IP forwarding table (FIB) derived from IGP and BGP routes.

2.2. IS-IS Extensions/Re-uses

2.2.1. Advertising Binding Segment

For supporting binding SID proxy forwarding, a new IS-IS TLV, called Binding Segment TLV, is defined. It contains a binding SID and a list of segments (SIDs). This TLV is advertised in Circuit Scoped Link State PDUs (CS-LSP) [[RFC7356](#)]. Its format is shown in [Figure 4](#).

which is the direct upstream node of the failed node, it fast re-routes the traffic around the failed node to the direct downstream node of the failed node along the SR-TE path. These behaviors are internal to a network and should not cause extra security issues.

4. IANA Considerations

4.1. OSPFv2

Under Subregistry Name "OSPF Router Functional Capability Bits" within the "Open Shortest Path First v2 (OSPFv2) Parameters" [[RFC7770](#)], IANA is requested to assign one bit for Proxy Forwarding Capability as follows:

Bit number	Capability Name	Reference
31	Proxy Forwarding	This document

Under Registry Name "OSPFv2 Extended Prefix Opaque LSA TLVs" [[RFC7684](#)], IANA is requested to assign one new TLV value for OSPF Proxy Node SIDs as follows:

TLV Value	TLV Name	Reference
2	Proxy Node SIDs TLV	This document

Under Registry Name "Opaque Link-State Advertisements (LSA) Option Types" [[RFC5250](#)], IANA is requested to assign new Opaque Type registry values for Binding Segment LSA as follows:

Registry Value	Opaque Type	Reference
10	Binding Segment	This document

IANA is requested to create and maintain new registries:

- o OSPFv2 Binding Segment Opaque LSA TLVs

Initial values for the registry are given below. The future assignments are to be made through IETF Review [[RFC5226](#)].

Value	TLV Name	Definition
-----	-----	-----
0	Reserved	
1	Binding Segment TLV	This Document
2-32767	Unassigned	
32768-65535	Reserved	

4.2. OSPFv3

Under Registry Name "OSPFv3 LSA Function Codes", IANA is requested to assign new registry values for Binding Segment LSA as follows:

Value	LSA Function Code Name	Reference
-----	-----	-----
16	Binding Segment LSA	This document

IANA is requested to create and maintain new registries:

o OSPFv3 Binding Segment LSA TLVs

Initial values for the registry are given below. The future assignments are to be made through IETF Review [[RFC5226](#)].

Value	TLV Name	Definition
-----	-----	-----
0	Reserved	
1	Binding Segment TLV	This Document
2-32767	Unassigned	
32768-65535	Reserved	

4.3. IS-IS

Under Registration "Segment Routing Capability" in the "sub-TLVs for TLV 242" registry [[RFC8667](#)], IANA is requested to assign one bit flag for Proxy Forwarding Capability as follows:

Bit number	Capability Name	Reference
-----	-----	-----
2	Proxy Forwarding (PF)	This document

Under Registration "Segment Identifier/Label Binding TLV 149" [[RFC8667](#)], IANA is requested to assign one bit P-Flag as follows:

Bit number	Flag Name	Reference
5	P-Flag	This document

Under Registry Name: IS-IS TLV Codepoints, IANA is requested to assign one new TLV value for IS-IS Binding Segment as follows:

Value	TLV Name	Reference
152	Binding Segment TLV	This Document

5. Acknowledgements

The authors would like to thank Peter Psenak, Acee Lindem, Les Ginsberg, Bruno Decraene and Jeff Tantsura for their comments to this work.

6. References

6.1. 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>>.
- [RFC5226] Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", RFC 5226, DOI 10.17487/RFC5226, May 2008, <<https://www.rfc-editor.org/info/rfc5226>>.
- [RFC5250] Berger, L., Bryskin, I., Zinin, A., and R. Coltun, "The OSPF Opaque LSA Option", RFC 5250, DOI 10.17487/RFC5250, July 2008, <<https://www.rfc-editor.org/info/rfc5250>>.
- [RFC7356] Ginsberg, L., Previdi, S., and Y. Yang, "IS-IS Flooding Scope Link State PDUs (LSPs)", RFC 7356, DOI 10.17487/RFC7356, September 2014, <<https://www.rfc-editor.org/info/rfc7356>>.
- [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>>.

[RFC7770] Lindem, A., Ed., Shen, N., Vasseur, JP., Aggarwal, R., and S. Shaffer, "Extensions to OSPF for Advertising Optional Router Capabilities", RFC 7770, DOI 10.17487/RFC7770, February 2016, <<https://www.rfc-editor.org/info/rfc7770>>.

[RFC8665] Psenak, P., Ed., Previdi, S., Ed., Filsfils, C., Gredler, H., Shakir, R., Henderickx, W., and J. Tantsura, "OSPF Extensions for Segment Routing", RFC 8665, DOI 10.17487/RFC8665, December 2019, <<https://www.rfc-editor.org/info/rfc8665>>.

[RFC8667] Previdi, S., Ed., Ginsberg, L., Ed., Filsfils, C., Bashandy, A., Gredler, H., and B. Decraene, "IS-IS Extensions for Segment Routing", RFC 8667, DOI 10.17487/RFC8667, December 2019, <<https://www.rfc-editor.org/info/rfc8667>>.

6.2. Informative References

[I-D.hu-spring-segment-routing-proxy-forwarding]

Hu, Z., Chen, H., Yao, J., Bowers, C., Yongqing, and Yisong, "SR-TE Path Midpoint Restoration", Work in Progress, Internet-Draft, draft-hu-spring-segment-routing-proxy-forwarding-20, 18 August 2022, <<https://www.ietf.org/archive/id/draft-hu-spring-segment-routing-proxy-forwarding-20.txt>>.

[I-D.ietf-spring-segment-routing-policy]

Filsfils, C., Talaulikar, K., Voyer, D., Bogdanov, A., and P. Mattes, "Segment Routing Policy Architecture", Work in Progress, Internet-Draft, draft-ietf-spring-segment-routing-policy-22, 22 March 2022, <<https://www.ietf.org/archive/id/draft-ietf-spring-segment-routing-policy-22.txt>>.

[RFC8402] Filsfils, C., Ed., Previdi, S., Ed., Ginsberg, L., Decraene, B., Litkowski, S., and R. Shakir, "Segment Routing Architecture", RFC 8402, DOI 10.17487/RFC8402, July 2018, <<https://www.rfc-editor.org/info/rfc8402>>.

Authors' Addresses

Zhibo Hu
Huawei Technologies
Huawei Bld., No.156 Beiqing Rd.
Beijing

100095

China

Email: huzhibo@huawei.com

Huaimo Chen

Futurewei

Boston, MA,

United States of America

Email: Huaimo.chen@futurewei.com

Junda Yao

Huawei Technologies

Huawei Bld., No.156 Beiqing Rd.

Beijing

100095

China

Email: yaojunda@huawei.com

Chris Bowers

Juniper Networks

1194 N. Mathilda Ave.

Sunnyvale, CA, 94089

United States of America

Email: cbowers@juniper.net

Yongqing

China Telecom

109, West Zhongshan Road, Tianhe District

Guangzhou

510000

China

Email: zhuyq8@chinatelecom.cn

Yisong

China Mobile

510000

China

Email: liuyisong@chinamobile.com