IDR Working Group C. Xie
Internet-Draft C. Li
Intended status: Informational China Telecom
Expires: 17 April 2026 J. Dong
Z. Li
Huawei Technologies
14 October 2025

Applicability of Border Gateway Protocol - Link State (BGP-LS) with Multi-Topology (MT) for Segment Routing based Network Resource Partitions (NRPs)

draft-ietf-idr-bgpls-sr-vtn-mt-14

Abstract

When Segment Routing (SR) is used for building Network Resource Partitions (NRPs), each NRP can be allocated with a group of Segment Identifiers (SIDs) to identify the topology and resource attributes of network segments in the NRP. This document describes how BGP-Link State (BGP-LS) with Multi-Topology (MT) can be used to distribute the information of ~~SR~~ SR-based NRPs to a network controller in specific contexts whe~~, when~~re each NRP is associated with a separate logical topology identified by a Multi-Topology ID (MT-ID). This document sets out the targeted scenarios for the approach suggested, and presents the scalability limitations that arise.

Commenté [MB1]: Make it clear we are targeting a subset of NRP deployment options.

Status of This Memo

Copyright Notice

Table of Contents

1. Introduction

[RFC9543] discusses the general framework, components, and interfaces for requesting and operating network slices using IETF technologies. [RFC9543] also introduces the concept of the Network Resource Partition (NRP), which is defined as a subset of the buffer/queuing/scheduling resources and associated policies on each of a connected set of links in an underlay network. An NRP can be associated with a logical network topology to select or specify the set of links and nodes involved. [RFC9732] specifies ~~the~~ a framework of NRP-based enhanced VPNs and describes the candidate component technologies in different network planes and network layers. An NRP could be used as the underlay to meet the requirements of one or a group of network slices or enhanced VPN services. The mechanism of enforcing NRP resource allocation and the mechanism of mapping one or group of enhanced VPN services to a specific NRP ~~is~~ are outside the scope of this document. Similarly, classification and means to bind packets to NRPs are out of scope this document.

Commenté [MB2]: This one should be cited as informative, not normative.

[I-D.ietf-spring-resource-aware-segments] introduces resource awareness to Segment Routing (SR) [RFC8402]. As described in [I-D.ietf-spring-sr-for-enhanced-vpn], a group of resource-aware SIDs can be used to build SR-based NRPs with the required network topology and network resource attributes. The group of resource-aware SR SIDs together with the associated topology and resource attributes of an NRP need to be distributed in the network using IGPs~~,~~. ~~and~~ BGP-Link State (BGP-LS) [RFC9552] can be then used to advertise the SR SIDs and the resource related Traffic Engineering (TE) attributes (e.g., link bandwidth) of NRPs in each IGP area or AS to a network controller.

As specified in [RFC9543], some NRP realizations may build NRPs with dedicated topologies, while other realizations may use a shared topology for multiple NRPs. The exact NRPs characterization, the number of NRPs, and their binding to a topology are deployment-specific.

In some network scenarios, the required number of NRPs ~~could~~ may be small, each NRP can be associated with ~~an~~ a separate logical topology, i.e., there is 1:1 mapping between an NRP and ~~an~~ a Multi-Topology (MT) ID, and the set of dedicated or shared network resources of the NRP can be considered to be associated with the logical topology. [I-D.ietf-lsr-isis-sr-vtn-mt] describes how IS-IS Multi-Topology (MT) [RFC5120] can be used to advertise an independent topology and the associated SR SIDs, together with the topology-specific resource related TE attributes in the network.

In some network scenarios, for instance, an operator's network consists of multiple network parts, such as metro area networks, backbone networks, or data center networks, each part being a different AS. NRPs can be enabled independently in each network part. Specifically, NRPs are not required to be enabled in all network parts. Likewise, the number of NRPs is local to a domain. However, there might ~~Thus there may~~ be a need to ~~create or concatenate~~ stitch NRPs ~~which~~ that span multiple ASes, typically belonging to the same provider. This document describes ~~the~~ how BGP-LS with MT can be used distribute information of the logical topology, the associated SIDs, and the topology-specific resource information to a network controller for SR-based ~~based~~ NRPs. The limitations and the targeted scenario of this approach are described in ~~section 4~~ "~~scalability~~ Scalability ~~considerations~~Considerations" (Section 4). NRP stitching is likely to require classification, (re)marking, admission control, etc. at ingress nodes. These considerations are out of scope of this document.

2. Advertisement of Topology Information

This section describes the corresponding BGP-LS mechanism to distribute both the intra-domain and inter-domain topology information and the associated SR SIDs.

For the inter-domain case, the involved network domains should be under a common administration, or they belong to the same trusted domain as specified in ~~section~~ Section 8 of [RFC8402].

2.1. Intra-domain Topology Advertisement

Section 5.2.2.1 of [RFC9552] defines the Multi-Topology Identifier (MT-ID) TLV ~~(Type 263)~~, which can contain one or more Multi-Topology Identifiers for a link, node, or prefix. The MT-ID TLV may be included as a Link Descriptor, as a Prefix Descriptor, or in the BGP-LS Attribute of a Node Network Layer Reachability Information (NLRI).~~,~~ ~~the~~ The detailed rules of the usage of MT-ID TLV in BGP-LS is also ~~described~~specified in ~~section~~ Section 5.2.2.1 of [RFC9552]~~-~~.

~~[RFC9085] defines the BGP-LS extensions to carry the SR-MPLS information using TLVs of BGP-LS Attribute.~~ When Multi-Topology is used with the SR-MPLS data plane [RFC8660], topology-specific Prefix-SIDs and topology-specific Adjacency Segment Identifiers (Adj-SIDs) can be carried in the BGP-LS Attribute associated with the Prefix NLRI and

Link NLRI respectively (Section 2 of [RFC9085]), the MT-ID TLV carried in the ~~P~~Prefix ~~descriptor~~ Descriptor or ~~link~~ Link ~~descriptor~~ Descriptor [RFC9552] can be used to identify the corresponding topology of the SIDs.

~~[RFC9514] defines the BGP-LS extensions to advertise Segment Routing over IPv6 (SRv6) information along with their functions and attributes.~~ When Multi-Topology is used with the SRv6 data plane [RFC8754], the SRv6 Locator TLV is carried in the BGP-LS Attribute associated with the Prefix NLRI, the MT-ID TLV can be carried as a Prefix Descriptor to identify the corresponding topology of the SRv6 Locator (Section 6 of [RFC9514]). The SRv6 End.X SIDs are carried in the BGP-LS Attribute associated with the Link NLRI, the MT-ID TLV can be carried in the L~~l~~ink ~~descriptor~~ Descriptor to identify the corresponding topology of the End.X SIDs. The SRv6 SID NLRI is defined to advertise other types of SRv6 SIDs, in which the SRv6 SID descriptors can include the MT-ID TLV so as to advertise topology-specific SRv6 SIDs.

2.2. Inter-Domain Topology Advertisement

[RFC9086] defines the BGP-LS extensions for BGP Egress Peer Engineering (EPE) with SR-MPLS. The BGP-LS extensions for ~~Egress Peer Engineering~~EPE with SRv6 are specified in [RFC9514]. ~~Such~~These extensions ~~information~~ could be used by a network controller for the collection of inter-domain topology and SR SID information, which can be used for the computation and instantiation of inter-AS SR-TE paths.

For the case of inter-domain, the inter-domain connectivity and the BGP peering SR SIDs associated with each logical topology on the inter-domain links need to be advertised. This section describes the applicability of multi-topology for the advertisement of inter-domain topology and the associated SR SIDs using BGP-LS. It does not introduce multi-topology into the operation of BGP sessions on the inter-domain links.

When an MT-ID is configured consistently in multiple domains, the MT-ID may also be carried in the link NLRI of the inter-domain links for the advertisement of inter-domain logical topology and the topology-specific BGP peering SIDs. This can be achieved with the combination of existing mechanisms as defined in [RFC9552], [RFC9086], and [RFC9514].

Commenté [MB3]: Whether the configuration is consistent or not is not something that a ASBR can infer.

An explicit mapping is still needed here as well.

Depending on the different inter-domain scenarios, the approach for the inter-domain topology advertisement can be one of the following:

Commenté [MB4]: Some deployment may have a mix of the BGP setup described here.

* One External BGP (EBGP) session between two ASes can be established over multiple underlying links~~.~~: ~~In this case, d~~Different underlying links may be assigned to different inter-domain logical topologies. In another similar case, the EBGP session is established over a single physical link, while the network resource (e.g., bandwidth) on this link is partitioned ~~into multiple pieces~~, each of which is instantiated as a logical sub-interface, and each logical link can be associated with a

separate logical topology. Different BGP Peer-Adj-SIDs or SRv6 End.X SIDs need to be allocated to each underlying physical or logical link. The association between the underlying physical or logical links and the corresponding MT-ID, together with the BGP Peer-Adj-SIDs or SRv6 End.X SID need to be advertised by the ASBR to a network controller.

* For inter-domain connection(s) between two ASes, multiple EBGP sessions can be established between different sets of peering ASBRs:~~.~~ It is possible that some of these BGP peers are only used for one inter-domain logical topology, while some other BGP peers are used for another inter-domain logical topology. In this case, different BGP Peer Node SIDs can be allocated to steer traffic to a specific peer within an inter-domain logical topology. The association between the link of the BGP peering session and the corresponding MT-ID, together with the BGP Peer Node SIDs need to be advertised by the ASBR to a network controller.

* At the level inter-AS topology, different inter-domain logical topologies may have different inter-AS connectivity:~~.~~ ~~In this case, d~~Different BGP Peer Set SIDs may be allocated to represent a ~~groups~~ group of BGP peers which can be used for load-balancing within each inter-domain logical topology. The BGP Peer Set SIDs may be advertised in the BGP-LS attributes of the link NLRI which carries the corresponding MT-ID.

In network scenarios where consistent allocation of MT-ID among multiple domains can not be achieved, the MT-ID advertised by the two peering ASBRs to a network controller for the same inter-domain link could be different. Some mapping mechanism may be needed by the controller to match the MT-IDs of an inter-domain link in two directions (e.g., for one inter-domain link, MT-ID A in domain X will be matched with MT-ID B in domain Y), and concatenate the inter-domain topology. The detailed mechanism is out of the scope of this document.

3. Advertisement of Resource related TE Attribute

~~This section describes the applicability of BGP-LS with multi-topology for reporting topology-specific resource related TE attributes to the network controllers.~~

The information of the network resources attributes of a link associated with a specific topology can be specified by carrying the corresponding TE Link attribute TLVs in BGP-LS Attribute [RFC9552], with the associated MT-ID carried in the corresponding Link NLRI.

For example, a subset of the bandwidth resource on a link for a specific logical topology can be advertised by carrying the Maximum Link Bandwidth sub-TLV in the BGP-LS Attribute associated with the Link NLRI which carries the corresponding MT-ID. The bandwidth advertised can be exclusive for this logical topology. The advertisement of other topology-specific TE attributes in BGP-LS is for further study. The receiving BGP-LS speaker should be prepared to receive any TE attributes in BGP-LS Attribute with the associated MT-ID carried in the corresponding Link NLRI.

Commenté [MB5]: And provisioned as well

Commenté [MB6]: And provisioned as well

Commenté [MB7]: Isn't that the definition of «not being consistent» :-

As indicated above, eve, having the same value does not mean that the NRP are consistent.

The notion of consistent need to be defined.

Commenté [MB8]: Isn't this imposing a protocol behavior?

4. Scalability Considerations

~~The mechanism described in t~~This document assumes that each NRP is associated with an independent topology, and for the inter-domain NRPs, the MT-IDs used in the involved domains are consistent, so that the associated MT-ID can be used to identify the NRP in the control plane.

Commenté [MB9]: I guess the assumption should be that a mapping is in place to stitch adjacent topos.

Reusing MT-ID can avoid introducing new mechanisms with similar functionality in the control plane, while it also has some limitations. For example, even if multiple NRPs share the same topology, each NRP still need to be identified using a unique MT-ID in the control plane. ~~Thus~~Therefore, independent path computation needs be executed for each NRP. The number of NRPs supported in a network may be dependent on the number of topologies supported, which is related to both the number of topologies supported in the protocol and the control plane overhead which the network could afford. Since no new control protocol extension is required, the mechanism described in this document is considered useful for network scenarios in which the required number of NRPs is small (e.g., less than 10).

Commenté [MB10]: I don't parse this.

For network scenarios where the number of required NRPs is large, more scalable solutions would be needed which may require further protocol extensions and enhancements.

5. Security Considerations

The security considerations in [RFC9552] [RFC9085] and [RFC9514] apply to this document.

This document introduces no additional security vulnerabilities to BGP-LS. The mechanism proposed in this document is subject to the same vulnerabilities as any other protocol that relies on BGP-LS.

6. IANA Considerations

This document does not request any IANA actions.

7. Acknowledgments

The authors would like to thank Shunwan Zhuang, Adrian Farrel, Susan Hares, Jeffrey Haas, Ketan Talaulikar and Mohamed Boucadair for the review and discussion of this document.

8. References

8.1. Normative References

[I-D.ietf-lsr-isis-sr-vtn-mt]
Xie, C., Ma, C., Dong, J., and Z. Li, "Applicability of IS-IS Multi-Topology (MT) for Segment Routing based Network Resource Partition (NRP)", Work in Progress, Internet-Draft, draft-ietf-lsr-isis-sr-vtn-mt-10, 13 April 2025, <https://datatracker.ietf.org/doc/html/draft-ietf-

lsr-isis-sr-vtn-mt-10>.

[I-D.ietf-spring-resource-aware-segments]
Dong, J., Miyasaka, T., Zhu, Y., Qin, F., and Z. Li, "Introducing Resource Awareness to SR Segments", Work in Progress, Internet-Draft, draft-ietf-spring-resource-aware-segments-15, 3 September 2025, <https://datatracker.ietf.org/doc/html/draft-ietf-spring-resource-aware-segments-15>.

[I-D.ietf-spring-sr-for-enhanced-vpn]
Dong, J., Miyasaka, T., Zhu, Y., Qin, F., and Z. Li, "Segment Routing based Network Resource Partition (NRP) for Enhanced VPN", Work in Progress, Internet-Draft, draft-ietf-spring-sr-for-enhanced-vpn-09, 10 June 2025, <https://datatracker.ietf.org/doc/html/draft-ietf-spring-sr-for-enhanced-vpn-09>.

[RFC5120] Przygienda, T., Shen, N., and N. Sheth, "M-ISIS: Multi Topology (MT) Routing in Intermediate System to Intermediate Systems (IS-ISs)", RFC 5120, DOI 10.17487/RFC5120, February 2008, <https://www.rfc-editor.org/info/rfc5120>.

[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>.

[RFC9085] Previdi, S., Talaulikar, K., Ed., Filsfils, C., Gredler, H., and M. Chen, "Border Gateway Protocol - Link State (BGP-LS) Extensions for Segment Routing", RFC 9085, DOI 10.17487/RFC9085, August 2021, <https://www.rfc-editor.org/info/rfc9085>.

[RFC9086] Previdi, S., Talaulikar, K., Ed., Filsfils, C., Patel, K., Ray, S., and J. Dong, "Border Gateway Protocol - Link State (BGP-LS) Extensions for Segment Routing BGP Egress Peer Engineering", RFC 9086, DOI 10.17487/RFC9086, August 2021, <https://www.rfc-editor.org/info/rfc9086>.

[RFC9514] Dawra, G., Filsfils, C., Talaulikar, K., Ed., Chen, M., Bernier, D., and B. Decraene, "Border Gateway Protocol - Link State (BGP-LS) Extensions for Segment Routing over IPv6 (SRv6)", RFC 9514, DOI 10.17487/RFC9514, December 2023, <https://www.rfc-editor.org/info/rfc9514>.

[RFC9543] Farrel, A., Ed., Drake, J., Ed., Rokui, R., Homma, S., Makhijani, K., Contreras, L., and J. Tantsura, "A Framework for Network Slices in Networks Built from IETF Technologies", RFC 9543, DOI 10.17487/RFC9543, March 2024, <https://www.rfc-editor.org/info/rfc9543>.

[RFC9552] Talaulikar, K., Ed., "Distribution of Link-State and Traffic Engineering Information Using BGP", RFC 9552, DOI 10.17487/RFC9552, December 2023, <https://www.rfc-editor.org/info/rfc9552>.

[RFC9732] Dong, J., Bryant, S., Li, Z., Miyasaka, T., and Y. Lee, "A Framework for NRP-Based Enhanced Virtual Private Networks", RFC 9732, DOI 10.17487/RFC9732, March 2025, <https://www.rfc-editor.org/info/rfc9732>.

8.2. Informative References

Authors' Addresses

Chongfeng Xie
China Telecom
China Telecom Beijing Information Science & Technology, Beiqijia
Beijing
102209
China
Email: xiechf@chinatelecom.cn

Cong Li
China Telecom
China Telecom Beijing Information Science & Technology, Beiqijia
Beijing
102209
China
Email: licong@chinatelecom.cn

Jie Dong
Huawei Technologies
Huawei Campus, No. 156 Beiqing Road
Beijing
100095
China
Email: jie.dong@huawei.com

Zhenbin Li
Huawei Technologies
Huawei Campus, No. 156 Beiqing Road
Beijing
100095
China
Email: lizhenbin@huawei.com