BGP-LS Extensions for
Scalable SR based Enhanced VPN (VPN+)

draft-dong-idr-bgpls-sr-enhanced-vpn-04

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• VPN+ framework is described in draft-ietf-teas-enhanced-vpn
  • One typical use case is to deliver IETF network slice service

• IETF network slice framework is described in draft-ietf-teas-ietf-network-slices
  • It introduces the concept Network Resource Partition (NRP) for network slice realization
  • An NRP is an instantiation of VTN defined in VPN+ framework

• The scalability of NRP is analyzed in draft-dong-teas-nrp-scalability
  • It also provides guidelines for control plane and data plane optimization

• The IGP extensions for Scalable SR VPN+ are defined in draft-dong-lsr-sr-enhanced-vpn
  • Follows the mechanisms described in draft-dong-teas-nrp-scalability

• This document defines the BGP-LS extensions for scalable SR VPN+
  • To distribute the intra and inter-domain NRP topology and resource attributes to network controller
### Overview of the Related Drafts

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**Control Plane**
- VTN/NRP specific path computation & instantiation
  - draft-dong-idr-sr-policy-nrp
  - draft-dong-pce-pcep-vtn

**Data Plane**
- Resource-aware SID based data plane
  - draft-ietf-spring-sr-for-enhanced-vpn
- IPv6 HBH EH based data plane
  - draft-ietf-6man-enhanced-vpn-vtn-id
- MPLS EH/AD based data plane
  - draft-li-mpls-enhanced-vpn-vtn-id

**Framework**
- IETF Network Slice Concept and general framework
  - draft-ietf-teas-ietf-network-slices
- VPN+ framework can be used for slice realization
  - draft-ietf-teas-enhanced-vpn
- NRP Scalability considerations
  - draft-dong-teas-nrp-scalability
Optimizations for Better Scalability

- Multiple overlay connectivity services can map to the same VTN/NRP
  - NRP provides the underlay network topology and resources required by a group of overlay connectivity services

- Decouples the topology and resource attributes of NRP
  - Multiple NRPs can share the same topology, and the topology-specific route computation
  - Multiple NRPs may share the same set of resources on some network segments

- Introduces network-wide VTN/NRP ID in data plane
  - Avoids the allocation and distribution of per-NRP SR SIDs/SRv6 Locators
BGP-LS Extensions: NRP Definition sub-TLV

- A new TLV of BGP-LS Attribute associated with a Node NLRI
  - Is used to advertise the associated topology and other attributes of an NRP

- NRP-ID: 32-bit network-wide identifier of NRP
- MT-ID: 16-bit identifier which contains the MT-ID of the IGP topology
- Algorithm: 8-bit algorithm ID, can be normal algorithm or Flex-Algo
- Sub-sub-TLVs: optional for additional attributes of NRP
BGP-LS Extensions: NRP IDs Sub-TLV

• Is used to describe the list of NRPs that a link belongs to
  • Can be carried in the BGP-LS attribute associated with a Link NLRI
    • For both intra-domain links and the inter-domain links
  • Can also be carried as a sub-TLV in the L2 Bundle Member Attributes TLV
BGP-LS Extensions: Link Attribute Flags TLV

- Is used to specify the attributes of a link
  - Can be carried in the BGP-LS attribute associated with a Link NLRI
  - Can also be carried as a sub-TLV in the L2 Bundle Member Attributes TLV

```
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+--------------------------------------------------+
| Type | Length |
+--------------------------------------------------+
| Flags |
+--------------------------------------------------+
```

- Flags: 16-bit flags. This field is consistent with the Flag field in IS-IS Link Attribute sub-TLV in [RFC 5029].
- A new Flag "E" is defined:
  - Link excluded from load balancing. When the flag is set, it indicates this link is only used for traffic of the associated NRPs.
The intra-domain topology associated with an NRP can be distributed by reusing MT and/or Flex-Algo mechanisms

- MT can be used to define logical topology and per-topology node/link attributes
- Flex-Algo can be used to specify the metric type and topological constraints applied to a topology
- The <topology, algorithm> tuple can be referred to by multiple NRPs

BGP-LS extensions for SR provide the distribution of per <topology, algorithm> SR SIDs and SRv6 Locators
Inter-domain Topology Advertisement

• Uses BGP-LS EPE to distribute the inter-domain links and the BGP peering segments
  • BGP peer-adj-SID, peer-node-SID or peer-set-SIDs

• NRP IDs TLV can be carried in the BGP-LS attribute of the inter-domain link NLRI
  • To describe the list of NRPs the inter-domain link is associated with
Advertisement of NRP Resource Attributes

• Option 1: L2 bundle based approach
  • A partition of the link resource can be realized using a physical or virtual L2 member link of the L3 link, thus can be advertised using BGP-LS for L2 bundle member link

• An NRP IDs sub-TLV is carried under the BGP-LS L2 Bundle Member Attributes TLV
  • To specify the list of NRPs associated with the L2 member link

• A Link Attribute Flags TLV is carried under the L2 Bundle Member Attributes TLV
  • Use E flag to indicate whether this member link can be used for load balancing

• The bandwidth and other TE attributes of the L2 bundle member links can be advertised using the existing TE attribute TLVs of BGP-LS
Option 2: Per-NRP link TE attributes

A new NRP-specific TE attribute TLV is defined to advertise the link attributes associated with different NRPs.

- NRP IDs Sub-TLV: A list of NRP IDs which are associated the same set of TE attributes
- Other Sub-TLVs: The TE attributes TLVs, e.g. bandwidth sub-TLV
Advertisement of NRP-specific Data Plane IDs

• Option 1: Per-NRP SR SIDs and SRv6 Locators
  • New TLVs for NRP-specific SR-MPLS Prefix-SID and Adj-SID
  • New sub-TLV for NRP-specific SRv6 Locators and SRv6 End SIDs
  • New sub-TLVs for NRP-specific SRv6 End.X SIDs

• Option 2: Dedicated NRP-ID in data plane
  • The data plane NRP-ID can be the same as the NRP-ID in control plane
  • No need to advertise additional NRP-specific data plane information
  • The encapsulation of NRP ID information is defined for IPv6 and MPLS data plane
Next Steps

• Solicit comments and feedbacks

• Refine the draft accordingly

• Work on the terminology alignment with the TEAS documents and the IGP extensions draft
Thank You