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Using Flex-Algo for Segment Routing based VTN
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Abstract

As defined in I-D.ietf-teas-enhanced-vpn, enhanced VPN (VPN+) aims to provide enhanced VPN service to support the needs of enhanced isolation and stringent performance requirements. VPN+ requries integration between the overlay VPN and the underlay network. A Virtual Transport Network (VTN) is a virtual network which consists of a subset of network toplogy and network resources allocated from the underlay network. A VTN could be used as the underlay for one or a group of VPN+ services.

I-D-dong-lsr-sr-enhanced-vpn defines the IGP mechanisms with necessary extensions to build a set of Segment Routing (SR) based VTNs. This document describes a simplified mechanism to build the SR based VTNs using SR Flex-Algo with minor extensions to IGP L2 bundle.

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

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on September 10, 2020.

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1. Introduction

Enhanced VPN (VPN+) is an enhancement to VPN services to support the needs of new applications, particularly including the applications that are associated with 5G services. These applications require enhanced isolation and have more stringent performance requirements than that can be provided with traditional overlay VPNs. These properties cannot be met with pure overlay networks, as they require integration between the underlay and the overlay networks. [I-D.ietf-teas-enhanced-vpn] specifies the framework of enhanced VPN and describes the candidate component technologies in different network planes and layers. An enhanced VPN may be used for 5G transport network slicing, and will also be of use in other generic scenarios.

To meet the requirement of enhanced VPN services, a number of virtual transport networks (VTN) need to be created, each with a subset of

the underlay network topology and a set of network resources allocated to meet the requirement of a specific VPN+ service or a group of VPN+ services. Another existing approach is to build a set of point-to-point paths, each with a set of network resource reserved along the path, such paths are called Virtual Transport Paths (VTPs). Although using a set of dedicated VTPs can provide similar characteristics, it has some scalability issues in large networks.

[I-D.dong-spring-sr-for-enhanced-vpn] specifies how segment routing (SR) [RFC8402] can be used to build virtual transport networks (VTNs) with the required network topology and network resource attributes to support enhanced VPN services. With segment routing based data plane, Segment Identifiers (SIDs) can be used to represent the topology and the set of network resources allocated by network nodes to a virtual network. The SIDs of each VTN and the associated topology and resource attributes need to be distributed using control plane.

[I-D.dong-lsr-sr-enhanced-vpn] defines the IGP mechanisms with necessary extensions to build a set of Segment Routing (SR) based VTNs. The VTNs could be used as the underlay of the enhanced VPN service. The mechanism described in [I-D.dong-lsr-sr-enhanced-vpn] allows flexible combination of the topology and resource attribute to build customized VTNs. In some network scenarios, it is assumed that each VTN has an independent topology and a set of dedicated network resources. This document describes a simplified mechanism to build the SR based VTNs in those scenarios.

2. Advertisement of SR VTN Topology Attribute

[I-D.ietf-lsr-flex-algo] specifies the mechanism to provide distributed constraint-path computation, and the usage of SR-MPLS prefix-SIDs and SRv6 locators for steering traffic along the constrained paths.

The Flex-Algo definition provides the topological constraints for path computation. When each VTN has an independent network topology, the Flex-Algo Identifier could be used as the identifier of a VTN in control plane. Thus the topology attribute of a VTN could be defined using Flex-Algo.

According to the network nodes' participation of a Flex-Algo, and the rules of including or excluding specific Admin Groups (colors) and Shared Risk Link Groups (SRLGs), the topology attribute of a VTN can be determined using the associated Flex-Algo.

With the mechanisms defined in[RFC8667] [I-D.ietf-lsr-flex-algo], prefix-SID advertisement can be associated with a specific topology

and a specific algorithm, which can be a Flex-Algo. This allows the nodes to use the prefix-SID to steer traffic along distributed computed paths according to the identified Flex-Algo in the associated topology.

[I-D.ietf-lsr-isis-srv6-extensions] specifies the IS-IS extensions to support SRv6 data plane, in which the SRv6 locators advertisement can be associated with a specific topology and a specific algorithm, which can be a Flex-Algo. This allows the the nodes to used the SRv6 locator to steer traffic along distributed computed paths according to the identified Flex-Algo in the associated topology. In addition, topology/algorithm specific SRv6 End SID and End.X SID can be used to enforce traffic over the LFA computed backup path.

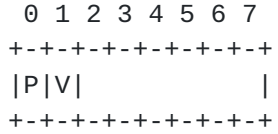
3. Extensions to IGP L2 Bundles

In order to perform constraint based path computation for each VTN on network controller and the ingress nodes, the resource attribute of VTN also needs to be advertised.

[RFC8668] was defined to advertise link attributes of the Layer 2 bundle member links. In this section it is extended to advertise the network resource attributes associated with different VTNs on one Layer 3 interface.

On a Layer 3 interface, it is assumed that different subset of the link resources are allocated to different VTNs it participates in. A subset of the link resource can be seen as a virtual layer-2 member link of the Layer 3 interface. If the Layer 3 interface is a L2 link bundle, it is also possible that the subset of link resource for a specific VTN is provided by a physical Layer 2 member link.

A new flag "V" (Virtual) is defined in the flag field of the Parent L3 Neighbor Descriptor in the L2 Bundle Member Attributes TLV (25).



V flag: When the V flag is set, it indicates the advertised member links under the Parent L3 link are virtual member links. When the V flag is clear, it indicates the member links are physical member links.

For each virtual or physical member link, the TE attributes such as the Maximum Link Bandwidth and admin-groups can be advertised using the mechanism as defined in [RFC8668].

In order to associate different virtual or physical member links with the corresponding VTNs, each member link SHOULD be assigned with a dedicated admin-group or extended admin-group (color), which is included in the definition of the corresponding Flex-Algo. Note that in this case the admin-group or extended admin-group of the Layer 3 interface SHOULD be set to the union of all the admin-groups of the virtual or physical member links. This is to ensure that the Layer 3 link will be included in the constraint-based computation of the corresponding Flex-Algo.

4. Scalability Considerations

The mechanism described in this document requires that each VTN maps to an independent Flex-Algo. Even if multiple VTNs share the same topology constraints. While this brings the benefits of simplicity, it also has some limitations. For example, it means that even if multiple VTNs have the same topology constraints, they would still need to be identified using different Flex-Algos in the control plane. Then this requires that for each VTN, independent path computation would be executed. The number of VTNs supported in a network may be dependent on the number of Flex-Algos supported, which is related to the control plane computation overhead.

Another aspect which may impact the number of VTNs supported is that at most 128 Flex-Algos can be defined in a network.

5. Security Considerations

This document introduces no additional security vulnerabilities to IS-IS and OSPF.

The mechanism proposed in this document is subject to the same vulnerabilities as any other protocol that relies on IGPs.

6. IANA Considerations

This document does not request any IANA actions.

7. Acknowledgments

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8.1. Normative References

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