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BGP Extensions of SR Policy for Composite Candidate Path
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Abstract

Segment Routing is a source routing paradigm that explicitly indicates the forwarding path for packets at the ingress node. An SR Policy is associated with one or more candidate paths. A candidate path is either dynamic, explicit or composite. This document defines extensions to BGP to distribute SR policies carrying composite candidate path information. So that composite candidate paths can be installed when the SR policy is applied.

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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1. Introduction

Segment routing (SR) [RFC8402] is a source routing paradigm that explicitly indicates the forwarding path for packets at the ingress node. The ingress node steers packets into a specific path according to the Segment Routing Policy (SR Policy) as defined in [RFC9256].In order to distribute SR policies to the headend,[RFC9830] specifies a mechanism by using BGP.

An SR Policy is associated with one or more candidate paths. A composite candidate path acts as a container for grouping of SR Policies. As described in section 2.2 in [RFC9256], the composite candidate path construct enables combination of SR Policies, each with explicit candidate paths and/or dynamic candidate paths with potentially different optimization objectives and constraints, for a load-balanced steering of packet flows over its constituent SR Policies.

This document defines extensions to Border Gateway Protocol (BGP) to distribute SR policies carrying composite candidate path information.So that composite candidate paths can be installed when the SR policy is applied.

1.1. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

2. Constituent SR Policy Attributes in SR Policy

As defined in [RFC9830], the SR policy encoding structure is as follows:

```
SR Policy SAFI NLRI: <Distinguisher, Policy-Color, Endpoint>
    Attributes:
        Tunnel Encaps Attribute (23)
            Tunnel Type: SR Policy
                Binding SID
                SRv6 Binding SID
                Preference
                Priority
                Policy Name
                Policy Candidate Path Name
                Explicit NULL Label Policy (ENLP)
                Segment List
                    Weight
                    Segment
                    Segment
                    ...
                ...
```

As described in section 2.2 in [RFC9256], the endpoints of the constituent SR Policies and the parent SR Policy MUST be identical, and the colors of each of the constituent SR Policies and the parent SR Policy MUST be different. Therefore a constituent SR Policy is referenced only by color in the composite candidate path since its headend and endpoint are identical to the parent SR policy.

SR policy with composite candidate path information is expressed as below:

```
SR Policy SAFI NLRI: <Distinguisher, Policy-Color, Endpoint>
    Attributes:
        Tunnel Encaps Attribute (23)
            Tunnel Type: SR Policy
                Binding SID
                SRv6 Binding SID
                Preference
                Priority
                Policy Name
                Policy Candidate Path Name
                Explicit NULL Label Policy (ENLP)
                Segment List
                    Weight
                    Segment
                    Segment
                    ...
                Constituent SR Policy
                    Color
                    Weight
                    Fowarding Class
                ...
```

As described in section 8.6 in [RFC9256], different flows bound to the same BGP endpoint are steered on different SR Policy paths, By using Constituent SR Policy to define the Flow Forwarding Class for the flow, it is possible to map different flows to different color SR Policy paths.

2.1. Constituent SR Policy Sub-TLV

The Constituent SR Policy sub-TLV encodes a single composite path towards the endpoint. The Constituent SR Policy sub-TLV is an optional sub-TLV of BGP Tunnel Encapsulation Attribute, and MAY appear multiple times in the SR Policy encoding. The ordering of Constituent SR Policy sub-TLVs does not matter. The Constituent SR Policy sub-TLV MAY contain a Weight sub-TLV.

Since a candidate path is either dynamic, explicit or composite, the Constituent SR Policy sub-TLV and the Segment List sub-TLV SHOULD NOT appear in the same candidate path.

The Constituent SR Policy sub-TLV has the following format:

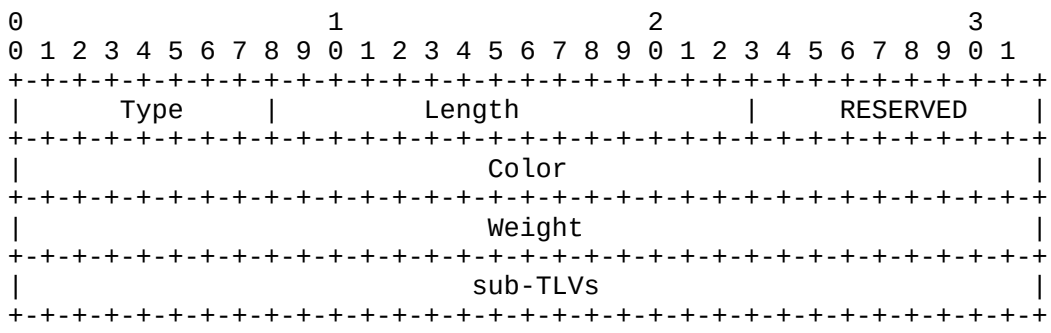

Figure 1: Constituent SR Policy sub-TLV format

where:

* Type: to be assigned by IANA.

* Length: the total length of the value field not including Type and Length fields.

* RESERVED: 2 octet of reserved bits. SHOULD be set to zero on transmission and MUST be ignored on receipt.

* Color: 4-octet value identifying the constituent SR policy.

* Weight: 4 octet field that indicates the weight associated with the SID-List for weighted load-balancing. Refer Section 2.2 and 2.11 of [RFC9256].

* sub-TLVs currently defined:

- An optional single Per-Flow Forwarding Class sub-TLV which is defined in section 2.2 on this document.

2.2. Per-Flow Forwarding Class

Per-Flow Forwarding Path builds on top of the concept of the Composite Candidate Path. Each Path in a Per-Flow Forwarding Path is assigned a 3-bit Forward Class(FC) value, which allows QoS classified traffic to be steered depending on the FC.

The Per-flow FC sub-TLV is OPTIONAL and it MUST NOT appear more than once inside the Constituent SR Policy sub-TLV.

The Per-flow FC sub-TLV has the following format:

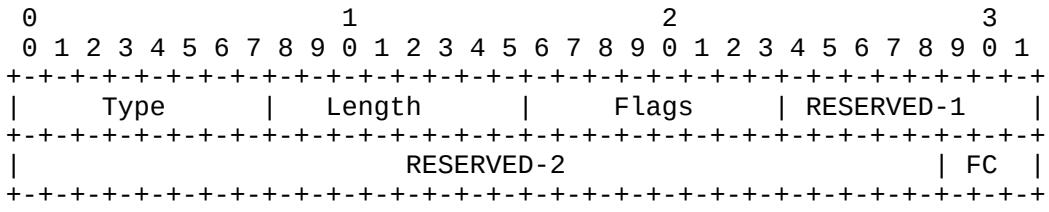

Figure 2 Per-Flow FC Sub-TLV

where:

* Type: to be assigned by IANA.

* Length: Specifies the length of the value field (i.e., not including Type and Length fields) in terms of octets. The value MUST be 6.

* Flags: 1 octet of flags. No flags are defined in this document. The Flags field MUST be set to zero on transmission and MUST be ignored on receipt.

* RESERVED-1: 1 octet of reserved bits. This field MUST be set to zero on transmission and MUST be ignored on receipt.

* Reserved-2(29 bits): This field MUST be set to zero on transmission and MUST be ignored on receipt.

* FC (3 bits): Forward class value that is given by the QoS classifier to traffic entering the given Candidate Path. Different classes of traffic that enter the given Candidate Path can be differentially steered into different Colors.

3. Operations

The document does not bring new operation beyond the description of operations defined in [RFC9830]. The existing operations defined in [RFC9830] can apply to this document directly.

Typically but not limit to, the SR policies carrying composite candidate path information are configured by a controller.

After configuration, the SR policies carrying path composite candidate path information will be advertised by BGP update messages.

The operation of advertisement is the same as defined in [RFC9830], as well as the reception.

4. Security Considerations

The security requirements and mechanisms described in [RFC9830] also apply to this document.

This document does not introduce any new security consideration.

5. IANA Considerations

This document defines two new Sub-TLVs in the registry "SR Policy Segment List Sub-TLVs" [RFC9830]:

Value	Description	Reference
TBA	Constituent SR Policy Sub-TLV	This document
TBA	FC Sub-TLV	This document

6. References

6.1. Normative References

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

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, May 2017

[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>.

[RFC9830] Previdi, S., Filsfils, C., Talaulikar, K., Mattes, P., and D. Jain, "Advertising Segment Routing Policies in BGP", RFC 9830, DOI 10.17487/RFC9830, September 2025, <https://www.rfc-editor.org/info/rfc9830>.

6.2. Informative References

[RFC9256] Filsfils, C., Talaulikar, K., Ed., Voyer, D., Bogdanov, A., and P. Mattes, "Segment Routing Policy Architecture", RFC 9256, DOI 10.17487/RFC9256, July 2022, <https://www.rfc-editor.org/info/rfc9256>.

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