BGP SR Policy Extensions for Performance-Aware Path Selection

draft-li-idr-sr-policy-metric-01

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Scenario to be addressed

- Two SR Policies
  - *P1: PE3--P1--PE1*
  - *P2: PE3--P2--PE2*
- PE3 learns the same private routes.
- PE3 chooses PE1 as the next hop for the VPN routes

```
          +----------------------------------------------+
          |SR Policy Computation and Provisioning System|
          +----------------------------------------------+
                  *        *             *         *
                 *        *               *         *Extended BGP
                *        *                 *         *SR Policy
               *        *                   *         *
           +----+  15ms*    +----+      5ms   *      +----+
          /|PE1| ----*----| P1 |-------------*-----|PE3|\
         / +----+    *      +----+----\      /--*----+----+ \
        /    |       *        |        \    /   *     |      \
+----+/      |      *         |         ----\    *    |       \+----+
|CE1|0.5ms|      *          |0.5ms   /      \    *   |0.5ms  |CE2|
+----+\      |    *           |    ----       ---\  *  |       /+----+
        \    |   *            |   /1ms       5ms\  *  |      /
         \ +----+             +----+             --+----+   /
          \|PE2|------------|P2  |-----------------|PE4|/
           +----+   11ms     +----+      1ms       +----+
```

The Extended BGP SR Policy Encoding Structure

SR Policy SAFI NLRI: <Distinguisher, Policy-Color, Endpoint>
- Attributes:
  - Tunnel Encapsulation Attribute (23)
    - Tunnel Type: SR Policy (15)
      - Binding SID
      - ...
      - **Metric**
      - Policy Name
      - Policy Candidate Path Name
      - Explicit NULL Label Policy (ENLP)
      - Segment List
        - Weight
        - Segment
        - Segment
        - ...
      - ...

Metric Sub-TLV

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 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     |   Reserved    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                 Delay(8 octets, optinal)                      |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              Bandwidth(4 octets, optional)                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Reliability(4 octets, optional)                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

- Three types of optional performance metrics are introduced.
- The Flags field is used to indicate which metric is present.

Policy Computation and Provisioning System Behavior

- Collect Network State Information: including performance metrics related to each link (e.g., delay, available bandwidth, and reliability).
- Compute SR Policies: based on service requirements and network status.
- Encapsulate Performance Metrics: within the Metric Sub-TLV
- Provision BGP Update Messages: and send them to headend nodes.

Headend Behavior

- Validate BGP Update Messages: Extract performance metrics from the received messages.
- Store Performance Metrics: in a local database for subsequent path selection.
- Select best SR Policy: prefer the SR policy with optimal performance metrics. The BGP Tie-Breaking Procedure needs to be updated.
- Update Routing Tables: populate the routing table based on the selected SR policy.

Updated BGP Tie-Breaking Procedure

A new step is inserted before Step e of the tie-breaking (Phase 2) logic specified in [RFC4271].

- d) If at least one of the candidate routes was received via EBGP, remove from consideration all routes that were received via IBGP.

- e0)If any routes have the Color Extended Community attribute with identical values, remove from consideration all routes lacking the Color Extended Community attribute.

  Compare the SR policies corresponding to the remaining routes. If any SR policies include the Metric Sub-TLV, remove from consideration all routes whose corresponding SR policies lack the Metric Sub-TLV.

  Remove from consideration all routes whose Metric Sub-TLV are not the best.

- e) Remove from consideration any routes with less-preferred interior cost.

Next Steps

- Further reviews and comments are welcome and appreciated.

Thanks!