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SRv6 Policy Selector
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Abstract

Segment routing (SR) [RFC8402] 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, and each candidate path is either dynamic, explicit or composite. This document describes a policy selection mechanism among the candidate SRv6 Policies based on network quality in IPv6 environments.

Status of This Memo

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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. An SR Policy is associated with one or more candidate paths, and each candidate path is either dynamic, explicit or composite.

The [I-D.ietf-idr-performance-routing] specification defines a mechanism for disseminating path delay information across multiple Autonomous Systems (ASes). This information is used for BGP route computation.

An SRv6 Policy is associated with one or more candidate paths. A composite candidate path acts as a container for grouping SRv6 Policies. As described in section 2.2 in [RFC9256], the composite candidate path construct enables combination of SRv6 Policies, each with explicit candidate paths and/or dynamic candidate paths with potentially different optimization objectives and constraints, for load-balanced steering of packet flows over its constituent SRv6 Policies. For convenience, the composite candidate path formed by the combination of SRv6 Policies is called parent SRv6 Policy in [I-D.cheng-spring-sr-policy-group].

Different enterprise applications have varying network performance requirements. For instance, conference is highly sensitive to packet loss and jitter, while CRM applications are not highly demanding in terms of latency and packet loss.

This document describes a policy selection mechanism among the candidate SRv6 Policies based on network quality in IPv6 environments.

2. 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.

3. Terminology

The definitions of the basic terms are identical to those found in Segment Routing Policy Architecture [RFC9256].

CRM: Customer Relationship Management is a critical application that requires low bandwidth and low latency network connection.

Parent SR Policy: Refer to [I-D.cheng-spring-sr-policy-group]. A Parent SR Policy is the composite candidate path that acts as a container for grouping SR Policies which meet different service optimization objectives and constraints and have the same destination endpoint.

4. Problem and Requriements

Take the networking shown in Figure 1 below as an example to illustrate the current problems.

CE1 and CE2 are the two access endpoints of the IP telecom network. There are many service flows between CE1 and CE2 that have different requirements for forwarding quality. E.g. CRM and conference traffic have different SLA requirement, and expected be carried by different SRv6 Policies. Generally, from CE1 to CE2, conference services with low latency requirements are forwarded along SRv6 Policy PE1->P1->P2->PE2 and PE1->P3->P4->PE2. The CRM traffic is forwarded along the other SRv6 Policy PE1->P5->P6->PE2. When failure or degradation happened in CRM SRv6 Policy, there should be possible to switchover CRM traffic to conference SRv6 Policy.

```
                            +---------------+
                            |   Controller  |
                            +---------------+

                           +------+    +------+
                     +-----+  P1  +----+  P2  +-------+
                     |     +------+    +------+       |
                     |                                |
                     |     +------+    +------+       |
                     +-----+  P3  +----+  P4  +-------+
                     |     +------+    +------+       |
                     |                                |
       +-----+   +---+--+                         +---+--+   +-----+
       | CE1 +---+  PE1 |                         |  PE2 +---+ CE2 |
       +-----+   +---+--+                         +---+--+   +-----+
                     |                                |
                     |     +------+    +------+       |
                     +-----+  P5  +----+  P6  +-------+
                           +------+    +------+
```

Figure 1

Based on such scenarios, the following requirements should be met:

1. Maximize failure/degradation protection

   In case of failure or degradation detected on one SRv6 Policy, it should be possible to do inter-policy protection.

2. Minimal impact after taking repairing action

   Repair action can be done on flow level to minimize the ripple effect cause by forwarding path switchover.

3. Maximize bandwidth efficiency

   For some critical applications, it should be possible to forward the traffic over lower class policy in case of higher class SRv6 Policy degradation.

Refer to [I-D.cheng-spring-sr-policy-group], the services with different forwarding quality requirements to the same destination endpoint can be implemented through parent SRv6 Policy.

This document proposes an SRv6 Policy selector for parent SRv6 Policy based on network quality requirement. The head end node of parent SRv6 Policy selects the best constituent SRv6 Policy for the application according to the quality of the constituent SRv6 Policy.

Take Figure 1 as an example, there is a parent SRv6 Policy between PE1 to PE2, which has multiple constituent SRv6 Policies. An SRv6 Policy selection mechanism is needed, which should select best constituent SRv6 Policy in the parent SRv6 Policy. When the head node detects the quality degradation of the active constituent SRv6 Policy, it will select another one in the parent SRv6 Policy.

5. SRv6 Policy Selector

5.1. Processing Model

A new priority and a new quality threshold is created for the parent SRv6 Policy. The lower the priority number, the higher the priority. That means avtive constituent SRv6 Policy will be the one with higher priority and meeting the quality threshold. When the network quality degradation is happened on the active constituent SRv6 Policy, such as the packet loss rate exceeds the threshold, switch to the next high priority constituent SRv6 Policy which can meet the threshold value.

If the quality of the high priority constituent SRv6 Policy is restored and the specified quality threshold is met, the traffic will be switched back after a period of wait-to-restore time.

According to the processing logic, the SRv6 Policy Selector model can be divided into five units, including Flow Classification, Flow Steering, SRv6 Policy Selector, Flow Forwarding, and Network Quality Measurement, as shown in Figure 2 below.

```
                          +----------------------+
  +----------------+      |  Parent SRv6 Policy  |    +------------+
  |      Flow      +----->|                      +--->|    Flow    |
  | Classification |      | SRv6 Policy Selector |    | Forwarding |
  +----------------+      +----------------------+    +------------+
                                       ^
                                       |
                             +---------+-------+
                             | Network Quality |
                             |   Measurement   |
                             +-----------------+
```

Figure 2

The functions of each unit are described below.

5.2. Flow Classification

After receiving the traffic, the head node first needs to label the traffic with application type according to classification configuration.

5.3. SRv6 Policy Selector

SRv6 Policy Selector obtains the current quality of each constituent SRv6 Policy from the Network Quality Measurement unit. Based on the quality threshold and the priority, SRv6 Policy Selector selects the active constituent SRv6 Policy.

```
                +-------------------------------------+
                |        Parent SRv6 Policy           |
                |                +-----------------+  |
                |                |   Constituent   |  |
                |  +----------+  |   SRv6 Policy   |  |
                |  |          +->| (high priority) |  |
+------------+  |  |   SRv6   |  +-------------+---+  |
| Classified |  |  |  Policy  |               /       |
|            +---->| Selector |<-Measurement-+        |
|   Traffic  |  |  |          |               \       |
+------------+  |  |Threshold |  + -----------+---+   |
                |  |          +->|   Constituent   |  |
                |  +----------+  |   SRv6 Policy   |  |
                |                | (lower priority)|  |
                |                + ----------------+  |
                +-------------------------------------+
```

Figure 3

Each parent SRv6 Policy contains multiple constituent SRv6 Policies. Each constituent SRv6 Policy will include two new configuration parameters, "priority" and "threshold" in this proposal. The constituent SRv6 Policy with the highest priority and qualified threshold will be selected to carry the traffic.

To avoid frequent path switching when the network quality is unstable, a wait-to-restore timer is required. Only after automatic restore is allowed and the wait-to-restore timer is timeout, the forwarding path switch from the current constituent SRv6 Policy to the one with higher priority.

5.4. Network Quality Measurement

The Network Quality Measurement unit regularly monitors the quality of all effective forwarding paths according to the measurement cycle, records the current performance measurement data of the path, and reports it to the SRv6 Policy Selector unit, which decides whether to switch paths.

The following network quality parameters can be used:

* Jitter

* Latency

* Packet loss

* Available bandwidth

* Bandwidth utilization

* Current traffic statistics

* Other forwarding performance parameters

The quality parameters can be obtained through active or passive performance measurement methods, such as iCRMM, STAMP, TWAMP, SRv6 bandwidth measurement[I-D.liu-ippm-srv6-bandwidth-measurement], etc. The network quality parameters can be calculated by the controller and distributed to the head end node, or calculated by the head end node according to the network measurement data. The measurement method and quality parameter acquisition method are beyond the scope of this document.

5.5. Flow Forwarding

The service flow is forwarded according to the path determined by the SRv6 Policy Selector unit.

When there are multiple paths with the same priority, the traffic will share the load among these SRv6 Policy paths with the same priority according to the weight value.

6. Examples of SRv6 Policy Selector

The application of SRv6 Policy Selector is described in detail in L3VPN over TE scenario. Take the exmpale shown in Figure 1.

There are two services between CE1 and CE2: conference and CRM. The traffic from CE1 to CE2 can be forwarded through two paths: Path1 (PE1->P1->P2->PE2 and PE1->P3->P4->PE2) and Path2 (PE1->P5->P6->PE2).

The conference service traffic will be forwarded through Path1 first. The CRM service traffic will be forwarded through Path2 first. When the transmission delay of Path1 exceeds the threshold value and Path2 can meet the delay requirements, switch the conference service to Path2.

When the remaining bandwidth of Path2 is less than the bandwidth guarantee threshold, if Path1 still has enough remaining bandwidth, the CRM traffic exceeding the bandwidth will be directed to Path1.

The configuration on the head node PE1 includes the following three parts. These configurations can be directly configured on the node or distributed through the controller.

1. Configure the parent SRv6 Policy.

```
parent-sr-policy sr-policy-1(color 10, PE2_SID)
  service conference use routing-policy-selector irp1
  service crm use routing-policy-selector irp2
```

2. Configure constituent SRv6 Policy.

```
sr-policy path1 (color 100, PE2_SID)
  segment-list <SID_P1, SID_P2, SID_PE2>
  segment-list <SID_P3, SID_P4, SID_PE2>
sr-policy path2 (color 200, PE2_SID)
  segment-list <SID_P5, SID_P6, SID_PE2>
```

3. Define three SRv6 Policy Selector policies, and specify the threshold of network quality, priority.

```
routing-policy-selector irp1
  traffic-delay threshold 1000ms
  priority 1 mapping-to color 100
  priority default mapping-to color 200
routing-policy-selector irp2
  remaining-bandwidth threshold 50M
  priority 1 mapping-to color 200
  priority default mapping-to color 100
```

7. IANA Considerations

This memo includes no request to IANA.

8. Security Considerations

This document does not introduce any security considerations.

9. References

9.1. Normative References

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