BGP SR Policy Extension for Path Scheduling

draft-zzd-idr-sr-policy-scheduling

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Background

- Tidal Network Use Case.

  - The tidal effect of network traffic leads to low network resource utilization and **high energy consumption** when the traffic is at a low level.

  - When the network traffic is at a low level, the **network can disable some links or nodes** to reduce network power consumption.

  - Due to topology changes, the controller needs to collect the topology information and deliver SR Policies frequently. If the SR Policies are not delivered in time, **packets may not be forwarded correctly and lead to packet loss**.

- Resource Utilization Efficiency Use Case.

  - In traditional SR policy path planning, **resources need to be scheduled for each path**.

  - However，the traffic on the path usually just **last for a short time**;

  - As a result, resources scheduled for this path are **wasted for a long time**.
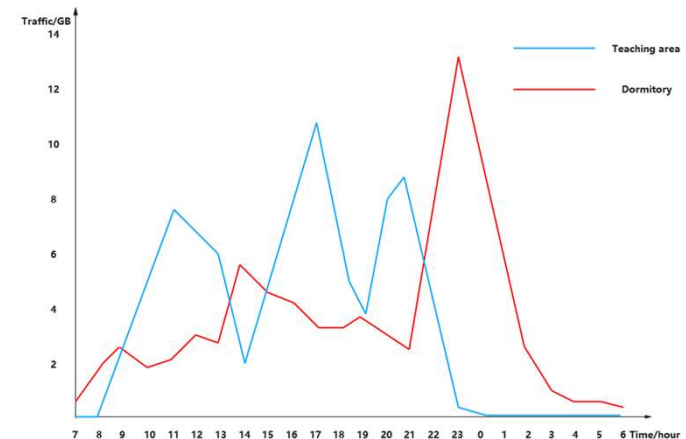
Traffic Curve of Teaching Area and Dormitory in Campus Network

In order to reduce the **packet loss** and improve the network **resource utilization,** the **scheduling time information** needs to be added for paths. So that paths can be **scheduled based on time**.

Extension to SR Policy

Extension method 1: Add the time scheduling information for each candidate path.

SR Policy SAFI NLRI: <Distinguisher, Policy-Color, Endpoint>
    Attributes:
      Tunnel Encapsulation Attribute (23)
        Tunnel Type: SR Policy (15)
          Binding SID
          SRv6 Binding SID
          Preference
          Priority
          Policy Name
          Policy Candidate Path Name
          Explicit NULL Label Policy (ENLP)
          Scheduling Time Information
          Segment List
            Weight
            Segment
            Segment
            ...
          ...

Extension method 2：Add the time scheduling time information for each segment list.

SR Policy SAFI NLRI: <Distinguisher, Policy-Color, Endpoint>
    Attributes:
      Tunnel Encapsulation Attribute (23)
        Tunnel Type: SR Policy (15)
          Binding SID
          SRv6 Binding SID
          Preference
          Priority
          Policy Name
          Policy Candidate Path Name
          Explicit NULL Label Policy (ENLP)
          Segment List
            Scheduling Time Information
            Weight
             Segment
             Segment
   ...
          ...

Considering that the Segment Lists within a candidate path usually are for load balancing, so the method 1 maybe more reasonable.

Procedures

Controller: when computing paths, the controller generates an **SR Policy with scheduling time information** based on predictable traffic and topology changes.

Headend:

1. **Parses and stores the paths and time information** when received a SR Policy with scheduling time information.
2. When a packet arrives, **steer it into an SR Policy**.
3. Within a specific policy, the headend **determines the forwarding path based on the arrival time and path's scheduling time information**.
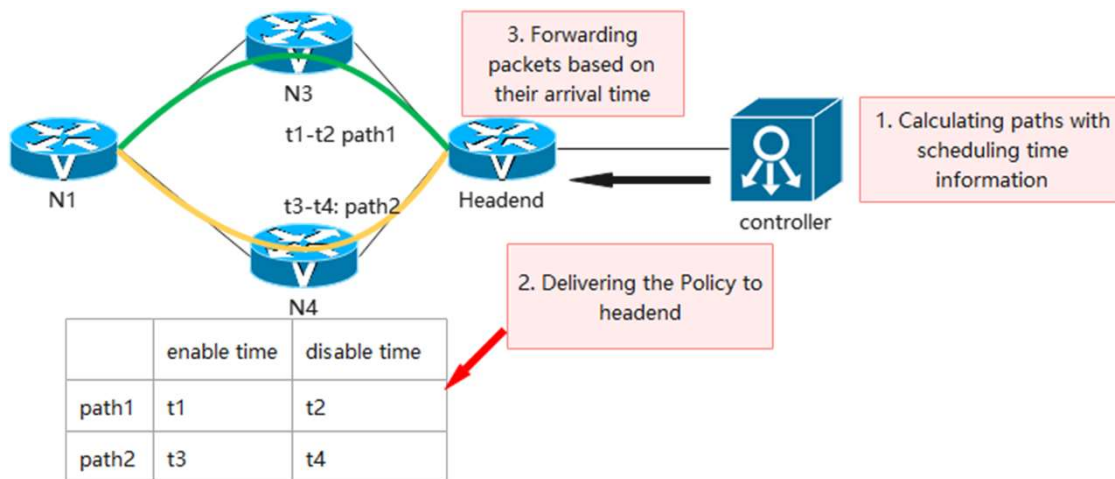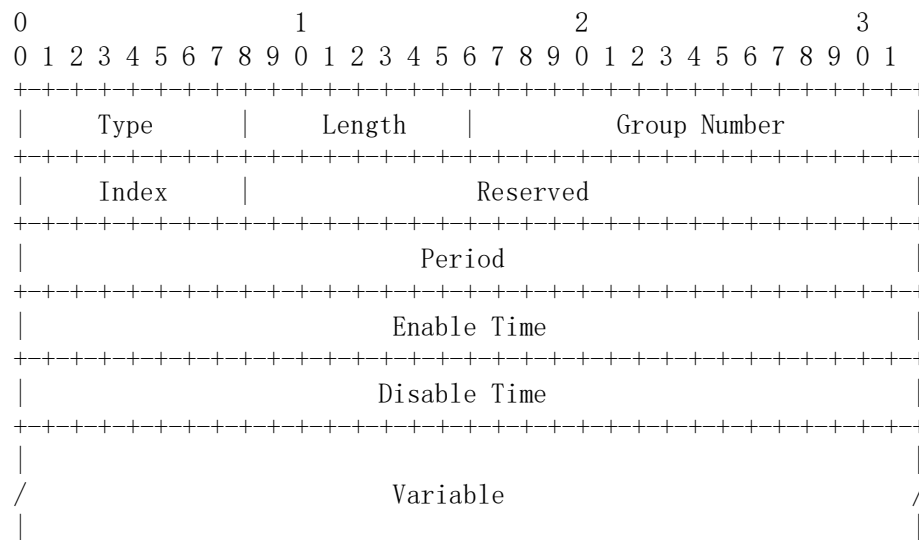

The headend can determine the forwarding path in the follow methods:

1. The forwarding path is **dynamically determined whenever a packet arrives**.

2. **A timer is set according to the scheduling time information of each path**, so the path can be switched periodically.
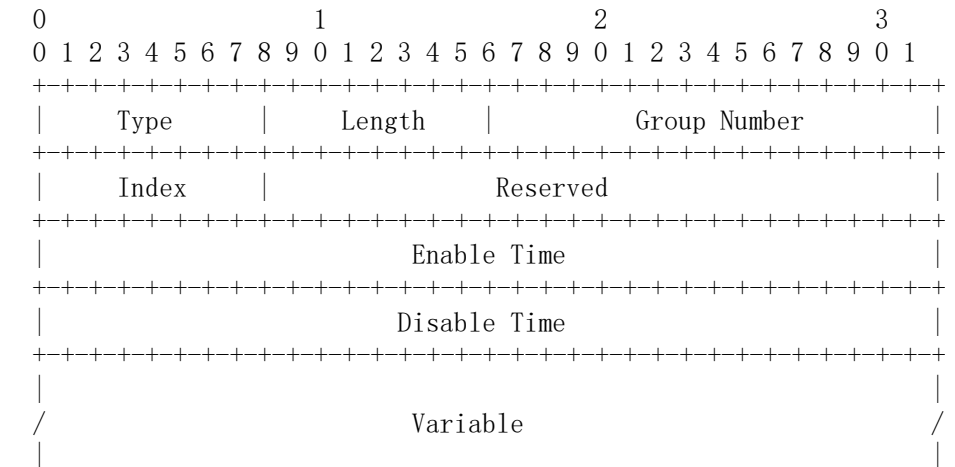
Scheduling Time Information

There are two formats of scheduling time information for periodic and aperiodic scenarios based on the traffic and topology change regularity.

Periodic Scheduling Time Information(PSTI)：

```
 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    |        Group Number           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Index     |                Reserved                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                           Period                              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         Enable Time                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Disable Time                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
/                         Variable                              /
|                                                               |
```

Aperiodic Scheduling Time Information(ASTI)：

```
 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    |        Group Number           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Index     |                Reserved                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         Enable Time                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Disable Time                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
/                         Variable                              /
|                                                               |
```

Group Number： indicates the number of information groups, each information group has fields of Index, Flags, Enable Time and Disable Time；
Index： the number used to identify specific information group.

Any comments and opinions are welcome!

Thank You