The IPv6 Compressed Routing Header (CRH)

Draft-bonica-6man-comp-rtg-hdr

R. Bonica, Juniper Networks
N. So, F. Xu, Reliance Jio
G. Chen, Baidu
Y. Zhu, G. Yang, China Telecom
Y. Zhao, ByteDance
Network Programming -> Two SID Classes

Transport SIDs
- Steers packets to the terminal segment
- Processed at non-terminal segment endpoints (SL > 0)
- Example: END, END.X
- Relatively few of these
- Simple semantic
  - Carries relatively little information

Service SIDs
- Determines behavior at the terminal segment
- Processed at terminal segment endpoint only (SL = 0)
- Example: END.DX4, END.DX6
- Relatively many of these
- Rich semantic
  - Carry many bits of information
IPv6 -> Two Ways To Deliver Instructions To Downstream Nodes

**Routing Extension Header**
- Steer packets from ingress to egress
- Processed at non-terminal segment endpoints (SL > 0)
- Well-positioned to carry Transport SIDs

**Destination Options Header**
- Determine behavior at egress node
- Processed at terminal segment endpoint only (SL = 0)
- Well-positioned to carry Service SIDs
The Problem With Routing Headers

• Too Long
  • Typically 8 bytes of overhead (4 bytes are mandatory)
  • Typically, another 16 bytes per SID
  • Routing header with 3 SIDs is 56 bytes long

• Not ASIC Friendly
  • Processing long extension headers is computationally expensive

• Impose unreasonable bandwidth overhead
  • Short packets ( >500) bytes are common on the Internet
  • Routing header with three SIDS may become common
  • > 10% Routing header overhead
Proposal

• Encode Transport SIDs in a new, compressed routing header
  • Draft-bonica-6man-comp-rtg-hdr
  • Topic of this talk

• Encode Service SIDs in a new IPv6 Destination Option
  • Draft-bonica-6man-vpn-dest-opt
  • To be presented in 6man on Friday
Compressed Routing Header (CRH)

<table>
<thead>
<tr>
<th>SID List</th>
<th>Reserved</th>
<th>Last Entry</th>
<th>Com</th>
<th>Routing Type</th>
<th>Segments Left</th>
<th>Hdr Ext Len</th>
<th>Next Header</th>
</tr>
</thead>
<tbody>
<tr>
<td>SID List</td>
<td>Reserved</td>
<td>Last Entry</td>
<td>Com</td>
<td>Routing Type</td>
<td>Segments Left</td>
<td>Hdr Ext Len</td>
<td>Next Header</td>
</tr>
</tbody>
</table>

+++-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Next Header        | Hdr Ext Len             | Routing Type | Segments Left | Last Entry | Com | Reserved |
+++-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| SID List           |                        |             |               |            |     |          |
+++-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
Compressed Routing Header (CRH)

- Initial fields are defined in RFC 8200 and common to all Routing headers
  - Next Header, Header Extension Length, Routing Type and Segments Left
- Last Entry is a pointer to the final entry
- Com field indicates whether SIDs are 8, 16, or 32 bits long
- Each SID maps to an IPv6 address
  - Either through a table lookup or an algorithm
- IPv6 address is copied to the Destination Address field of the IPv6 header
Compressed Routing Header (CRH): Com Equals Zero (8-bit SIDs)

```
+---------------+---------------+---------------+---------------+
+---------------+---------------+---------------+---------------+
```

```
+---------------+---------------+---------------+---------------+
| Last Entry    |   Com        |   Reserved    |   |           |
+---------------+---------------+---------------+---------------+
| Next Header   |  Hdr Ext Len |   Routing Type|   Segments Left|
+---------------+---------------+---------------+---------------+
|    0          |     1        |     2        |     3        |
+---------------+---------------+---------------+---------------+
```
Compressed Routing Header (CRH):
Com Equals One (16-bit SIDs)
Compressed Routing Header (CRH): Com Equals Two (32-bit SIDs)

```
 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
+-----------------------------------------------+
|   Next Header   |   Hdr Ext Len   |   Routing Type   |   Segments Left   |
+-----------------------------------------------+
|   Last Entry    |   Com          |   Reserved       |
+-----------------------------------------------+
|                                 SID[0]         |
+-----------------------------------------------+
|                                 SID[1]         |
+-----------------------------------------------+
```
Status

- Operators are expressing interest
- Prototypes under development
  - Forwarding plane
  - ISIS Extensions to support SID Advertisement
Next Steps

• Wide review in SPRING and 6man WGs
• Call for adoption in 6man WG