Compressed Routing Header (CRH) Helper Option

draft-bonica-6man-crh-helper-opt-00

Abstract

This document defines the IPv6 CRH Helper option. When an SRm6 ingress node originates a packet, it can use the IPv6 CRH Helper option to provide SID Forwarding Information Base (SFIB) information to downstream nodes that do not maintain a complete SFIB.

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SRm6 [I-D.bonica-spring-srv6-plus] leverages two new IPv6 [RFC8200] Routing types. Generically, they are called the Compressed Routing Header (CRH) [I-D.bonica-6man-comp-rtg-hdr]. More specifically, the 16-bit version of the CRH is called the CRH-16, while the 32-bit version of the CRH is called the CRH-32.

Both CRH versions contain the following fields:

- **Next Header** - Identifies the header immediately following the CRH.
- **Hdr Ext Len** - Length of the CRH.
- **Routing Type** - Identifies the Routing header variant (i.e., CRH-16 or CRH-32).
- **Segments Left** - The number of segments still to be traversed before reaching the SRm6 path egress node.
- **Segment Identifier (SID) List** - Represents the SRm6 path as an ordered list of Segment Identifiers (SID). SIDs are listed in reverse order, with SID[0] representing the final segment, SID[1] representing the penultimate segment, and so forth. SIDs are listed in reverse order so that Segments Left can be used as an index to the SID List. The SID indexed by Segments Left is called the current SID.

As per [RFC8200], when an IPv6 node receives a packet, it examines the packet’s destination address. If the destination address
represents an interface belonging to the node, the node processes the
next header. If the node encounters and recognizes the CRH, it
processes the CRH as follows:

- If Segments Left equal 0, skip over the CRH and process the next
  header in the packet.
- Decrement Segments Left.
- Query a local data structure, called the SID Forwarding
  Information Base (SFIB), searching for an entry that is indexed by
  the current SID.
- If the above-mentioned query returns an SFIB entry, update the
  packet’s IPv6 Destination Address and forward the packet.

In a typical SRm6 deployment, every segment ingress node maintains a
complete SFIB and the above-mentioned query returns an SFIB entry.
However, in some SRm6 deployments, some segment ingress nodes
maintain a complete SFIB while others do not. The following are
reasons why a segment ingress node might not maintain a complete
SFIB:

- the node is a Network Interface Card (NIC) in a data center.
  Although it originates many segments, it does not participate in
  the SRm6 control plane [I-D.bonica-lsr-crh-isis-extensions].
- the node resides in another autonomous system and does not
  participate in the SRm6 control plane.

This document defines the IPv6 CRH Helper option. When an SRm6 path
ingress node originates a packet, it can use the IPv6 CRH Helper
option to provide SFIB information to downstream nodes that do not
maintain a complete SFIB.

If a segment ingress node queries its SFIB, searching for an entry
that is indexed by the current SID, and that query returns nothing,
the segment ingress node can obtain the required SFIB information
from the IPv6 CRH Helper option. If the segment ingress node cannot
obtain the required SFIB information from either source, it discards
the packet sends an ICMPv6 [I-D.bonica-lsr-crh-isis-extensions]
Parameter Problem message to the source node.

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
3. Option Format

The CRH Helper option contains the following fields:

- Option Type - (8-bits) CRH Helper option. Value TBD by IANA. (Suggested value: 0x11). See Note below.
- Opt Data Len - (8-bits) Length of the option, in octets, excluding the Option Type and Option Length fields.
- SFIB Helper (SFIBH) List - (Variable length) A list of SFIBHs.

Each SFIBH contains the following fields:

- SFIBH Length - (8-bits) Length of the SFIBH, in octets, excluding SFIBH Length. Value MUST be greater than 2 and less than 19.
- Low SID - (8-bits) Index to the CRH SID List. References the first member of the SID List to which this SFIBH applies.
- High SID - (8-bits) Index to the CRH SID List. References the last member of the SID List to which this SFIBH applies.
- Prefix field (variable length): An IPv6 Prefix.

NOTE: The highest-order two bits of the Option Type (i.e., the "act" bits) are 00. These bits specify the action taken by a destination node that does not recognize the option. The required action is to skip over this option and continue processing the header.

The third highest-order bit of the Option Type (i.e., the "chg" bit) is 0. This indicates that Option Data cannot be modified along the path between the packet’s source and its destination.

4. Option Processing

When a segment endpoint node processes a CRH, it attempts to resolve the SID using information contained by its SFIB. If it cannot resolve the SID using SFIB, it attempts to resolve the SID using information received in an applicable SFIBH. If no SFIBH applies to the current SID, the processing node discards the packet and sends an ICMPv6 Parameter Problem message to the source node.

When the processing node uses an SFIBH to resolve a SID, it executes the following procedure:
o Set the IPv6 Destination Address to 0::

o Overwrite the low order bits of the IPv6 Destination Address with the current SID found in the CRH

o Overwrite the high order bits of the IPv6 Destination Address with the prefix found in the applicable SFIBH

If the prefix found in the applicable SFIBH is 16 bytes long, it overwrites the entire IPv6 Destination Address.

The CRH Helper option MAY occur in a Destination Options header that precedes a CRH. It SHOULD NOT occur in a Hop-by-hop options header or in a Destination Options header that precedes an upper-layer header.

When a segment ingress node resolves a SID using information obtained from the CRH helper option, the SID is understood to be a prefix SID. Therefore, the packet is forwarded to its destination via the least cost path.

Information obtained from the CRH Helper option is transient. It is discarded as soon as the packet that carried it has been processed.

5. Security Considerations

When a segment endpoint node processes a CRH, it attempts to resolve the SID using information contained by its SFIB. If it can resolve the SID using SFIB, it MUST ignore the CRH Helper option, even if it contains an applicable SFIBH.

6. IANA Considerations

IANA is requested to allocate a code point from the Destination Options and Hop-by-hop Options registry (https://www.iana.org/assignments/ipv6-parameters/ipv6-parameters.xhtml#ipv6-parameters-2). This option is called "CRH Helper Option". The "act" bits are 00 and the "chg" bit is 0. (Suggested value: 0x11).

7. Acknowledgements

Thanks to TBD for their careful review of this document.
8. References

8.1. Normative References

[I-D.bonica-6man-comp-rtg-hdr]

[I-D.bonica-spring-srv6-plus]


8.2. Informative References

[I-D.bonica-lsr-crh-isis-extensions]
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