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The IPv6 Segment Endpoint Option
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Abstract

This document defines the IPv6 Segment Endpoint Option. Source nodes can use this option to convey internet-layer information to selected segment endpoints along a packet's delivery path.

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1. Introduction

IPv6 [RFC8200] options convey optional internet-layer information to selected nodes along a packets delivery path. IPv6 options can be encoded as follows:

- o In a Hop-by-hop Options header.

- o In a Destination Options header that precedes a Routing header.

- o In a Destination Options header that precedes an upper-layer header.

If an option is encoded in a Hop-by-hop Options header, it conveys information to every node along the packet's delivery path, including the destination node. (See NOTE 1). If an option is encoded in a Destination Options header that precedes a Routing header, it conveys information to every segment endpoint along the packet's delivery path, including the destination node. If an option is encoded in a Destination Options header that precedes an upper-layer header, it conveys information to the destination node only. (See Section 4.3.4 of [RFC8200])

This document defines the IPv6 Segment Endpoint option. The IPv6 Segment Endpoint option provides a mechanism through which a source node can convey optional internet-layer information to selected segment endpoints. For example, assume that a packet's delivery path contains three segments. The source node can use the Segment Endpoint option to convey one piece of information to the first segment endpoint, another piece if information to the second segment endpoint, and no information to the third segment endpoint.

NOTE 1: As per IPv6 [RFC8200], it is now expected that nodes along a packet's delivery path only examine and process the Hop-by-Hop Options header if explicitly configured to do so.

2. Terminology

- o Segment Endpoint - A packet that contains a Routing header traverses multiple segments. Each segment has an endpoint. The first destination that appears in the IPv6 Destination Address identifies the first segment endpoint. Subsequent destinations listed in the Routing header identify subsequent segment endpoints. A packet that does not contain a Routing Header traverses exactly one segment had has exactly one segment endpoint (i.e., the packet's ultimate destination).

3. 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.

4. Option Format

The Segment Endpoint option MAY appear in a Destination Options header, regardless of whether that Destination Options header precedes a Routing header or an upper-layer header. The Segment Endpoint option MUST NOT appear in a Hop-by-hop Options header.

Figure 1 depicts the Segment Endpoint option.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Option Type  |  Opt Data Len |    Option Data
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
```

Figure 1: Segment Endpoint Option

- o Option Type - Segment Endpoint option. Value TBD by IANA. See NOTE 1 and NOTE 2, below.

- o Opt Data Len - 8-bit unsigned integer. Length of the Option Data field, in octets.

o Option Data - See Figure 2.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Segments Left |   Containers  |   Container List
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
```

Figure 2: Option Data

Option Data contains the following fields:

o Segments Left - 8-bit unsigned integer. Number of route segments remaining. If the packet also contains a Routing header, this value MUST be identical to the value of the Segments Left field in the Routing heder. See Section 5.

o Containers - 8-bit unsigned integer. The number of containers in the Container List.

o Container List - A list of Containers (Figure 3).

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Segment ID   |     IPv6 Option
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
```

Figure 3: A Container

Each element of Container List contains the following fields:

o Segment ID - 8-bit unsigned integer. Identifies the segment that should process the IPv6 Option contained by this container. See Section 5.

o IPv6 Option - Any IPv6 Option [IPv6-OPT] except for the Segment Endpoint Option.

Within a Container list, Containers MUST be sorted in descending order by Segment ID.

NOTE 1: The highest-order two bits of the Option Type (i.e., the "act" bits) are 10. These bits specify the action taken by a

destination node that does not recognize Segment Endpoint option. The required action is to discard the packet and send an ICMPv6 [RFC4443] Parameter Problem, Code 2, message to the packet's Source Address, pointing to the Segment Endpoint option Type.

NOTE 2: The third highest-order bit of the Option Type (i.e., the "chg" bit) is 1. This indicates that Option Data can be modified along the path between the packet's source and its destination.

5. Option Processing

If the option appears in a Hop-by-hop Options header, the processing node discards the packet and sends an ICMPv6 [RFC4443] Parameter Problem, Code 2, message to the packet's Source Address, pointing to the Segment Endpoint option Type.

If the option appears in a Destination Options header, the processing node locates the following fields in Option Data:

- Segments Left.
- Containers.
- Container List.

It then processes each member of the Container List as follows:

- Locate the Segment ID and IPv6 Option field in the container.
- If Segments Left less than the Segment ID, skip over the container.
- If Segments Left equals the Segment ID, and the IPv6 Option is a Segment Endpoint option, skip over the container.
- If Segments Left equals the Segment ID, and the IPv6 Option is not a Segment Endpoint option, process the IPv6 Option as per [RFC8200].
- If Segments Left is greater than Segment ID, skip over all remaining members of the Container List.

Finally, decrement the Segment ID field and process the next option or header.

6. Mutability

The Segments Left field of the Segment Endpoint option is mutable. Intermediate nodes MAY change the value of this field.

All other fields in the Segment Endpoint option are immutable. Intermediate nodes MUST NOT change the values of these fields.

7. Security Considerations

The Segment Endpoint Option shares many security concerns with IPv6 routing headers. In particular, any boundary filtering protecting a domain from external routing headers should also protect against external Segment Endpoint Options being processed inside a domain. This occurs naturally if encapsulation is used to add routing headers to a packet. If external routing headers are allowed, then protections must also include ensuring that any provided Segment Endpoint option before the routing header is properly protect, e.g. with an IPSEC AH header or other suitable means.

As with Routing headers, the security assumption within a domain is that the domain is trusted to provide, and to avoid improperly modifying, the Segment Endpoint Option.

8. IANA Considerations

IANA is requested to allocate a codepoint 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 "Segment Endpoint". The "act" bits are 10 and the "chg" bit is 1.

9. Acknowledgements

Thanks to TBD for their careful review of this document.

10. References

10.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

[RFC4443] Conta, A., Deering, S., and M. Gupta, Ed., "Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification", STD 89, RFC 4443, DOI 10.17487/RFC4443, March 2006, <https://www.rfc-editor.org/info/rfc4443>.

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <https://www.rfc-editor.org/info/rfc8174>.

[RFC8200] Deering, S. and R. Hinden, "Internet Protocol, Version 6 (IPv6) Specification", STD 86, RFC 8200, DOI 10.17487/RFC8200, July 2017, <https://www.rfc-editor.org/info/rfc8200>.

10.2. Informative References

[IPv6-OPT] IANA, ""Destination Options and Hop-by-Hop Options"", August 1987, <https://www.iana.org/assignments/ipv6-parameters/ipv6-parameters.xhtml#ipv6-parameters-2>.

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