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October 22, 2018

Segment Routing Header encapsulation for In-situ OAM Data
draft-ali-spring-ioam-srv6-00

Abstract

In-situ Operations, Administration, and Maintenance (IOAM) records operational and telemetry information in the data packet while the packet traverses a path between two points in the network. This document defines how IOAM data fields are transported as part of the Segment Routing with IPv6 data plane (SRv6) header.

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1. Introduction

In-situ Operations, Administration, and Maintenance (IOAM) records OAM information within the packet while the packet traverses a particular network domain. The term "in-situ" refers to the fact that the IOAM data fields are added to the data packets rather than being sent within probe packets specifically dedicated to OAM.

This document defines how IOAM data fields are transported as part of the Segment Routing with IPv6 data plane (SRv6) header [I-D.6man-segment-routing-header].

The IOAM data fields carried are defined in [I-D.ietf-ippm-ioam-data], and can be used for various use-cases including Performance Measurement (PM) and Proof-of-Transit (PoT).

2. Conventions

2.1. Requirement Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

2.2. Abbreviations

Abbreviations used in this document:

IOAM In-situ Operations, Administration, and Maintenance

OAM Operations, Administration, and Maintenance

PM Performance Measurement

PoT Proof-of-Transit

SR Segment Routing

SRH SRv6 Header

SRv6 Segment Routing with IPv6 Data plane

3. IOAM Data Field Encapsulation in SRH

The SRv6 encapsulation header (SRH) is defined in [I-D.6man-segment-routing-header]. IOAM data fields are carried in the SRH, using a single SRH TLV. The different IOAM data fields defined in [I-D.ietf-ippm-ioam-data] are added as sub-TLVs.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  SRH-TLV-Type |      LEN      |     RESERVED                  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+<-+
|  IOAM-Type    | IOAM HDR LEN  |     RESERVED                  |  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+  I
!                                                               |  O
!                                                               |  A
~                 IOAM Option and Data Space                    ~  M
|                                                               |  |
|                                                               |  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+<-+
|                                                               |
|                                                               |
|                 Payload + Padding (L2/L3/...)                 |
|                                                               |

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

Figure 1: IOAM data encapsulation in SRH

SRH-TLV-Type: IOAM TLV Type for SRH is defined as TBA1.

The fields related to the encapsulation of IOAM data fields in the SRH are defined as follows:

IOAM-Type: 8-bit field defining the IOAM Option type, as defined in Section 7.2 of [I-D.ietf-ippm-ioam-data].

IOAM HDR LEN: 8-bit unsigned integer. Length of the IOAM HDR in 4-octet units.

RESERVED: 8-bit reserved field MUST be set to zero upon transmission and ignored upon receipt.

IOAM Option and Data Space: IOAM option header and data is present as defined by the IOAM-Type field, and is defined in Section 4 of [I-D.ietf-ippm-ioam-data].

The IOAM TLVs MAY change en route [I-D.ietf-ippm-ioam-data]. For the IOAM TLVs carried in SRH that can change en route, the most significant bit of the SRH-TLV-Type is set [I-D.6man-segment-routing-header]. Furthermore, such IOAM TLV in SRH is considered mutable for ICV computation, the Type Length, and Variable Length Data is ignored for ICV Computation as defined in [RFC4302].

4. Procedure

This section summarizes the procedure for IOAM data encapsulation in SRv6 SRH. The SR nodes implementing the IOAM functionality follows the MTU and other considerations outlined in [I-D.6man-extension-header-insertion].

4.1. Ingress Node

The ingress node of an SR domain or an SR Policy [I-D.spring-segment-routing-policy] may insert the IOAM TLV in the SRH of the data packet. The ingress node may also insert the IOAM data about the local information in the IOAM TLV in the SRH. When IOAM data from the last node in the segment-list (Egress node) is desired, the ingress uses an Ultimate Segment Pop (USP) SID at the Egress node.

4.2. SR Segment Endpoint Node

The SR segment endpoint node is any node receiving an IPv6 packet where the destination address of that packet is a local SID or a local interface address. As part of the SR Header processing as described in [I-D.6man-segment-routing-header] and [I-D.spring-srv6-network-programming], the SR Segment Endpoint node performs the following IOAM operations. The description borrows the terminology used in [I-D.6man-segment-routing-header]. Specifically, n refers to the number of segments encoded in the SRH, "Hdr Ext Len" refers to the length of the SRH. The "SRH Header Len" is the length of the SRH header, which is 8 octets [I-D.6man-segment-routing-header].

The SR Segment Endpoint node compares the "Hdr Ext Len" of the SRH with the length of the "segment-list" in the SRH. Specifically, if the SRH.Hdr_Ext_Len > n*16 + 8, the node looks for the presence of the IOAM TLV in the SRH. If an IOAM TLV is present in the SRH and is supported by the Segment Endpoint Node, the SR segment endpoint node MAY modify the IOAM TLV in SRH with local IOAM data as per IOAM draft [I-D.ietf-ippm-ioam-data].

4.3. Egress Node

The Egress node is the last node in the segment-list of the SRH. When IOAM data from the Egress node is desired, a USP SID advertised by the Egress node is used.

The processing of IOAM TLV at the Egress node is similar to the processing of IOAM TLV at the SR Segment Endpoint Node. The only difference is that the Egress node also performs the functionality required by the Egress node in an IOAM domain. E.g., the Egress node may telemeter the IOAM data to a controller.

5. IANA Considerations

IANA is requested to allocate SRH TLV Type for IOAM TLV data fields under registry name "Segment Routing Header TLVs" requested by %[I-D.6man-segment-routing-header].

SRH TLV Type	Description	Reference
TBA1	TLV for IOAM Data Fields	This document

6. Security Considerations

The security considerations of SRv6 are discussed in [I-D.spring-srv6-network-programming] and [I-D.6man-segment-routing-header], and the security considerations of IOAM in general are discussed in [I-D.ietf-ippm-ioam-data].

IOAM is considered a "per domain" feature, where one or several operators decide on leveraging and configuring IOAM according to their needs. Still, operators need to properly secure the IOAM domain to avoid malicious configuration and use, which could include injecting malicious IOAM packets into a domain.

7. Acknowledgements

The authors would like to thank Shwetha Bhandari and Vengada Prasad Govindan for the discussions on IOAM.

8. References

8.1. Normative References

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8.2. Informative References

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