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Segment Routing Header encapsulation for In-situ OAM Data
draft-ali-spring-ioam-srv6-01

Abstract

   OAM and PM information from the SR endpoints can be piggybacked in
   the data packet. The OAM and PM information piggybacking in the data
   packets is also known as In-situ OAM (IOAM). 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.

Status of This Memo

   This Internet-Draft is submitted in full conformance with the
   provisions of BCP 78 and BCP 79.

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1. Introduction

OAM and PM information from the SR endpoints can be piggybacked in
the data packet. The OAM and PM information piggybacking in the data
packets is also known as In-situ OAM (IOAM). 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. OAM Metadata Piggybacked in Data Packets

OAM and PM information from the SR endpoints can be piggybacked in
the data packet. The OAM and PM information piggybacking in the data
packets is also known as In-situ OAM (IOAM). This section describes
iOAM functionality in SRv6 network.

The IOAM data is carried in SRH.TLV. This enables the IOAM mechanism
to build on the network programmability capability of SRv6. The
ability for an SRv6 endpoint to determine whether to
process or ignore some specific SRH TLVs is based on the SID
function. This enables collection of the IOAM information from the
intermediate endpoint nodes of choice. The nodes that are not
capable of supporting the IOAM functionality does not have to look or
process SRH TLV (i.e., such nodes can simply ignore the SRH IOAM
TLV).

3.1 IOAM Data Field Encapsulation in SRH

The SRv6 encapsulation header (SRH) is defined in [I-D.ietf-6man-
segment-routing-header]. IOAM data fields are carried in the SRH,
using a single pre-allocated 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/...)                |
|                                                               |

|                                                               |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
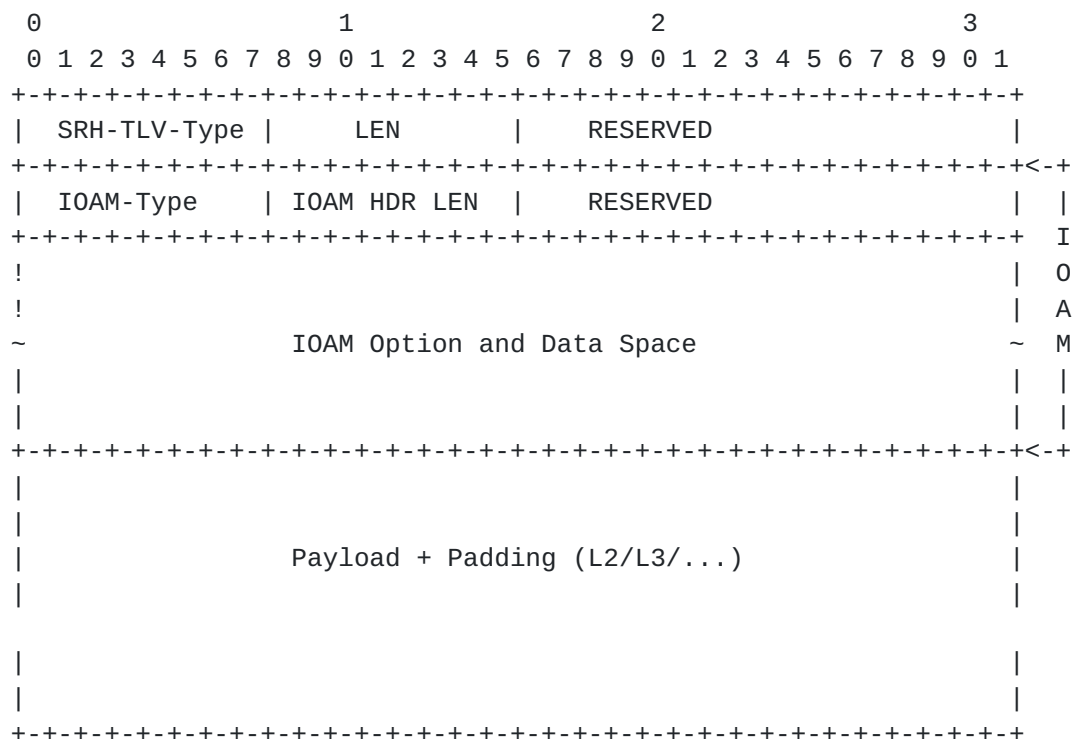
Figure 1: IOAM data encapsulation in SRH

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].

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

As part of the SRH encapsulation, the ingress node of an SR domain or
an SR Policy [I-D.ietf-spring-segment-routing-policy] MAY add the
IOAM TLV in the SRH of the data packet. If an ingress node supports
IOAM functionality and, based on a local configuration, wants to
collect IOAM data, it adds IOAM TLV in the SRH. Based on the size of
the segment list (SL), the ingress node preallocates space in the
IOAM TLV.

If IOAM data from the last node in the segment-list (Egress node) is
desired, the ingress uses an Ultimate Segment Pop (USP) SID
advertised by the Egress node.

The ingress node may also insert the IOAM data about the local
information in the IOAM TLV in the SRH at index 0 of the preallocated
IOAM TLV.

4.2. Intermediate 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. As part
of the SR Header processing as described in [I-D.ietf-6man-segment-
routing-header] and [I-D.ietf-spring-srv6-network-programming], the
SR Segment Endpoint node performs the following IOAM operations.

If an intermediate SR segment endpoint node is not capable of
processing IOAM TLV, it simply ignores it. I.e., it does not have to
look or process SRH TLV.

If an intermediate SR segment endpoint node is capable of processing
IOAM TLV and the local SID supports IOAM data recording, it checks if
any SRH TLV is present in the packet using procedures defined in [I-
D.ietf-6man-segment-routing-header]. If the node finds IOAM TLV in
the SRH it finds the local index at which it is expected to record
the IOAM data. The local index is found using the SRH.SL field. The

node records the IOAM data at the desired preallocated space.

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 by the Ingress node.

   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 may telemeter the IOAM data to an
   external entity.

5. IANA Considerations

   IANA is requested to allocate a mutable 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 Greater | TLV for IOAM Data Fields | This document |
    | than 128     |                          |               |
    +--------------+--------------------------+---------------+
```

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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