

SPRING Working Group  
Internet-Draft  
Intended status: Standards Track  
Expires: July 12, 2022

Z. Ali  
R. Gandhi  
C. Filsfils  
F. Brockners  
N. Nainar  
C. Pignataro  
Cisco Systems, Inc.  
C. Li  
M. Chen  
Huawei  
G. Dawra  
LinkedIn  
January 12, 2022

**Segment Routing Header encapsulation for In-situ OAM Data**  
**draft-ali-spring-ioam-srv6-05**

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](#).

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at <https://datatracker.ietf.org/drafts/current/>.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on July 12, 2022.

Copyright Notice

Copyright (c) 2019 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to [BCP 78](#) and the IETF Trust's Legal

Provisions Relating to IETF Documents

(<https://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

## Table of Contents

<a href="#">1.</a>	<a href="#">Introduction . . . . .</a>	<a href="#">2</a>
<a href="#">2.</a>	<a href="#">Conventions . . . . .</a>	<a href="#">3</a>
<a href="#">2.1.</a>	<a href="#">Requirement Language . . . . .</a>	<a href="#">3</a>
<a href="#">2.2.</a>	<a href="#">Abbreviations . . . . .</a>	<a href="#">3</a>
<a href="#">3.</a>	<a href="#">OAM Metadata Piggybacked in Data Packets . . . . .</a>	<a href="#">4</a>
<a href="#">3.1.</a>	<a href="#">IOAM Data Field Encapsulation in SRH . . . . .</a>	<a href="#">4</a>
<a href="#">4.</a>	<a href="#">Procedure . . . . .</a>	<a href="#">5</a>
<a href="#">4.1.</a>	<a href="#">Ingress Node . . . . .</a>	<a href="#">5</a>
<a href="#">4.2.</a>	<a href="#">SR Segment Endpoint Node . . . . .</a>	<a href="#">5</a>
<a href="#">4.3.</a>	<a href="#">Egress Node . . . . .</a>	<a href="#">6</a>
<a href="#">5.</a>	<a href="#">IANA Considerations . . . . .</a>	<a href="#">6</a>
<a href="#">6.</a>	<a href="#">Security Considerations . . . . .</a>	<a href="#">6</a>
<a href="#">7.</a>	<a href="#">Acknowledgements . . . . .</a>	<a href="#">6</a>
<a href="#">8.</a>	<a href="#">References . . . . .</a>	<a href="#">7</a>
<a href="#">8.1.</a>	<a href="#">Normative References . . . . .</a>	<a href="#">7</a>
<a href="#">8.2.</a>	<a href="#">Informative References . . . . .</a>	<a href="#">7</a>
	<a href="#">Authors' Addresses . . . . .</a>	<a href="#">8</a>

## [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. Specifically, 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 hardware friendly based on the intermediate endpoint capability. 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). This also enable collection of IOAM data only from segment endpoint.

#### 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.

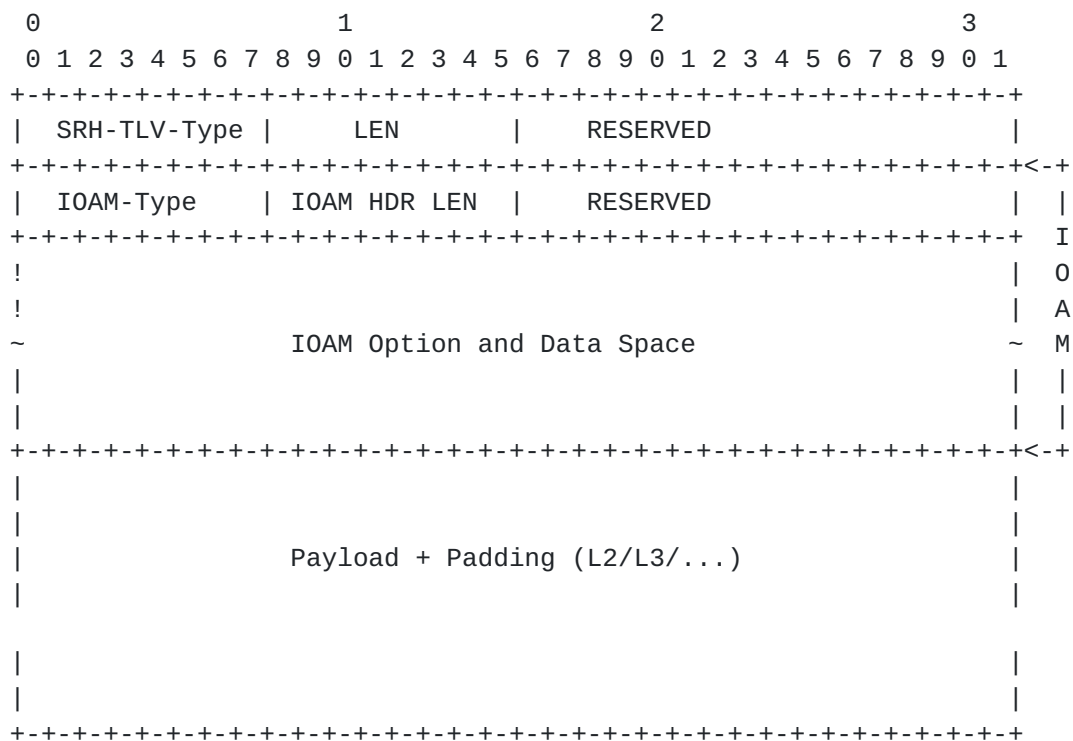


Figure 1: IOAM data encapsulation in SRH

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 than 128	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**

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), DOI 10.17487/RFC2119, March 1997.
- [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in [RFC 2119](#) Key Words", [RFC 8174](#), May 2017.
- [I-D.spring-srv6-network-programming] Filsfils, C. et al. "SRv6 Network Programming", [draft-filsfils-spring-srv6-network-programming](#), work in progress.
- [I-D.6man-segment-routing-header] Previdi, S., Filsfils, C. et al, "IPv6 Segment Routing Header (SRH)", [draft-ietf-6man-segment-routing-header](#), work in progress.
- [I-D.ietf-ippm-ioam-data] Brockners, F., Bhandari, S., Pignataro, C., Gredler, H., Leddy, J., Youell, S., Mizrahi, T., Mozes, D., Lapukhov, P., Chang, R., and Bernier, D., "Data Fields for In-situ OAM", [draft-ietf-ippm-ioam-data](#), work in progress.
- [I-D.spring-segment-routing-policy] Filsfils, C., et al., "Segment Routing Policy Architecture", [draft-ietf-spring-segment-routing-policy](#), work in progress.

### **8.2. Informative References**

- [I-D.6man-extension-header-insertion] D. Voyer, et al., "Insertion of IPv6 Segment Routing Headers in a Controlled Domain", [draft-voyer-6man-extension-header-insertion](#), work in progress.



Authors' Addresses

Zafar Ali  
Cisco Systems, Inc.  
  
Email: zali@cisco.com

Rakesh Gandhi  
Cisco Systems, Inc.  
Canada  
  
Email: rgandhi@cisco.com

Clarence Filsfils  
Cisco Systems, Inc.  
Belgium  
  
Email: cf@cisco.com

Frank Brockners  
Cisco Systems, Inc.  
Germany  
  
Email: fbrockne@cisco.com

Nagendra Kumar Nainar  
Cisco Systems, Inc.  
  
Email: naikumar@cisco.com

Carlos Pignataro  
Cisco Systems, Inc.  
  
Email: cpignata@cisco.com

Cheng Li  
Huawei  
  
Email: chengli13@huawei.com

Mach(Guoyi) Chen  
Huawei  
  
Email: mach.chen@huawei.com

Gaurav Dawra  
LinkedIn

Email: [gdawra.ietf@gmail.com](mailto:gdawra.ietf@gmail.com)

Ali, et al.

[Page 8]