

SPRING
Internet-Draft
Intended status: Standards Track
Expires: December 5, 2021

Y.Qiu
J.Ye
H.Li
H3C Technology Co.LTD
June 3, 2021

**Data Fields Encapsulation Model of In-situ OAM in SRv6 Network
draft-qiu-spring-srv6-ioam-encap-model-00**

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 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 the data fields encapsulation model of IOAM TLV in SRv6 network.

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 15, 2021.

Copyright Notice

Copyright (c) 2020 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

1.	Introduction	3
2.	Conventions	3
2.1.	Requirement Language	3
2.2.	Abbreviations	3
3.	Data Encapsulation Model of In-situ OAM	4
3.1.	Pipe Model	4
3.2.	Uniform Model	5
4.	In-situ OAM Process Example For Uniform Model	5
5.	In-situ OAM Process Example For Pipe Model	6
6.	IANA Considerations	7
7.	Security Considerations	8
8.	Acknowledgements	8
9.	References	8
9.1.	Normative References	8
9.2.	Informative References	8
	Authors' Addresses	9

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 the data fields encapsulation model of IOAM TLV for the Segment Routing headend with H.Encaps encapsulation behavior in SRv6 network.

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", "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.

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

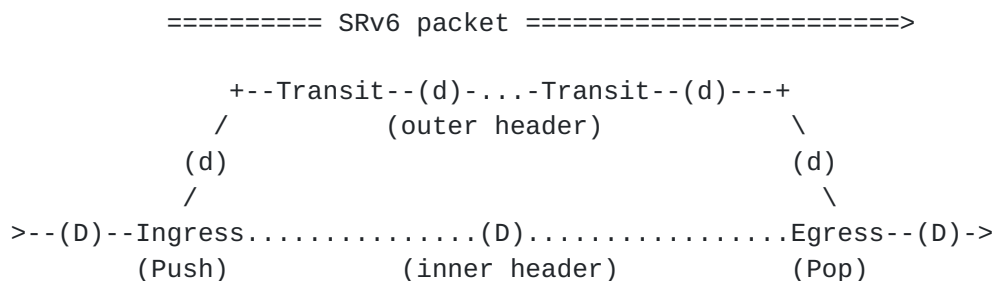
3. Data Encapsulation Model of In-situ OAM

The encapsulation format of IOAM TLV and where to fill it in SRv6 network are already defined in [I-D.[draft-ali-spring-ioam-srv6](#)]. It elaborates on the process of encapsulating IOAM data by individual nodes of SRv6. However, it lacks a process for how to perform IOAM detection when encapsulating an SRv6 packet, For example, in inter-AS scenarios and in scenarios exist to protect tunnel paths.

This document defines two models for IOAM data fields encapsulation operation: Pipe and Uniform Models.

3.1. Pipe Model

In the Pipe Model, the SRv6 network acts like a circuit when IOAM data packets traverse the network such that only the IOAM data of ingress and egress nodes are collected to report to analyzer with the same Flow Monitoring Identification (FlowMonID) and same type. It means that only ingress node and egress node of SRv6 network are visible to the analyzer. The analyzer can only calculate the end-to-end performance of the SRv6 network.



(d) represents the data field values in the outer SRH

(D) represents the data field values in the encapsulated header

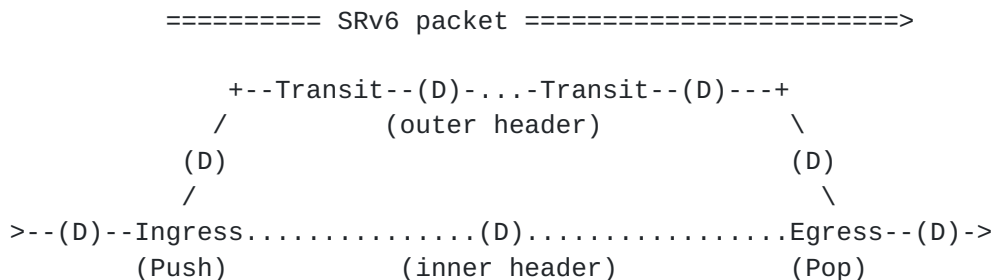
This picture shows data field encapsulation method of In-situ OAM processing in the Pipe Model. The outer IOAM data fields in packet have no relationship to the inner.

The network nodes encapsulate IOAM TLV according to local configuration with a new FlowMonID and a new IOAM-Trace-Type value, and do not care about the IOAM information that is already carried in the packet.

The Pipe model is more suitable for end-to-end measurement scenarios, since the intermediate router does not need to collect and report data.

3.2. Uniform Model

In the Uniform Model, all the nodes collect IOAM data according to the same IOAM-Trace-Type, and report IOAM data to analyzer with the same FlowMonID. So the analyzer can calculate hop-by-hop forwarding performance based on the IOAM data received from all nodes in the SRv6 network.



(D) represents the data field values in the corresponding IOAM TLV

This picture shows data field encapsulation of In-situ OAM processing for a Uniform Model.

With the Uniform model, the inner and outer IOAM data-fields are synchronized, including FlowMonID IOAM-trace-Type IOAM-option-Types, etc. The contents of IOAM fields are uniform before and after tunnel encapsulation. The easy way to do it is to copy directly from the inner IOAM TLV.

Uniform model is suitable for postcard IOAM in Hop-by-Hop measurement scenario. Because cannot see how many routers are contained in another autonomous system in inter-AS scenario, Uniform mode is not applicable to passport IOAM measurement. Postcard IOAM measurement in inter-AS scenario is outside the scope of this document.

4. In-situ OAM Process Example For Uniform Model

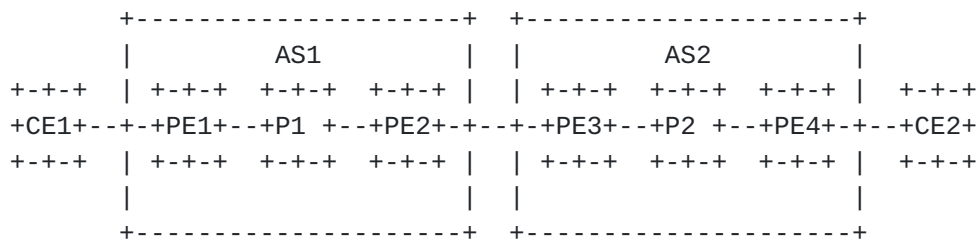


Figure 1: Example Inter-AS Scenario of In-situ OAM

This figure shows an example of In-situ OAM used in across SRv6 autonomous systems. PE1, P1 and PE2 are SRv6-capable nodes in autonomous system AS1. PE3, P2, PE4 are SRv6-capable nodes in autonomous system AS2. An SRv6 instantiation of a Binding SID (BSID) of PE3 is used to cross autonomous system. When the traffic is sent from CE1 to CE2, the process is:

- 1) PE1 receives the packets and encapsulates SRH with a list of segments destined to BSID of PE3, which is instantiated as an ordered list of SRv6 SIDs <PE1, P1, PE2, BSID>. As part of the SRH encapsulation, AS1's ingress node PE1 adds IOAM TLV to the SRH of the packets. The IOAM TLV contains FlowMonID and IOAM-trace-Type fields. The FlowMonID is used to identify a monitored flow. IOAM-Trace-Type is a 24-bit identifier which specifies which data types are used in this node.
- 2) When the packet flow arrives in P1, P1 collects the IOAM data based on the IOAM-trace-Type field in IOAM TLV of the packet, and reports the collected data to the analyzer.
- 3) When the packet flow arrives in PE3, PE3 also collects IOAM data based on the IOAM-trace-Type field in IOAM TLV of packet, and reports the collected data to the analyzer. After that PE3 matches Binding SID with H.encaps behavior, and pushes a outer IPv6 header with its own SRH according SRv6 policy of BSID, which contains an SID list {PE3, P2, PE4}.
- 4) PE3 encapsulates an outer IOAM TLV to SRH in the outer IPv6 header according local configuration and the data fields of IOAM TLV carried in packet. The outer IOAM data-fields synchronize IOAM information from the inner IOAM TLV, such as FlowMonID, IOAM-trace-Type, IOAM-option-Types and so on.
- 5) When the packet flow arrives in P2, the routers in AS2 collect IOAM data based on the IOAM-trace-Type in IOAM TLV of the outer SRH.
- 6) PE4 removes the outer IPv6 header, and recovers the inner packet. Subsequent devices continue to forward packet according to the inner IPv6 header and collect IOAM data according to the inner IOAM TLV.

Because the same FlowMonID is used throughout the forward path across multiple autonomous systems, the analyzer detects and identifies anomalies in the network based on the collected data reported by each of the devices, so as to accurately detect the delay and packet loss of each service, making the network quality service level agreement (SLA) visible in real time, and achieving rapid fault delimitation and location.

5. In-situ OAM Process Example For Pipe Model

The Pipe model is also illustrated using Figure 1. When the traffic is sent from CE1 to CE2, the process is:

- 1) PE1 receives the packets and encapsulates SRH with a list of segments destined to BSID of PE3, which is instantiated as an ordered list of SRv6 SIDs <PE1, P1, PE2, BSID>. As part of the SRH encapsulation, AS1's ingress node PE1 adds IOAM TLV to the SRH of the packets.
- 2) When the packet flow arrives in P1 and PE2, P1 and PE2 collect the IOAM data based on the IOAM-trace-Type field in IOAM TLV of the packet, and report the collected data to the analyzer.
- 3) When the packet flow arrives in PE3, PE3 also collects IOAM data based on the IOAM-trace-Type field in IOAM TLV of packet, and reports the collected data to the analyzer. After that PE3 matches Binding SID with H.encaps behavior, and pushes a outer IPv6 header with its own SRH according SRv6 policy of BSID, which contains an SID list {PE3, P2, PE4}.
- 4) If configuration requires, PE3 identifies target traffic flow that require IOAM detection based on the local configuration, and encapsulates the IOAM TLV in the outer SRH. Then PE3 assigns a new FlowMonID to the target flow, populates the IOAM data fields with the new IOAM-trace-Type and IOAM-option-Types.
- 5) When the packet flow arrives in P2, the routers in AS2 collect IOAM data based on the IOAM-trace-Type in IOAM TLV of the outer SRH.
- 6) PE4 removes the outer IPv6 header, and recovers the inner packet. Subsequent devices continue to forward packet according to the inner IPv6 header and collect IOAM data according to the inner IOAM TLV.

Because the two AS's use different FlowMonIDs for the same flow, according to the FlowMonID identified by PE1, the analyzer can only calculate the forwarding performance of this flow between PE3 and PE4 in AS2. It is not possible to measure performance data between other nodes in AS2.

6. IANA Considerations

No requirements for IANA.

7. Security Considerations

TBA

8. Acknowledgements

The authors would like to thank people for their comments to this work.

9. References

9.1. 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>>.
- [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>>.
- [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.[draft-ali-spring-ioam-srv6](#)] Ali, Z., Gandhi, R., Filsfils, C., Brockners, F., Nainar, N., Pignataro, C., Li, C., Chen, M., Dawra, G., "Segment Routing Header encapsulation for In-situ OAM Data", [draft-ali-spring-ioam-srv6](#), work in progress.

9.2. 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.
- [I-D.ietf-6man-ipv6-alt-mark] Fioccola, G., Zhou, T., Cociglio, M., Qin, F., and R. Pang, "IPv6 Application of the Alternate Marking Method", [draft-ietf-6man-ipv6-alt-mark-04](#) (work in progress), March 2021.

Authors' Addresses

Yuanxiang Qiu
H3C Technology Co.LTD, No.466 Changhe Rd.
Hangzhou 310008
China

Email: qiuyuanxiang@h3c.com

Jinrong Ye
H3C Technology Co.LTD

Email: jrong.y@h3c.com

Hao Li
H3C Technology Co.LTD

Email: lihao@h3c.com