

ippm  
Internet-Draft  
Intended status: Standards Track  
Expires: May 23, 2021

F. Brockners, Ed.  
Cisco  
S. Bhandari  
Thoughtspot  
V. Govindan  
C. Pignataro, Ed.  
N. Nainar, Ed.  
Cisco  
H. Gredler  
RtBrick Inc.  
J. Leddy  
  
S. Youell  
JMPC  
T. Mizrahi  
Huawei Network.IO Innovation Lab  
P. Lapukhov  
Facebook  
B. Gafni  
A. Kfir  
Mellanox Technologies, Inc.  
M. Spiegel  
Barefoot Networks, an Intel company  
November 19, 2020

Geneve encapsulation for In-situ OAM Data  
draft-brockners-ippm-ioam-geneve-05

Abstract

In-situ Operations, Administration, and Maintenance (IOAM) records operational and telemetry information in the packet while the packet traverses a path between two points in the network. This document proposes a new Geneve tunnel option and outlines how IOAM data fields are carried in the option data field.

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 May 23, 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 . . . . .	2
2. Conventions . . . . .	3
2.1. Requirement Language . . . . .	3
2.2. Abbreviations . . . . .	3
3. IOAM Data Field Encapsulation in Geneve . . . . .	3
4. Considerations . . . . .	5
4.1. Discussion of the encapsulation approach . . . . .	5
4.2. IOAM and the use of the Geneve O-bit . . . . .	6
4.3. Transit devices . . . . .	6
4.4. Additional Encapsulation Consideration . . . . .	7
5. IANA Considerations . . . . .	7
6. Security Considerations . . . . .	7
7. Acknowledgements . . . . .	7
8. Normative References . . . . .	7
Authors' Addresses . . . . .	8

#### 1. Introduction

In-situ OAM (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 is being sent within packets specifically dedicated to OAM. This document proposes a new Geneve tunnel option and defines how IOAM data fields are transported as part of the

tunnel option in the Geneve [I-D.ietf-nvo3-geneve] encapsulation. The IOAM data fields are defined in [I-D.ietf-ippm-ioam-data].

## 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].

### 2.2. Abbreviations

Abbreviations used in this document:

IOAM: In-situ Operations, Administration, and Maintenance

OAM: Operations, Administration, and Maintenance

Geneve: Generic Network Virtualization Encapsulation

## 3. IOAM Data Field Encapsulation in Geneve

Geneve is defined in [I-D.ietf-nvo3-geneve]. When Geneve encapsulation header is used, IOAM data fields can either be carried after the Geneve header, identified by the next protocol field or can be carried in the Geneve header itself as a tunnel option. The former approach is defined in [I-D.weis-ippm-ioam-eth] while the latter approach is defined in this document.

IOAM data fields are carried using a single Geneve Option Class TBD\_IOAM. The different IOAM data fields defined in [I-D.ietf-ippm-ioam-data] are added as TLVs using that Geneve Option Class. In an administrative domain where IOAM is used, insertion of the IOAM header in Geneve is enabled at the Geneve tunnel endpoints, which also serve as IOAM encapsulating/decapsulating nodes by means of configuration.

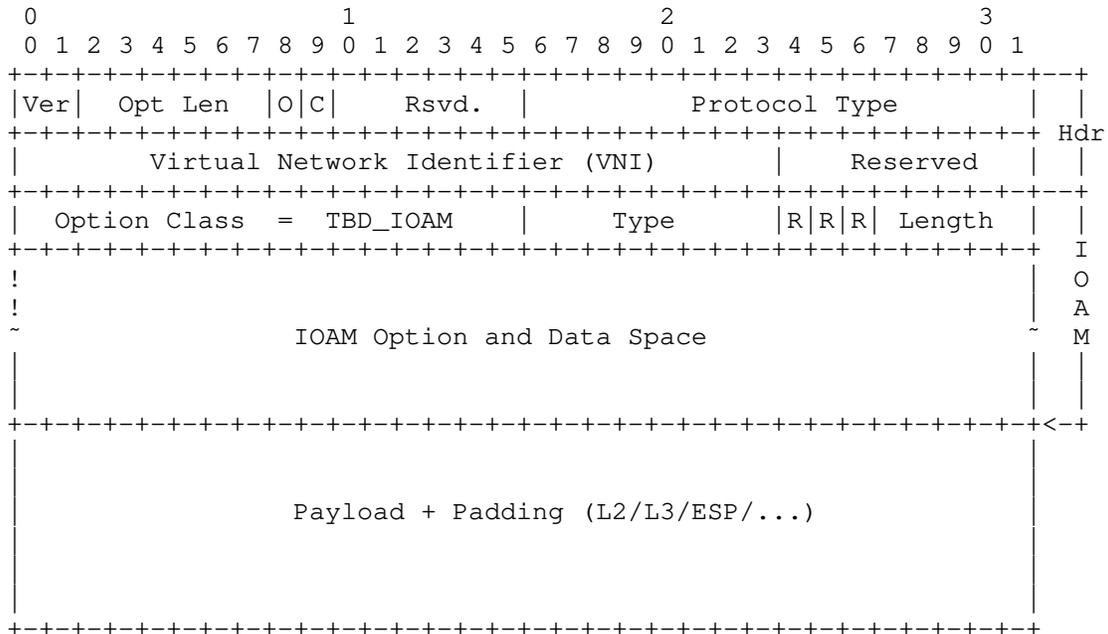


Figure 1: IOAM data encapsulation in Geneve

The Geneve header and fields are defined in [I-D.ietf-nvo3-geneve]. The Geneve Option Class value for use with IOAM is TBD\_IOAM.

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

**Option Class:** 16-bit unsigned integer that determines the IOAM option class. The value is from the IANA registry setup for Geneve option classes as defined in [I-D.ietf-nvo3-geneve].

**Type:** 8-bit field defining the IOAM Option type, as defined in Section 7.2 of [I-D.ietf-ippm-ioam-data]. The 'C' bit MUST be set to zero.

**R (3 bits):** Option control flags reserved for future use. The flags MUST be set to zero on transmission and ignored on receipt.

**Length:** 5-bit unsigned integer. Length of the IOAM HDR in 4-octet units.

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

Multiple distinct IOAM Option-Types MAY be included within the same Geneve encapsulation. Each IOAM Option-Type MUST occur at most once within the same Geneve encapsulation. For example, if a Geneve encapsulation contains two IOAM Option-Types before a data payload, there would be two fields with TBD\_IOAM Option Class each, differentiated by the Type field which specifies the type of the IOAM data included.

#### 4. Considerations

This section summarizes a set of considerations on the overall approach taken for IOAM data encapsulation in Geneve, as well as deployment considerations.

##### 4.1. Discussion of the encapsulation approach

This section is to support the working group discussion in selecting the most appropriate approach for encapsulating IOAM data fields in Geneve.

An encapsulation of IOAM data fields in Geneve should be friendly to an implementation in both hardware as well as software forwarders and support a wide range of deployment cases, including large networks that desire to leverage multiple IOAM data fields at the same time.

Hardware and software friendly implementation: Hardware forwarders benefit from an encapsulation that minimizes iterative look-ups of fields within the packet: Any operation which looks up the value of a field within the packet, based on which another lookup is performed, consumes additional gates and time in an implementation - both of which are desired to be kept to a minimum. This means that flat TLV structures are to be preferred over nested TLV structures. IOAM data fields are grouped into three option categories: Trace, proof-of-transit, and edge-to-edge. Each of these three options defines a TLV structure. A hardware-friendly encapsulation approach avoids grouping these three option categories into yet another TLV structure, but would rather carry the options as a serial sequence.

Total length of the IOAM data fields: The total length of IOAM data can grow quite large in case multiple different IOAM data fields are used and large path-lengths need to be considered. If for example an operator would consider using the IOAM trace option and capture node-id, app\_data, egress/ingress interface-id, timestamp seconds, timestamps nanoseconds at every hop, then a total of 20 octets would be added to the packet at every hop. In case this particular deployment would have a maximum path length

of 15 hops in the IOAM domain, then a maximum of 300 octets of IOAM data were to be encapsulated in the packet.

Concerns with the current encapsulation approach:

Hardware support: Using Geneve tunnel options to encapsulate IOAM data fields leads to a nested TLV structure. Each IOAM data field option (trace, proof-of-transit, and edge-to-edge) represents a type, with the different IOAM data fields being TLVs within this the particular option type. Nested TLVs require iterative look-ups, a fact that creates potential challenges for implementations in hardware. It would be desirable to offer a way to encapsulate IOAM in a way that keeps TLV nesting to a minimum.

Length: Geneve tunnel option length is a 5-bit field in the current specification [I-D.ietf-nvo3-geneve] resulting in a maximum option length of 128 ( $2^5 \times 4$ ) octets which constrains the use of IOAM to either small domains or a few IOAM data fields only. Support for large domains with a variety of IOAM data fields would be desirable.

#### 4.2. IOAM and the use of the Geneve O-bit

[I-D.ietf-nvo3-geneve] defines an "O bit" for Control packets. Per [I-D.ietf-nvo3-geneve] the O bit indicates that the packet contains a control message instead of data payload. Packets that carry IOAM data fields in addition to regular data payload / customer traffic must not set the O bit. Packets that carry only IOAM data fields without any payload must set the O bit.

#### 4.3. Transit devices

If IOAM is deployed in domains where UDP port numbers are not controlled and do not have a domain-wide meaning, such as on the global Internet, transit devices MUST NOT attempt to modify the IOAM data contained in the IOAM option class. In case UDP port numbers are not controlled there might be UDP packets, which leverage the UDP port number that Geneve utilizes, i.e. 6081, but the payload of these packets isn't Geneve. The scenario and associated reasoning is discussed in [RFC7605] which states that "it is important to recognize that any interpretation of port numbers -- except at the endpoints -- may be incorrect, because port numbers are meaningful only at the endpoints."

#### 4.4. Additional Encapsulation Consideration

Geneve encapsulation header supports carrying IOAM data fields either as part of the tunnel option or as the protocol data unit that follows the Geneve header. An operator may choose to enable either of the options but it is not recommended to include both in the same data packet.

#### 5. IANA Considerations

IANA is requested to allocate a Geneve "option class" numbers for IOAM:

Option Class	Description	Reference
x	TBD_IOAM	This document

#### 6. Security Considerations

The security considerations of Geneve are discussed in [I-D.ietf-nvo3-geneve], 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 Eric Vyncke, Nalini Elkins, Srihari Raghavan, Ranganathan T S, Karthik Babu Harichandra Babu, Akshaya Nadahalli, Stefano Previdi, Hemant Singh, Erik Nordmark, LJ Wobker, Andrew Yourtchenko and Nagendra Kumar Nainar for the comments and advice.

#### 8. Normative References

[I-D.ietf-ippm-ioam-data]  
 Brockners, F., Bhandari, S., and T. Mizrahi, "Data Fields for In-situ OAM", draft-ietf-ippm-ioam-data-10 (work in progress), July 2020.

[I-D.ietf-nvo3-geneve]

Gross, J., Ganga, I., and T. Sridhar, "Geneve: Generic Network Virtualization Encapsulation", draft-ietf-nvo3-geneve-16 (work in progress), March 2020.

[I-D.weis-ippm-ioam-eth]

Weis, B., Brockners, F., Hill, C., Bhandari, S., Govindan, V., Pignataro, C., Gredler, H., Leddy, J., Youell, S., Mizrahi, T., Kfir, A., Gafni, B., Lapukhov, P., and M. Spiegel, "EtherType Protocol Identification of In-situ OAM Data", draft-weis-ippm-ioam-eth-04 (work in progress), May 2020.

[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>>.

[RFC2784] Farinacci, D., Li, T., Hanks, S., Meyer, D., and P. Traina, "Generic Routing Encapsulation (GRE)", RFC 2784, DOI 10.17487/RFC2784, March 2000, <<https://www.rfc-editor.org/info/rfc2784>>.

[RFC3232] Reynolds, J., Ed., "Assigned Numbers: RFC 1700 is Replaced by an On-line Database", RFC 3232, DOI 10.17487/RFC3232, January 2002, <<https://www.rfc-editor.org/info/rfc3232>>.

[RFC7605] Touch, J., "Recommendations on Using Assigned Transport Port Numbers", BCP 165, RFC 7605, DOI 10.17487/RFC7605, August 2015, <<https://www.rfc-editor.org/info/rfc7605>>.

#### Authors' Addresses

Frank Brockners (editor)  
Cisco Systems, Inc.  
Hansaallee 249, 3rd Floor  
DUESSELDORF, NORDRHEIN-WESTFALEN 40549  
Germany

Email: [fbrockne@cisco.com](mailto:fbrockne@cisco.com)

Shwetha Bhandari  
Thoughtspot  
3rd Floor, Indiqube Orion, 24th Main Rd, HSR Layout  
Bangalore, KARNATAKA 560 102  
India

Email: shwetha.bhandari@thoughtspot.com

Vengada Prasad Govindan  
Cisco Systems, Inc.

Email: venggovi@cisco.com

Carlos Pignataro (editor)  
Cisco Systems, Inc.  
7200-11 Kit Creek Road  
Research Triangle Park, NC 27709  
United States

Email: cpignata@cisco.com

Nagendra Kumar Nainar (editor)  
Cisco Systems, Inc.  
7200-11 Kit Creek Road  
Research Triangle Park, NC 27709  
United States

Email: naikumar@cisco.com

Hannes Gredler  
RtBrick Inc.

Email: hannes@rtbrick.com

John Leddy  
United States

Email: john@leddy.net

Stephen Youell  
JP Morgan Chase  
25 Bank Street  
London E14 5JP  
United Kingdom

Email: [stephen.youell@jpmorgan.com](mailto:stephen.youell@jpmorgan.com)

Tal Mizrahi  
Huawei Network.IO Innovation Lab  
Israel

Email: [tal.mizrahi.phd@gmail.com](mailto:tal.mizrahi.phd@gmail.com)

Petr Lapukhov  
Facebook  
1 Hacker Way  
Menlo Park, CA 94025  
US

Email: [petr@fb.com](mailto:petr@fb.com)

Barak Gafni  
Mellanox Technologies, Inc.  
350 Oakmead Parkway, Suite 100  
Sunnyvale, CA 94085  
U.S.A.

Email: [gbarak@mellanox.com](mailto:gbarak@mellanox.com)

Aviv Kfir  
Mellanox Technologies, Inc.  
350 Oakmead Parkway, Suite 100  
Sunnyvale, CA 94085  
U.S.A.

Email: [avivk@mellanox.com](mailto:avivk@mellanox.com)

Mickey Spiegel  
Barefoot Networks, an Intel company  
4750 Patrick Henry Drive  
Santa Clara, CA 95054  
US

Email: [mickey.spiegel@intel.com](mailto:mickey.spiegel@intel.com)