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EtherType Protocol Identification for In-situ OAM Data

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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

defines an EtherType that identifies IOAM data fields as being the

next protocol in a packet, and a header that encapsulates the IOAM

data fields.

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Weis, et al. Expires August 25, 2022 [Page 1]

Internet-Draft EtherType IOAM February 2022

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Table of Contents

1. Introduction . . . . . . . . . . . . . . . . . . . . . . . . 2

2. Conventions . . . . . . . . . . . . . . . . . . . . . . . . . 3

2.1. Requirements Language . . . . . . . . . . . . . . . . . . 3

2.2. Abbreviations . . . . . . . . . . . . . . . . . . . . . . 3

3. IOAM EtherType . . . . . . . . . . . . . . . . . . . . . . . 3

4. Usage Examples of the IOAM EtherType . . . . . . . . . . . . 4

4.1. Example: GRE Encapsulation of IOAM Data Fields . . . . . 5

4.2. Example: Geneve Encapsulation of IOAM Data Fields . . . . 6

5. Security Considerations . . . . . . . . . . . . . . . . . . . 7

6. IANA Considerations . . . . . . . . . . . . . . . . . . . . . 8

7. Acknowledgements . . . . . . . . . . . . . . . . . . . . . . 8

8. References . . . . . . . . . . . . . . . . . . . . . . . . . 8

8.1. Normative References . . . . . . . . . . . . . . . . . . 8

8.2. Informative References . . . . . . . . . . . . . . . . . 9

Authors' Addresses . . . . . . . . . . . . . . . . . . . . . . . 9

1. Introduction

In-situ Operations, Administration, and Maintenance (IOAM) records

operational and telemetry information in the packet while the packet

traverses a particular IOAM domain within a network. The term "in-situ" refers to

Weis, et al. Expires August 25, 2022 [Page 2]

Internet-Draft EtherType IOAM February 2022

the fact that the IOAM data fields are added to the data packets

rather than being sent within packets specifically dedicated to OAM.

This document proposes a new Ethertype for IOAM and defines how IOAM

data fields are carried as part of encapsulations where the IOAM data

fields follow an encapsulation header that uses an EtherType to

denote the type of protocol data unit. Examples of these protocols

are GRE [RFC2784] [RFC2890] and Geneve [RFC8926]). This document

outlines how IOAM data fields are encoded in these encapsulation

headers.

2. Conventions

2.1. Requirements 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:

E2E: Edge-to-Edge

Geneve: Generic Network Virtualization Encapsulation

GRE: Generic Routing Encapsulation

IOAM: In-situ Operations, Administration, and Maintenance

OAM: Operations, Administration, and Maintenance

POT: Proof of Transit

3. IOAM EtherType

When IOAM data fields are included within an encapsulation that

identifies the next protocol using an EtherType (e.g., GRE or Geneve)

the presence of IOAM data fields are identified with TBD\_IOAM. When

this EtherType is used, an additional IOAM header is inserted before the ethernet frame.

This header indicates the type of IOAM data fields that follows, and

the next protocol that follows the IOAM data fields.

Weis, et al. Expires August 25, 2022 [Page 3]

Internet-Draft EtherType IOAM February 2022

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

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

| IOAM-Type | IOAM HDR len| Next Protocol |

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

! |

! |

~ IOAM Option and Data Space ~

| |

| |

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

The IOAM encapsulation is defined as follows.

IOAM Type: 8-bit field defining the IOAM Option type, as defined in

Section 5.1 of [rfc9197].

IOAM HDR Len: 8 bit Length field contains the length of the IOAM

header in 4-octet units.

Next Protocol: 16 bits Next Protocol Type field contains the

protocol type of the protocol data unit following IOAM protocol

header. Protocol Type is defined to be an EtherType value from

[ETYPES]. An implementation receiving a packet containing a

Protocol Type which is not listed in one of those registries

SHOULD discard the frame.

IOAM Option and Data Space: IOAM option header and data is present

as specified by the IOAM-Option-Type field, and is defined in

Section 5 of [rfc9197].

Multiple IOAM options MAY be included within the encapsulation

header. For example, if a GRE encapsulation contains two IOAM

options before the data payload, the Next Protocol field of the first

IOAM option will contain the value of TBD\_IOAM, while the Next

Protocol field of the second IOAM option will contain the EtherType

indicating the type of the data payload.

4. Usage Examples of the IOAM EtherType

The IOAM EtherType can be used with any encapsulation that uses

EtherType to denote the type of the protocol data unit. The

following sections show how it can be used when GRE and Geneve are

used as the encapsulation header.

Weis, et al. Expires August 25, 2022 [Page 4]

Internet-Draft EtherType IOAM February 2022

4.1. Example: GRE Encapsulation of IOAM Data Fields

When IOAM data fields are carried in GRE, the IOAM encapsulation

defined above follows the GRE header and is inserted before the ethernet or IP header, as shown in Figure 1.

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

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+<-+

|C| |K|S| Reserved0 | Ver | Protocol Type = <TBD\_IOAM> | |

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+ |

| Checksum (optional) | Reserved1 (Optional) | G

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+ R

| Key (optional) | E

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+ |

| Sequence Number (Optional) | |

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+<-+

| IOAM-Type | IOAM HDR len| Next Protocol | |

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+ I

! | O

! | A

~ IOAM Option and Data Space ~ M

| | |

| | |

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+<-+

| |

| Payload + Padding (L2/L3/ESP/...) |

| |

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

Figure 1: GRE Encapsulation Example

The GRE header and fields are defined in [RFC2890]. GRE can carry ethernet or IP payload. The GRE Protocol

Type value is set to TBD\_IOAM.

Figure 2 shows two example protocol header stacks that use GRE along

with IOAM. IOAM Option-Types (the below diagram uses "IOAM" as

shorthand for IOAM Option-Types) are sequenced in behind the GRE

header that follows the "outer" header of the next protocol unit.

Weis, et al. Expires August 25, 2022 [Page 5]

Internet-Draft EtherType IOAM February 2022

Example 1 Example 2

| ... | | ... |

+----------------+ +----------------+

| TCP/UDP header | | IP, ... |

+----------------+ +----------------+

| IP header | | Eth. header |

+----------------+ +----------------+

| IOAM | | IOAM |

+----------------+ +----------------+

| GRE header | | GRE header |

+----------------+ +----------------+

| IP header | | IP header |

+----------------+ +----------------+

| Layer 2 | | Layer 2 |

+----------------+ +----------------+

| Layer 1 | | Layer 1 |

+----------------+ +----------------+

Figure 2: GRE with IOAM examples

4.2. Example: Geneve Encapsulation of IOAM Data Fields

When IOAM data fields are carried in Geneve, the IOAM encapsulation

defined above follows the Geneve header, as shown in Figure 3.

Weis, et al. Expires August 25, 2022 [Page 6]

Internet-Draft EtherType IOAM February 2022

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

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+<-+

|Ver| Opt Len |O|C| Rsvd. | Protocol Type = <TBD\_IOAM> | |G

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+ |E

| Virtual Network Identifier (VNI) | Reserved | |N

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+ |E

| Variable Length Options | |V

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+<-+E

| IOAM-Type | IOAM HDR len| Next Protocol | |

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+ I

! | O

! | A

~ IOAM Option and Data Space ~ M

| | |

| | |

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+<-+

| |

| Inner header + Payload + Padding (L2/L3/ESP/...) |

| |

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

Figure 3: Geneve Encapsulation Example

The Geneve header and fields are defined in [RFC8926]. The Geneve

Protocol Type value is TBD\_IOAM.

5. Security Considerations

This document describes the encapsulation of IOAM data fields in the

encapsulation header such as GRE and Geneve that uses EtherType to

denote the protocol data unit. Security considerations of the

specific IOAM data fields for each case (i.e., Trace, Proof of

Transit, and E2E) are described in [section 9 of rfc9197].

As this document describes new protocol fields within the existing

encapsulation, any security considerations of the respective

encapsulation header is applicable. When the encapsulation is GRE,

the security considerations of [RFC2890] is applicable. When the

encapsulation is Geneve, the security considerations of [RFC8926] is

applicable.

IOAM data fields SHOULD be integrity protected (e.g., with

[I-D.ietf-ippm-ioam-data-integrity]) to detect changes made by a

device between the IOAM encapsulating node and the IOAM decapsulating

node.

Weis, et al. Expires August 25, 2022 [Page 7]

Internet-Draft EtherType IOAM February 2022

6. IANA Considerations

A new EtherType value is requested to be added to the [ETYPES] IANA

"IEEE 802 Numbers" registry. The description should be

"In-situ OAM (IOAM)".

7. Acknowledgements

We would like to thank Nagendra Kumar Nainar for the contribution.

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Weis, et al. Expires August 25, 2022 [Page 9]

Internet-Draft EtherType IOAM February 2022

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Weis, et al. Expires August 25, 2022 [Page 10]

Internet-Draft EtherType IOAM February 2022

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Weis, et al. Expires August 25, 2022 [Page 11]