Network Working Group T.
Mizrahi
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Huawei
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Iurman
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ULiege
F.
Brockners

Cisco
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In Situ OAM Profile for the Linux Kernel Implementation
draft-mizrahi-ippm-ioam-linux-profile-00

Abstract

In Situ Operations, Administration and Maintenance (IOAM) is used for monitoring network performance and for detecting traffic bottlenecks and anomalies. This document defines an IOAM profile that is used in the Linux kernel implementation, starting from the Linux 5.15 kernel.

Status of This Memo

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Table of Contents

1. Introduction

IOAM [I-D.ietf-ippm-ioam-data] is used for monitoring traffic in the network by incorporating IOAM data fields into in-flight data packets.

An IOAM profile [I-D.mizrahi-ippm-ioam-profile] defines a use case or a set of use cases for IOAM, and an associated set of rules that restrict the scope and features of the IOAM specification, thereby limiting it to a subset of the full functionality.

This document introduces a profile of IOAM that is used in the Linux kernel implementation. The profile is intended to formally specify the subset of features that are in scope, and to enable other implementations to interoperate with the Linux implementation.

2. The Linux IOAM Profile

2.1. Use Cases

The Linux kernel implementation enables the functionality of any of the following nodes:

- IOAM encapsulating node
- IOAM transit node

o IOAM decapsulating node

One possible use case is a set of Linux-based hosts that function as IOAM encapsulating and decapsulating nodes, interconnected by IOAM transit nodes that are not necessarily Linux-based. Thus, Linux-based implementations are expected to interoperate with other implementations that comply to this profile.

Another possible use case is a homogenous setting in which all IOAM nodes are Linux-based.

2.2. IOAM Version

The current profile is based on [I-D.ietf-ippm-ioam-data-14], which is a work-in-progress version of IOAM.

2.3. IOAM Options

The current profile uses the Pre-allocated Trace Option-Type. It is assumed that one IOAM option is used in an IOAM encapsulated packet.

2.4. Encapsulation

The IOAM encapsulation uses an IPv6 Extension Header. This extension header is used for the IOAM Pre-allocated Trace Option-Type, as defined in [I-D.ietf-ippm-ioam-ipv6-options-06], which is a work-in-progress version of the IPv6 IOAM option.

The IPv6 Extension Header is a Hop-by-Hop Options header, that contains the IOAM Trace Option-Type. The Hop-by-Hop Options header can include one or more options, such that one of these options is the IOAM Pre-allocated Trace Option-Type. Figure 1 illustrates the format of this Hop-by-Hop Options header when the IOAM Pre-allocated Trace Option-Type is the only Hop-by-Hop option. If more options are present the format will change accordingly.

As illustrated in Figure 1, the first 2 octets are the Hop-by-Hop Options header [RFC8200], followed by a 2 octet Padding field. The following 4 octets are the IOAM IPv6 option header [I-D.ietf-ippm-ioam-ipv6-options-06]. The IOAM Option includes the 8 octet Pre-allocated Trace Option-Type header [I-D.ietf-ippm-ioam-data-14], followed by the Option Data.

```
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |  Next Header  |  Hdr Ext Len  |            Padding            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+<-
+
    |  Option Type  |  Opt Data Len |   Reserved    |   IOAM Type   |
|
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
I
    |        Namespace-ID           |NodeLen  | Flags | RemainingLen|
O
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
A
    |               IOAM-Trace-Type                 |  Reserved     |
M
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
+  .
    |
|  .
    .                                                               .   .
    .                          Option Data                          .
O
    .                                                               .
P
    .                                                               .
T
    .                                                               .
I
    .                                                               .
O
    .                                                               .
N
    |                                                               |
|
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+<-
+
```

Figure 1: IPv6 IOAM Extension Header Format

2.5. IOAM Supported Data Fields

The current profile supports all the data field types that are defined in [I-D.ietf-ippm-ioam-data-14] for the Pre-allocated Trace Option-Type, except for the Checksum Complement field, which is not required in this profile, since the IOAM Trace Option is encapsulated directly in an IPv6 Extension Header, without any additional layers that use a checksum.

2.6. Trace Option-Type Flags

This profile only uses the Overflow flag.

2.7. Timestamp Format

This profile uses the POSIX timestamp format.

2.8. Profile Coexistence

It is assumed that the current profile is used in a confined administrative domain in which no other IOAM profiles are used. Therefore, it is assumed that the current profile does not coexist with other profiles.

2.9. Validity

An IOAM transit/decapsulating node that receives a packet with IOAM options that do not comply to the current profile is expected to forward/decapsulate the packet without IOAM processing, if it is able to do so. If a decapsulating node is not able to decapsulate an IOAM option that is not compliant to the current profile, the packet is discarded.

3. Notes about the IOAM Support in Linux

The current Linux implementation supports all the data field types defined in [I-D.ietf-ippm-ioam-data-14] for the Pre-allocated Trace Option-Type. Specifically, the Linux implementation does not update the transit delay, the queue depth, the checksum complement and the buffer occupancy. These four data field types are passively supported, meaning the Linux implementation can add the Pre-allocated Trace Option-Type including these fields, but cannot populate them with system information. They are populated with empty values and, therefore, interoperability is possible with other IOAM nodes that support these fields.

The following table summarizes the data field type support in the Linux implementation.

Data field type	Status
Hop_Lim and node_id (short format)	Supported
Ingress_if_id and egress_if_id (short format)	Supported
Timestamp seconds	Supported
Timestamp fraction	Supported
Transit delay	Passive support
Namespace specific data (short format)	Supported
Queue depth	Passive support
Checksum complement	Passive support
Hop_Lim and node_id (wide format)	Supported
Ingress_if_id and egress_if_id (wide format)	Supported
Namespace specific data (wide format)	Supported
Buffer occupancy	Passive support
Opaque State Snapshot	Supported

Both the Opaque State Snapshot and the Namespace specific data are supported in the Linux implementation by incorporating configurable values into these fields. Notably, Linux-based IOAM nodes can interoperate with other nodes that use the Opaque State Snapshot and/or the Namespace specific data in a more flexible way.

4. IANA Considerations

This document does not include any requests from IANA.

5. Security Considerations

The security considerations of IOAM profiles are discussed in [I-D.mizrahi-ippm-ioam-profile]. The current document does not present any new security considerations.

6. Normative References

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[RFC8200] Deering, S. and R. Hinden, "Internet Protocol, Version 6 (IPv6) Specification", STD 86, RFC 8200, DOI 10.17487/RFC8200, July 2017, <https://www.rfc-editor.org/info/rfc8200>.

Authors' Addresses

Tal Mizrahi
Huawei
8-2 Matam
Haifa
Israel

Email: tal.mizrahi.phd@gmail.com

Justin Iurman
Universite de Liege
10, Allee de la decouverte (B28)
Sart-Tilman, LIEGE 4000
Belgium

Email: justin.iurman@uliege.be

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

Email: fbrockne@cisco.com