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Network Service Header (NSH) Encapsulation for In-situ OAM (IOAM) Data
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Abstract

In-situ Operations, Administration, and Maintenance (IOAM) is used for recording and collecting operational and telemetry information while the packet traverses a path between two points in the network. This document outlines how IOAM data fields are encapsulated with the Network Service Header (NSH).

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[1.](#) Introduction

In-situ OAM (IOAM), as defined in [[I-D.ietf-ippm-ioam-data](#)], is used to record and collect OAM information while the packet traverses a particular network domain. The term "in-situ" refers to the fact that the OAM data is added to the data packets rather than is being sent within packets specifically dedicated to OAM. This document defines how IOAM data fields are transported as part of the Network Service Header (NSH) [[RFC8300](#)] encapsulation for the Service Function Chaining (SFC) [[RFC7665](#)]. The IOAM-Data-Fields are defined in [[I-D.ietf-ippm-ioam-data](#)]. An implementation of IOAM which leverages NSH to carry the IOAM data is available from the FD.io open source software project [[FD.io](#)].

[2.](#) Conventions

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.

Abbreviations used in this document:

IOAM: In-situ Operations, Administration, and Maintenance

NSH: Network Service Header

outside the scope of this document.

[4.](#) IANA Considerations

IANA is requested to allocate protocol numbers for the following "NSH Next Protocol" related to IOAM:

Next Protocol	Description	Reference
x	TBD_IOAM	This document

[5.](#) Security Considerations

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. For additional IOAM related security considerations, see Section 10 in [\[I-D.ietf-ippm-ioam-data\]](#).

[6.](#) Acknowledgements

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[Appendix A](#). Discussion of the IOAM encapsulation approach

This section lists several approaches considered for encapsulating IOAM with NSH and presents the rationale for the approach chosen in this document.

An encapsulation of IOAM-Data-Fields in NSH 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 several categories, including trace,

proof-of-transit, and edge-to-edge. Each of these 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-Fields 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-Type 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 were to be encapsulated in the packet.

Different approaches for encapsulating IOAM-Data-Fields in NSH could be considered:

1. Encapsulation of IOAM-Data-Fields as "NSH MD Type 2" (see [\[RFC8300\], Section 2.5](#)). Each IOAM-Option-Type (e.g. trace, proof-of-transit, and edge-to-edge) would be specified by a type, with the different IOAM-Data-Fields being TLVs within this the particular option type. NSH MD Type 2 offers support for variable length meta-data. The length field is 6-bits, resulting in a maximum of 256 ($2^6 \times 4$) octets.
2. Encapsulation of IOAM-Data-Fields using the "Next Protocol" field. Each IOAM-Option-Type (e.g trace, proof-of-transit, and edge-to-edge) would be specified by its own "next protocol".
3. Encapsulation of IOAM-Data-Fields using the "Next Protocol" field. A single NSH protocol type code point would be allocated for IOAM. A "sub-type" field would then specify what IOAM options type (trace, proof-of-transit, edge-to-edge) is carried.

The third option has been chosen here. This option avoids the additional layer of TLV nesting that the use of NSH MD Type 2 would result in. In addition, this option does not constrain IOAM data to a maximum of 256 octets, thus allowing support for very large deployments.

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