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MNA for Metadata in SR-MPLS Service Programming
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Abstract

This document defines MPLS Network Action(MNA) encoding to carry metadata in SR service programming with SR-MPLS data plane.

Status of This Memo

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1. Introduction

[I-D.ietf-spring-sr-service-programming] defines data plane functionality required to implement service segments and achieve service programming in SR-enabled MPLS and IPv6 networks. Metadata[RFC7665] provides contextual information about the data packets which traverse a programmed service path.

However, there’s yet no standard method to carry service metadata with the SR-MPLS data plane, which make the solution for service programming in SR-MPLS incomplete

MPLS Network Action (MNA) [I-D.ietf-mpls-mna-fwk] is used to indicate action for Label Switched Paths (LSPs) and/or MPLS packets, and to transfer data needed for the action. [I-D.ietf-mpls-mna-hdr] defines the MNA sub-stack solution for carrying Network Action Indicators and Ancillary Data in the label stack.

This document defines MPLS Network Action(MNA) encoding to carry metadata in SR service programming with SR-MPLS data plane.

2. Terminology

2.1. Acronyms

HBH: Hop-By-Hop

I2E: Ingress-To-Egress

IHS: Ingress-To-Egress (I2E), Hop-By-Hop (HBH) or Select Scope

ISD: In-Stack Data

PSD: Post-Stack Data

PSH: Post-Stack Header

LSE: Label Stack Entry

MPLS: Multiprotocol Label Switching

MNA: MPLS Network Action

2.2. Requirements Language

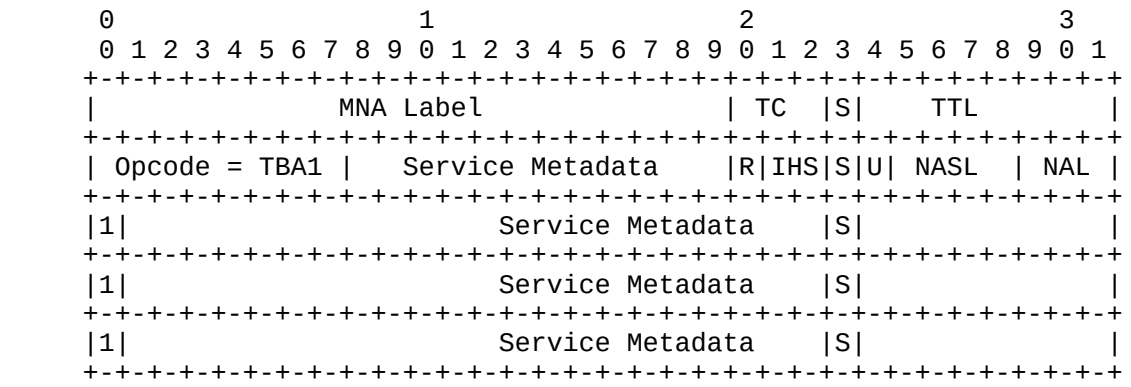
The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

3. MPLS Network Action ISD encoding for Metadata in SR-MPLS Service Programming

The metadata in SR-MPLS Service Programming is placed as part of the ISD block in an MPLS label stack according to the MNA encoding principles defined in [I-D.ietf-mpls-mna-hdr]. Two types of metadata for SR-MPLS service programming are defined: fixed-length service metadata and variable-length service metadata.

3.1. Fixed-Length Service Metadata

The format of fixed-length service metadata is shown as follows,



Where:

* The MNA Label is defined in [I-D.ietf-mpls-mna-hdr].

* S: the Bottom of Stack field [RFC3032].

* Opcode: TBA1, indicating the fixed-length service metadata.

* R,IHS and U fields are set as specified in [I-D.ietf-mpls-mna-hdr].

* NASL: The Network Action Sub-Stack Length (NASL) as specified in [I-D.ietf-mpls-mna-hdr]. The value is 3.

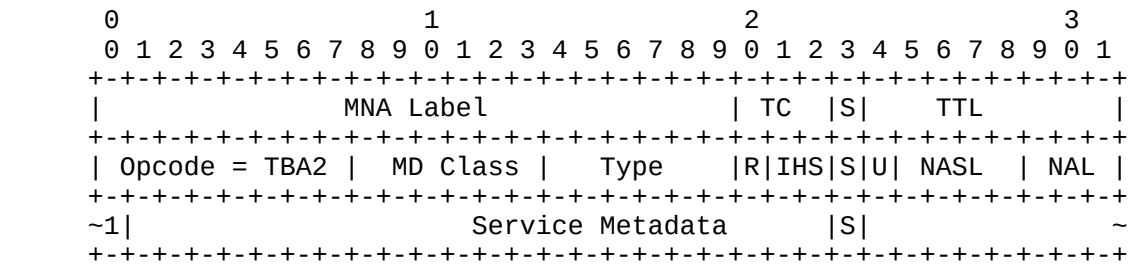
* NAL: Network Action Length as specified in [I-D.ietf-mpls-mna-hdr]. The number of extra LSEs used for Service metadata encoding. The value is 3.

* Service Metadata: 102-bit field to carry metadata. No assumption is made by this document on the structure or the content of the carried metadata.

3.2. Variable-Length Service Metadata

It should be noticed that although it is called "variable-length", the length of this service metadata MUST NOT be changed on the fly.

The format of variable-length service metadata is shown as follows,



Where:

* The MNA Label is defined in [I-D.ietf-mpls-mna-hdr].

* S: the Bottom of Stack field [RFC3032].

* Opcode: TBA2, indicating the variable-length service metadata.

* R,IHS and U fields are set as specified in [I-D.ietf-mpls-mna-hdr].

* NASL: The Network Action Sub-Stack Length (NASL) as specified in [I-D.ietf-mpls-mna-hdr].

* NAL: Network Action Length as specified in [I-D.ietf-mpls-mna-hdr]. The number of extra LSEs used for Service metadata encoding.

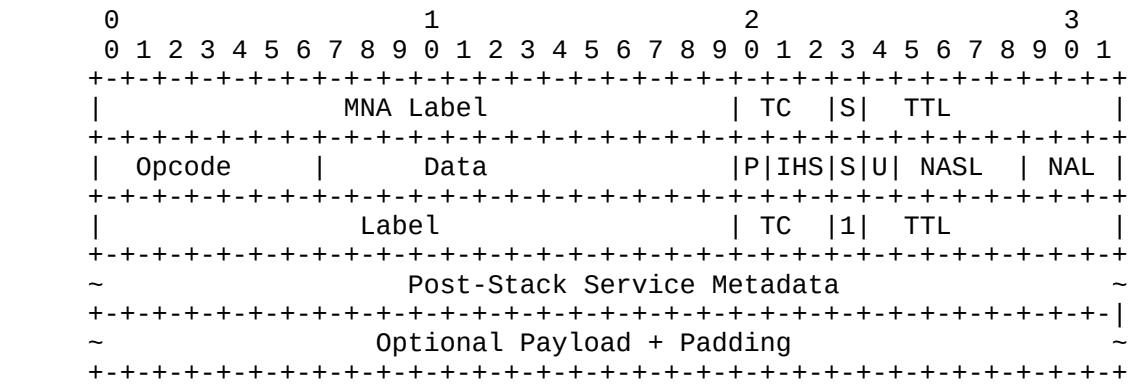
* Metadata Class (MD Class): Defines the scope of the Type field to provide a hierarchical namespace.

* Type: Indicates the explicit type of metadata being carried. The definition of the Type is the responsibility of the MD Class owner.

* Service Metadata: The field length depends on the value of NAL.

4. Post-Stack MNA Encoding for Metadata in SR-MPLS Service Programming

The presence of Post-Stack Header is indicated in an In-Stack Network Action Sub-stack as defined in [I-D.ietf-mpls-mna-ps-hdr] and is shown as below.



* The MNA Label is defined in [I-D.ietf-mpls-mna-hdr].

* P flag is set as specified in [I-D.ietf-mpls-mna-ps-hdr]

* The IHS scope field defined in [I-D.ietf-mpls-mna-hdr] is used to indicate that I2E or HBH or Select processing is required for the Network Action and Ancillary Data.

* S: the Bottom of Stack field [RFC3032].

* U: set as specified in [I-D.ietf-mpls-mna-hdr].

* NASL: The Network Action Sub-Stack Length (NASL) as specified in [I-D.ietf-mpls-mna-hdr].

* NAL: Network Action Length as specified in [I-D.ietf-mpls-mna-hdr]. The value is 0.

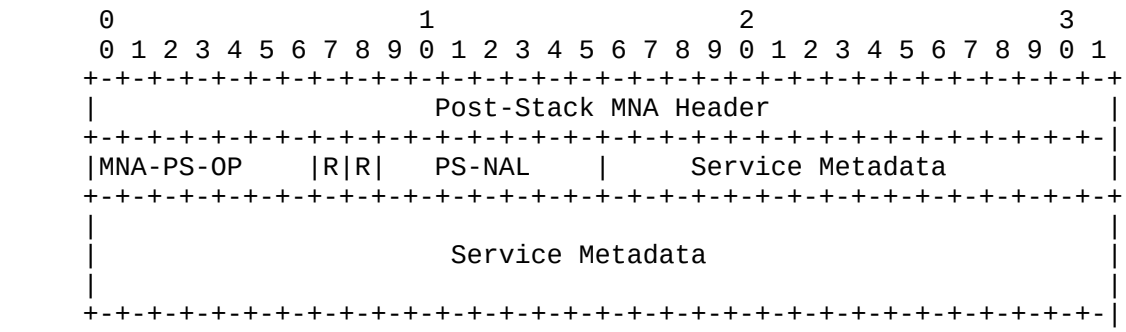
* Opcode: TBA3, In-Stack Network Action for the service metadata in PSH.

* Data (10 bits, next to the Opcode field) in the LSE contains the offset for PSH for this In-Stack Network Action in 4-octets units after BOS LSE to the start of the corresponding Post-Stack Network Action Opcode. Due to the Post-Stack Header type top-header, minimum value for the offset is 1 (i.e, 4-octets).

* Post-Stack Service Metadata: the service metadata carried in PSH, see section 4.1 and section 4.2.

4.1. Post-Stack Fixed-Length Metadata in SR-MPLS Service Programming

The encoding of the post-stack variable-length service metadata is shown as follows,



Where:

* Post-Stack MNA Header: the top-level header for all the Post-Stack Network Actions that are encoded as defined in [I-D.ietf-mpls-mna-ps-hdr].

* MNA-PS-OP: TBA4 for post-stack fixed -length service metadata.

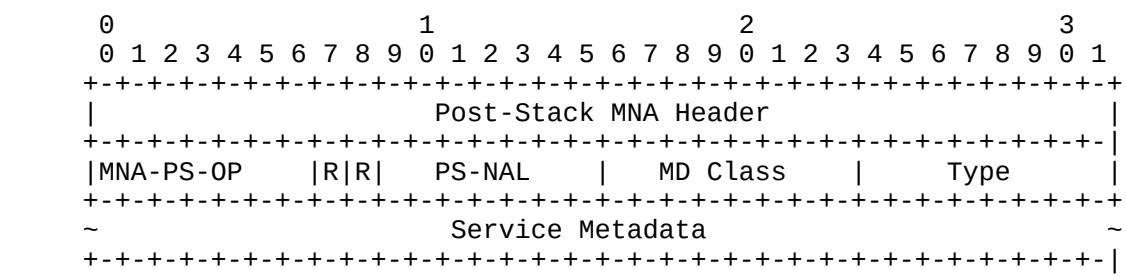
* R (2 bits): Reserved bits.

* PS-NAL (7 bits): Post-Stack Network Action Length in 4-octet units as in [I-D.ietf-mpls-mna-ps-hdr]. This excludes the first 4-octets starting PS-MNA-OP. The value is 3.

* Service Metadata: 14-byte field carrying the service metadata. No assumption is made by this document on the structure or the content of the carried metadata.

4.2. Post-Stack Variable-Length Metadata in SR-MPLS Service Programming

The encoding of the post-stack variable-length service metadata is shown as follows,



Where:

* Post-Stack MNA Header: the top-level header for all the Post-Stack Network Actions that are encoded as defined in [I-D.ietf-mpls-mna-ps-hdr].

* MNA-PS-OP: TBA5 for post-stack variable-length service metadata.

* R (2 bits): Reserved bits.

* PS-NAL (7 bits): Post-Stack Network Action Length in 4-octet units as in [I-D.ietf-mpls-mna-ps-hdr]. This excludes the first 4-octets starting PS-MNA-OP.

* Metadata Class (MD Class): Defines the scope of the Type field to provide a hierarchical namespace.

* Type: Indicates the explicit type of metadata being carried. The definition of the Type is the responsibility of the MD Class owner.

* Service Metadata: Metadata for SR-MPLS Service Programming, the length of field depends in the value of PS-NAL.

5. IANA Considerations

5.1. In-Stack MPLS Network Action Opcodes

IANA is requested to assign codepoints from its Network Action Opcodes registry (creation requested in [I-D.ietf-mpls-mna-hdr]) as specified in Table 1.

Opcode	Name	Reference
TBA1	In-Stack Network Action for Fixed-Length Service Metadata in ISD	This document
TBA2	In-Stack Network Action for Variable-Length Service Metadata in ISD	This document
TBA3	In-Stack Network Action for Service Metadata in PSH	This document

5.2. Post-Stack MPLS Network Action Opcodes

IANA is requested to assign codepoints for the Post-Stack Network Action for the post-stack service metadata from the Post-Stack Network Action Opcodes registry (to be created by in [I-D.ietf-mpls-mna-hdr]).

Opcode	Name	Reference
TBA4	Post-Stack Network Action for Fixed-Length Service Metadata	This document
TBA5	Post-Stack Network Action for Variable-Length Service Metadata	This document

6. Security Considerations

Security considerations discussed in [I-D.ietf-mpls-mna-fwk], [I-D.ietf-mpls-mna-hdr], [I-D.ietf-mpls-mna-ps-hdr] and [I-D.ietf-spring-sr-service-programming] apply to this document.

7. References

7.1. Normative References

[I-D.ietf-mpls-mna-fwk]
Andersson, L., Bryant, S., Bocci, M., and T. Li, "MPLS Network Actions (MNA) Framework", Work in Progress, Internet-Draft, draft-ietf-mpls-mna-fwk-15, 27 December 2024, <https://datatracker.ietf.org/doc/html/draft-ietf-mpls-mna-fwk-15>.

[I-D.ietf-mpls-mna-hdr]
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Rajamanickam, J., Gandhi, R., Zigler, R., Li, T., and J. Dong, "Post-Stack MPLS Network Action (MNA) Solution", Work in Progress, Internet-Draft, draft-ietf-mpls-mna-ps-hdr-01, 30 May 2025, <https://datatracker.ietf.org/doc/html/draft-ietf-mpls-mna-ps-hdr-01>.

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[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>.

7.2. Informative References

[RFC7665] Halpern, J., Ed. and C. Pignataro, Ed., "Service Function Chaining (SFC) Architecture", RFC 7665, DOI 10.17487/RFC7665, October 2015, <https://www.rfc-editor.org/info/rfc7665>.

[RFC8300] Quinn, P., Ed., Elzur, U., Ed., and C. Pignataro, Ed., "Network Service Header (NSH)", RFC 8300, DOI 10.17487/RFC8300, January 2018, <https://www.rfc-editor.org/info/rfc8300>.

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