Network Working Group
Internet-Draft
Intended status: Standards Track
Expires: March 13, 2020

Z. Li
S. Peng
Huawei Technologies
K. LEE
LG U+

September 10, 2019

IPv6 Encapsulation for SFC and IFIT
draft-li-6man-ipv6-sfc-ifit-02

Abstract

Service Function Chaining (SFC) and In-situ Flow Information Telemetry (IFIT) are important path services along with the packets. In order to support these services, several encapsulations have been defined. The document analyzes the problems of these encapsulations in the IPv6 scenario and proposes the possible optimized encapsulation for IPv6.

Requirements 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 RFC 2119 [RFC2119].

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 March 13, 2020.

Copyright Notice

Table of Contents

1. Introduction

Service Function Chaining (SFC) [RFC7665] and In-situ Flow Information Telemetry (IFIT) [I-D.song-opsawg-ifit-framework] are important path services along with the packets. In order to support these services, several encapsulations have been defined. Network Service Header (NSH) is defined in [RFC8300] as the encapsulation for SFC. For IFIT encapsulations, In-situ OAM (iOAM) Header is defined in [I-D.ietf-ippm-ioam-data] and Postcard-Based Telemetry (PBT) Header is defined in [I-D.song-ippm-postcard-based-telemetry]. Inband Flow Analyzer (IFA) is also defined in [I-D.kumar-ippm-ifa] to record flow specific information from an end station and/or switches across a network. In the application scenario of IPv6, these encapsulations propose challenges for the data plane. The document analyzes the problems and proposes the possible optimized encapsulation for IPv6.

2. Terminology

SFC: Service Function Chaining

IFIT: In-situ Flow Information Telemetry

IOAM: In-situ OAM

PBT: Postcard-Based Telemetry

IFA: Inband Flow Analyzer

SRH: Segment Routing Header

3. Problem Statement

The problems posed by the current encapsulations for SFC and IFIT in the application scenarios of IPv6 and SRv6 include:

1. According to the encapsulation order recommended in [RFC8200], if the IOAM is encapsulated in the IPv6 Hop-by-Hop options header, in the incremental trace mode of IOAM as the number of nodes traversed by the IPv6 packets increases, the recorded IOAM information will increase accordingly. This will increase the length of the Hop-by-Hop options header and cause increasing difficulties in reading the subsequent Segment Routing Extension Header (SRH) [I-D.ietf-6man-segment-routing-header] and thereby reduce the forwarding performance of the data plane greatly.

2. With the introduction of SRv6 network programming [I-D.ietf-spring-srv6-network-programming], the path services along with the IPv6 packets can be processed at all the IPv6 network nodes or only at the SRv6 enabled network nodes along the path. It is necessary to distinguish the encapsulations for the specific path service which should be processed by the IPv6 path or the SRv6 path.

3. Both NSH and IOAM need the Metadata field to record metadata information. However currently these metadata has to be recorded separately which may generate redundant metadata information or increase the cost of process.

4. There is unnecessary inconsistency in the current encapsulations for IOAM, IFA and PBT in the IPv6 scenario. Especially it seems unnecessary to define a new specific IPv6 header for IFA, i.e. IFA header.

4. Design Consideration

To solve the problems stated above, in the application scenarios of IPv6 and SRv6, the encapsulations of SFC and IFIT can be optimized with the following design considerations:

- To separate the SFC/IFIT path service into two parts, i.e. instruction and recording parts. The instruction part (normally with fixed length) can be placed in the front IPv6 extension headers including Hop-by-Hop options header, Destination options header, Routing header, etc. while the recording part can be placed in the back IPv6 extension headers such as being placed after IPv6 Routing Header. In this way the path service instruction in the IPv6 extension headers can be fixed as much as possible to facilitate hardware process to keep forwarding performance while the SFC/IFIT metadata recording part is placed afterwards which enables to stop recording when too much recording information has to be carried to reach the limitation of hardware process.

- To define SFC/IFIT path service instructions as IPv6 options uniformly whichs can be placed either in the Hop-by-hop options which indicates the path service processed by all IPv6 enabled nodes along the path or in the SRH option TLVs which indicates the path service processed only by the SRv6 nodes along the SRv6 path indicated by the Segment List in the SRH.

- To define a unified IPv6 metadata header which can be used as a container to record the service metadata of SFC, IFIT and other possible path services.

According to the above design optimization consideration, in the application scenarios of IPv6 and SRv6 the encapsulations for SFC and IFIT can be defined as below.

4.1. Service Options

1. NSH Service Option

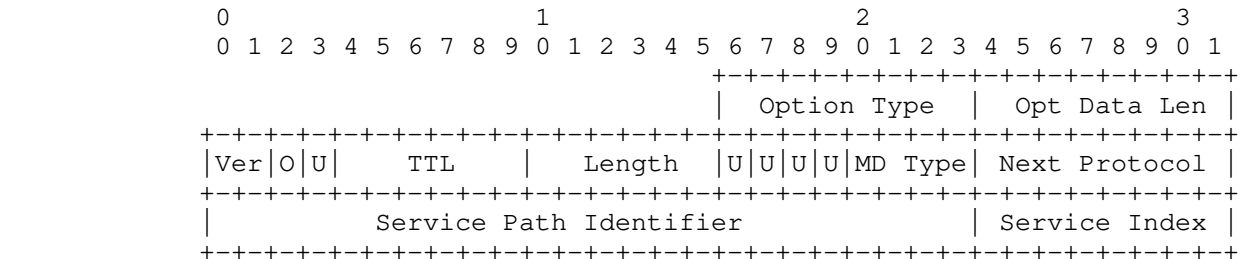

Figure 1. IPv6 Options with NSH instructions

Option Type: TBD_0

Opt Data Len: 8 octets.

Other fields: refer to [RFC8300].

2. IOAM Service Option

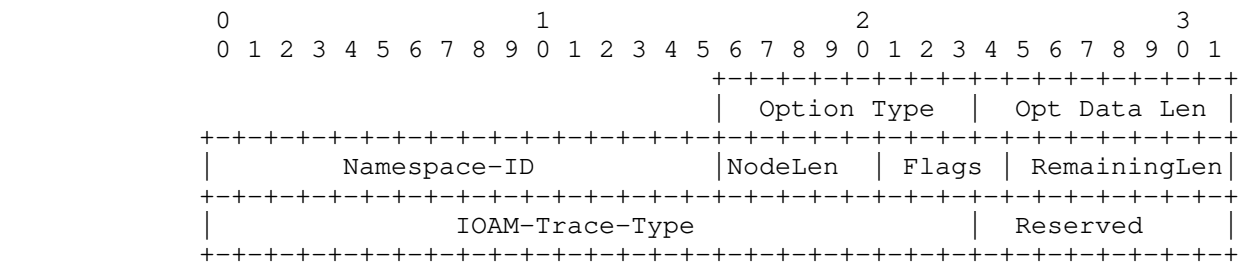

Figure 2. IPv6 Options with IOAM instructions

Option Type: TBD_1

Opt Data Len: 8 octets.

Other fields: refer to [I-D.ietf-ippm-ioam-data].

3. PBT Service Option

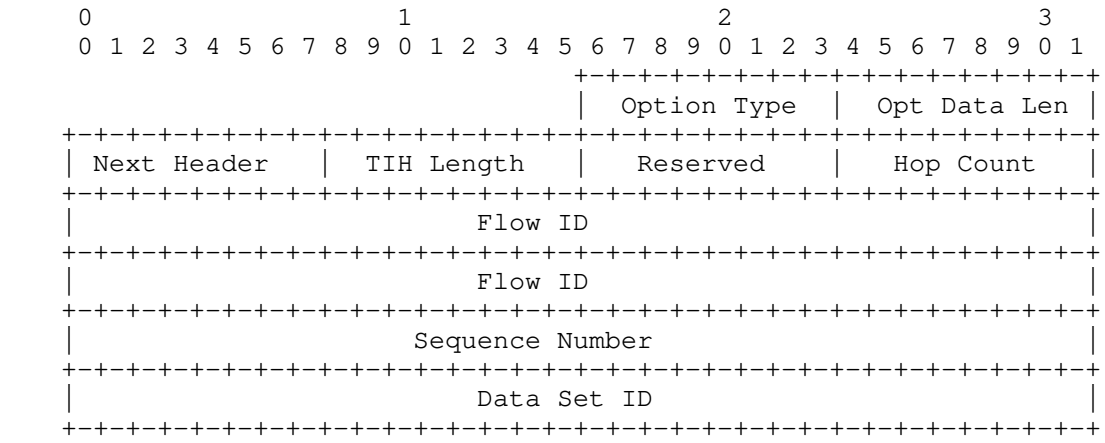

Figure 3. IPv6 Options with PBT instructions

Option Type: TBD_2

Opt Data Len: 20 octets.

Other fields: refer to [I-D.song-ippm-postcard-based-telemetry].

4. IFA Service Option

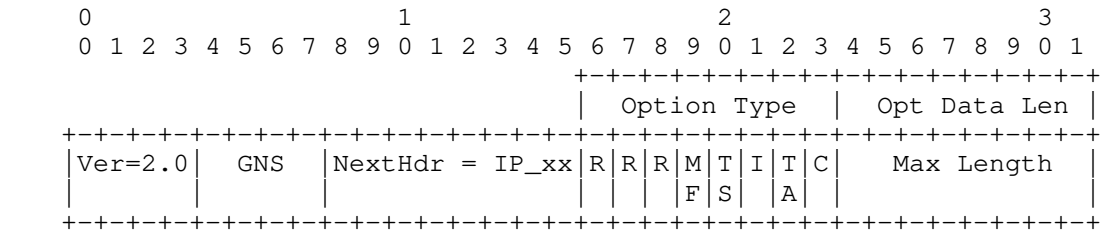

Figure 4. IPv6 Options with IFA instructions

Option Type: TBD_3

Opt Data Len: 4 octets.

Other fields: refer to [I-D.kumar-ippm-ifa].

These options can be put in the IPv6 Hop-by-Hop Options Header or SRH TLV.

4.2. IPv6 Service Metadata Options

As introduced in [I-D.li-6man-enhanced-extension-header], IPv6 Metadata Header is defined as a new type of IPv6 extension header. The metadata is the information recorded by each hop for specific path services, and carried in corresponding service metadata options. The length of the metadata is variable.

4.2.1. SFC Service Metadata Option

For the SFC service, the corresponding SFC service metadata option is defined as shown in Figure 5.

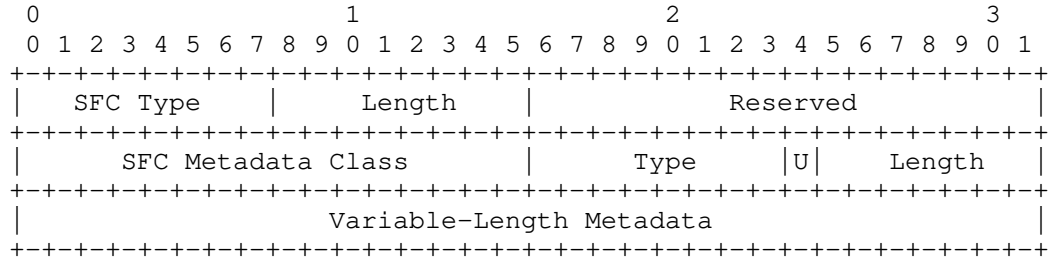

Figure 5. SFC Service Metadata

SFC Type	8-bit identifier of the service type, i.e. SFC. The value is TBD-4.
Length	8-bit unsigned integer. Length of the Service Metadata field, in octets.
Metadata Class	Defines the scope of the Type field to provide a hierarchical namespace. IANA has set up the "NSH MD Class" registry, which contains 16-bit values [RFC8300].
Type	Indicates the explicit type of metadata being carried. The definition of the Type is the responsibility of the MD Class owner.
Unassigned bit	One unassigned bit is available for future use. This bit MUST NOT be set, and it MUST be ignored on receipt.
Length	Indicates the length of the variable-length metadata, in bytes. Detailed specification in [RFC8300].

4.2.2. IOAM Service Metadata Option

For the IOAM service, the corresponding IOAM service metadata option is defined as shown in Figure 6.

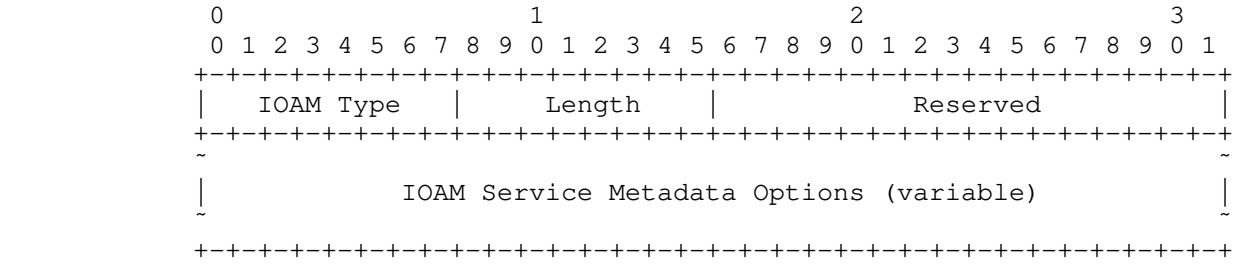

Figure 6. IOAM Service Metadata

IOAM Type	8-bit identifier of the IOAM Service Metadata type. The value is TBD-5.
Length	8-bit unsigned integer. Length of the IOAM Service Metadata field, in octets.
RESERVED	8-bit reserved field MUST be set to zero upon transmission and ignored upon receipt.
IOAM Service Metadata Options	IOAM option data is present as specified by the IOAM Type field, and is defined in Section 4 of [I-D.ietf-ippm-ioam-data].

All the IOAM IPv6 options require 4n alignment. This ensures that 4 octet fields specified in [I-D.ietf-ippm-ioam-data] such as transit delay are aligned at a multiple-of-4 offset from the start of the IPv6 Metadata header.

In addition, to maintain IPv6 extension header 8-octet alignment and avoid the need to add or remove padding at every hop, the Trace-Type for Incremental Tracing Option in IPv6 MUST be selected such that the IOAM node data length is a multiple of 8-octets.

4.2.3. IFA Service Metadata Option

For the IOAM service, the corresponding IOAM service metadata option is defined as shown in Figure 6.

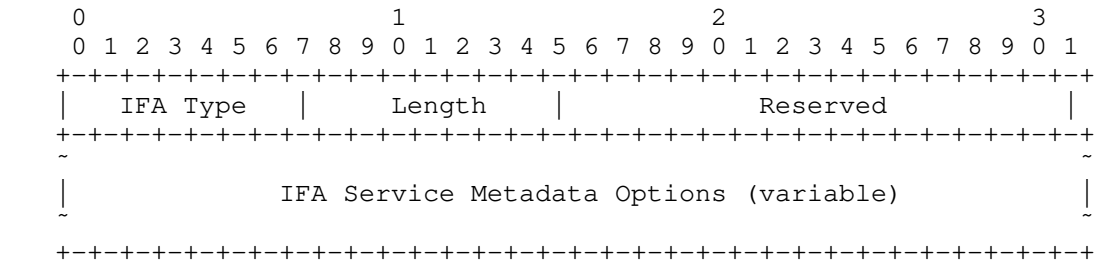

Figure 6. IFA Service Metadata

IFA Type	8-bit identifier of the IFA Service Metadata type. The value is TBD-6.
Length	8-bit unsigned integer. Length of the IOAM Service Metadata field, in octets.
RESERVED	8-bit reserved field MUST be set to zero upon transmission and ignored upon receipt.
IFA Service Metadata Options	IFA option data is present as specified by the IFA Type field.

5. IANA Considerations

Value	Description	Reference
TBD_0	NSH Service Option	[This draft]
TBD_1	IOAM Service Option	[This draft]
TBD_2	PBT Service Option	[This draft]
TBD_3	IFA Service Option	[This draft]
TBD_4	SFC Service Metadata Type	[This draft]
TBD_5	IOAM Service Metadata Type	[This draft]
TBD_6	IFA Service Metadata Type	[This draft]

6. Security Considerations

TBD.

7. References

7.1. Normative References

[I-D.guichard-spring-nsh-sr]
Guichard, J., Song, H., Tantsura, J., Halpern, J., Henderickx, W., Boucadair, M., and S. Hassan, "NSH and Segment Routing Integration for Service Function Chaining (SFC)", draft-guichard-spring-nsh-sr-01 (work in progress), March 2019.

[I-D.ietf-6man-segment-routing-header]
Filsfils, C., Dukes, D., Previdi, S., Leddy, J., Matsushima, S., and d. daniel.voyer@bell.ca, "IPv6 Segment Routing Header (SRH)", draft-ietf-6man-segment-routing-header-22 (work in progress), August 2019.

[I-D.ietf-ippm-ioam-data]
Brockners, F., Bhandari, S., Pignataro, C., Gredler, H., Leddy, J., Youell, S., Mizrahi, T., Mozes, D., Lapukhov, P., Chang, R., daniel.bernier@bell.ca, d., and J. Lemon, "Data Fields for In-situ OAM", draft-ietf-ippm-ioam-data-06 (work in progress), July 2019.

[I-D.ietf-spring-srv6-network-programming]
Filsfils, C., Camarillo, P., Leddy, J., daniel.voyer@bell.ca, d., Matsushima, S., and Z. Li, "SRv6 Network Programming", draft-ietf-spring-srv6-network-programming-01 (work in progress), July 2019.

[I-D.kumar-ippm-ifa]
Kumar, J., Anubolu, S., Lemon, J., Manur, R., Holbrook, H., Ghanwani, A., Cai, D., Ou, H., and L. Yizhou, "Inband Flow Analyzer", draft-kumar-ippm-ifa-01 (work in progress), February 2019.

[I-D.song-ippm-postcard-based-telemetry]
Song, H., Zhou, T., Li, Z., Shin, J., and K. Lee, "Postcard-based On-Path Flow Data Telemetry", draft-song-ippm-postcard-based-telemetry-04 (work in progress), June 2019.

[I-D.song-opsawg-ifit-framework]
Song, H., Li, Z., Zhou, T., Qin, F., Shin, J., and J. Jin, "In-situ Flow Information Telemetry Framework", draft-song-opsawg-ifit-framework-04 (work in progress), September 2019.

[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>.

[RFC8126] Cotton, M., Leiba, B., and T. Narten, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 8126, DOI 10.17487/RFC8126, June 2017, <https://www.rfc-editor.org/info/rfc8126>.

[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>.

[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>.

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>.

Authors' Addresses

Zhenbin Li
Huawei Technologies
Huawei Bld., No.156 Beiqing Rd.
Beijing 100095
China

Email: lizhenbin@huawei.com

Shuping Peng
Huawei Technologies
Huawei Bld., No.156 Beiqing Rd.
Beijing 100095
China

Email: pengshuping@huawei.com

Kihoon LEE
LG U+
71, Magokjungang 8-ro, Gangseo-gu
Seoul
Republic of Korea

Email: soho8416@lguplus.co.kr