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Data Fields for DetNet Enhanced Data Plane
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Abstract

The DetNet-specific metadata should be carried in enhanced data plane based on the enhancement requirements. This document proposes the common DetNet data fields and options including Deterministic Latency Option and Aggregation Option. It also considers the common DetNet options being encapsulated into a variety of protocols such as MPLS, IPv6 and SRv6 networks.

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1. Introduction

According to [RFC8655], Deterministic Networking (DetNet) operates at the IP layer and delivers service which provides extremely low data loss rates and bounded latency within a network domain. DetNet data planes has been specified in [RFC8938]. As described in [RFC9320], the end-to-end bounded latency depends on the value of queuing delay bound along with the queuing mechanisms. Multiple queuing mechanisms has been proposed to guarantee the bounded latency in IEEE802.1 TSN (Time-Sensitive Networking) Task Group. But the existing deterministic technologies are facing large-scale number of nodes and long-distance transmission, traffic scheduling, dynamic flows, and other controversial issues in large-scale networks. The DetNet is required to support a enhanced data plane method of flow identification and packet treatment.

For scaling networks, [I-D.ietf-detnet-scaling-requirements] has described the enhancement requirements for DetNet enhanced data plane, such as aggregated flow identification and deterministic latency guarantees. For example, the flow identification with service-level aggregation and explicit aggregated flow identification should be supported. And queuing mechanisms and solutions require different information to be defined as the DetNet-specific metadata to help the functions of ensuring deterministic latency, including regulation, queue management, etc. Several data plane enhancement solutions and queuing mechanisms have been discussed in DetNet. And [I-D.ietf-detnet-dataplane-taxonomy] has defined the classification criteria and the suitable categories for DetNet data plane solutions.

This document proposes the specific metadata which should be carried in DetNet enhanced data plane and proposes the common DetNet data fields and option including Deterministic Latency Option and Aggregation Option. The common DetNet options can be encapsulated into a variety of protocols such as MPLS, IPv6 and SRv6 networks.

2. Conventions used in this document

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. Terminology

This document uses the terms defined in [RFC8655], [RFC8938], [I-D.ietf-detnet-scaling-requirements] and [I-D.ietf-detnet-dataplane-taxonomy].

2.3. Abbreviations

This document uses the following abbreviations:

EDP: DetNet Enhanced Data Plane

IPv6: Internet Protocol version 6

SRH: Segment Routing Header

SRv6: Segment Routing for IPv6 forwarding plane

CQF: Cyclic Queuing and Forwarding

TCQF: Tagged CQF

TQF: Timeslot Queuing and Forwarding

C-SCORE: Work Conserving Stateless Core Fair Queuing

N-SCORE: Non-work Conserving Stateless Core Fair Queuing

PIFO: Push-In First-Out

EDF: Earliest Deadline First

TAS: Time Aware Shaper

ATS: Asynchronous Traffic Shaping

TSN: Time-Sensitive Networking

gLBF:guaranteed Latency Based Forwarding

MNA: MPLS Network Actions

3. Specific Metadata for DetNet Enhanced Data Plane

3.1. Deterministic Latency Metadata

As described in [RFC9320], the end-to-end bounded latency depends on the queuing delay bound and the queuing mechanisms. Multiple queuing mechanisms have been proposed such as TAS [IIEEE802.1Qbv], CBS [IEEE802.1Q-2014], ATS [IEEE802.1Qcr], CQF [IEEE802.1Qch] and so on. For the scaling networks which have large variation in latency among hops, great number of flows and multiple domains, [I-D.ietf-detnet-scaling-requirements] has described the technical requirements for enhanced data plane solutions. Many variations and extensions of queuing mechanisms have been proposed to resolve the scalability issues in DetNet Enhanced Data Plane (EDP) such as C-SCORE [I-D.joung-detnet-stateless-fair-queuing], TQF [I-D.ietf-detnet-packet-timeslot-mechanism], EDF [I-D.ietf-detnet-deadline-based-forwarding], TCQF [I-D.ietf-detnet-tcqf], gLBF [I-D.ietf-detnet-glbf], N-SCORE [I-D.ietf-detnet-nscore] and PIFO [I-D.ietf-detnet-ontime-forwarding].

And when the queuing mechanisms are used in large-scale networks, the per-flow states can not be maintained due to scalability issues. Some queuing parameters should be carried for coordination between nodes so as to make appropriate packet forwarding and scheduling decisions to meet the time bounds. As per [I-D.ietf-detnet-scaling-requirements], the information used by functions ensuring deterministic latency should be supported as such queuing-based information. And queuing mechanisms and solutions require different information to help the functions of ensuring deterministic latency, including regulation, queue management. The deterministic latency metadata should be defined as the DetNet-specific metadata for DetNet enhanced data plane.

[I-D.ietf-detnet-dataplane-taxonomy] has defined the classification criteria and the suitable categories for this solutions. This document proposes the deterministic latency metadata align with the categories in enhanced data plane for the DetNet nodes along the path to apply the queuing mechanisms and get the related deterministic latency metadata in the packet to achieve the end-to-end bounded latency.

3.2. Aggregation-based Metadata

As per [RFC8655], the DetNet data plane SHOULD support the aggregation of DetNet flows in order to support larger numbers of DetNet flows and improve scalability by reducing the per-hop states. And the flow aggregation may be necessary for scaling networks. As per [I-D.ietf-detnet-scaling-requirements], the deterministic services may demand different deterministic QoS requirements according to different levels of application requirements. The flow identification with service-level aggregation and explicit aggregated flow identification should be supported. In DetNet MPLS, A-Label defined as per [RFC8964] can be added explicitly to the packets. But in other DetNet data plane, no aggregated flow specific information is available.

Furthermore, it is required to be dynamic and simplified to ensure the aggregated flows have compatible DetNet flow-specific QoS characteristics. The individual flows may be aggregated for treatment based on shared service specification on aggregated-class level which identified by an aggregation class as per [I-D.xiong-detnet-flow-aggregation]. This document proposes the aggregation-based metadata in enhanced data plane for the DetNet nodes along the path to identify the aggregated flow and achieve the end-to-end QoS in scaling networks.

4. Data Fields for DetNet Enhanced Data Plane

4.1. DetNet Options

The enhanced functions and related metadata for DetNet should be confirmed before the encapsulations. While more than one metadata should be carried in enhanced data plane, the common DetNet header should be considered to cover all option-types and data as Figure 1 shown.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| DetNet-Type   | DetNet-Length |         RESERVED              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
~                 DetNet Option and Data Space                  ~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 1 DetNet Header for Enhanced Data Plane

DetNet-Type: 8-bit unsigned integer, defining the DetNet Option-type for enhanced DetNet. This document defines two options and option-types:

Deterministic Latency Option, DetNet-Type is TBD1, as defined in section 4.2.

Aggregation Option, DetNet-Type is TBD2, as defined in section 4.3.

DetNet-Length: 8-bit unsigned integer, defined the Length of the DetNet Header 4-octet units.

DetNet Option and Data Space: variable, it MUST be aligned by 4 octets. It carries data that is added by the DetNet encapsulating node and interpreted by the decapsulating node. The DetNet transit nodes MAY process the data by forwarding the option data determined by option type and may modify it. The DetNet Option consists of a fixed-size "Option Header" and a variable-size "Option Data". The Header and Data may be encapsulated continuously or separately. A Data or more than one Data in lists can be carried in packets.

4.2. Deterministic Latency Option

The format of Deterministic Latency Option is shown in Figure 2.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Deterministic Latency Type    |   Flag        |   Data Len    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
~                   Deterministic Latency Information           ~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 2 Deterministic Latency Option

Deterministic Latency Type(16 bits): indicates the type of deterministic latency information with related queuing and scheduling metadata and it aligned with the suitable categories as defined in [I-D.ietf-detnet-dataplane-taxonomy] and shown in Figure 3.

Value	Deterministic Latency Type
0x0000	Unassigned
0x0001	Right-bounded category
0x0002	Flow level periodic bounded category
0x0003	Class level periodic bounded category
0x0004	Flow level non-periodic bounded category
0x0005	Class level non-periodic bounded category
0x0006	Flow level rate based unbounded category
0x0007	Flow level rate based left-bounded category

Figure 3 Deterministic Latency Type

Flag: 8-bit flags field. Data Len: 8-bit unsigned integer. Length of option data, in octets.

The related option data is defined as Deterministic Latency Information which provides function-based or queuing-based information for a node to forward a DetNet flow. The data of which is determined by the deterministic latency type. The DetNet option data can be provided one time or in list. The examples of different types of data is as following sections shown.

4.2.1. Data Fields in Right-bounded Category

As per [I-D.ietf-detnet-dataplane-taxonomy], for solutions in the right-bounded category, a packet has only a maximum time bound. An example of this queuing solution is EDF [I-D.ietf-detnet-deadline-based-forwarding].

When the type is set to 0x0001, indicates the queuing and scheduling solutions in right-bounded category. The data fields and related information may be carried and designed as following shown:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Maximum time bound                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 4 Data Fields in Right-bounded Category

Maximum time bound: 32bits, indicates the required maximum time bound of a packet.

4.2.2. Date Fields in Flow Level Periodic Bounded Category

As per [I-D.ietf-detnet-dataplane-taxonomy], the flow Level periodic bounded solutions define a set of time slots, which will be scheduled for flows or flow aggregates. An example of this queuing solution is TQF [I-D.ietf-detnet-packet-timeslot-mechanism].

When the type is set to 0x0002, indicates the queuing and scheduling solutions in flow level periodic bounded category. The data fields and related information may be carried and designed as following shown:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                            Timeslot ID                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 5 Data Fields in Flow Level Periodic Bounded Category

Timeslot ID: indicates the identifier of the timeslot scheduled for a flow.

4.2.3. Date Fields in Class Level Periodic Bounded Category

As per [I-D.ietf-detnet-dataplane-taxonomy], the periodic bounded solutions can be further categorized by the traffic granularity with class level subcategory. The class Level periodic bounded solutions define a set of cycles and each cycle will be scheduled for flows or flow aggregates within a class level. An example of this queuing solution is TCQF [I-D.ietf-detnet-tcqf].

When the type is set to 0x0003, indicates the queuing and scheduling solutions in class level periodic bounded category. The data fields and related information may be carried and designed as following shown:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          Cycle ID                             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 6 Data Fields in Class Level Periodic Bounded Category

Cycle ID (32bits): indicates the identifier which the queue applied for a node to forward DetNet flows within a class level.

4.2.4. Date Fields in Flow Level Non-periodic Bounded Category

As per [I-D.ietf-detnet-dataplane-taxonomy], flow level non-periodic bounded solutions guarantee the minimum and maximum bounds of a packet in a flow or flow aggregate. An example of this queuing solution is PIFO [I-D.ietf-detnet-ontime-forwarding].

When the type is set to 0x0004, indicates the queuing and scheduling solutions in flow level non-periodic bounded category The data fields and related information may be carried and designed as following shown:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Maximum time bound                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Minimum time bound                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 7 Data Fields in Flow Level Non-periodic Bounded Category

Maximum time bound: 32bits, indicates the maximum time bound of a packet in a flow or flow aggregates.

Minimum time bound: 32bits, indicates the minimum time bound of a packet in a flow or flow aggregates.

4.2.5. Date Fields in Class Level Non-periodic Bounded Category

As per [I-D.ietf-detnet-dataplane-taxonomy], class level non-periodic bounded solutions guarantee the minimum and maximum bounds of a packet within a class level. An example of this queuing solution is gLBF [I-D.ietf-detnet-glbf].

When the type is set to 0x0005, indicates the queuing and scheduling solutions in class level non-periodic bounded category. The data fields and related information may be carried and designed as following shown:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Maximum time bound                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Minimum time bound                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 8 Data Fields in Class Level Non-periodic Bounded Category

Maximum time bound: 32bits, indicates the maximum time bound of a packet within a class level .

Minimum time bound: 32bits, indicates the minimum time bound of a packet within a class level.

4.2.6. Date Fields in Flow Level Rate-based Unbounded Category

In flow level rate based unbounded category, the latency bound is primarily influenced by the ratio of a flow’s maximum packet size, its allocated service rate and completion time. An example of this queuing solution is C-SCORE [I-D.joung-detnet-stateless-fair-queuing].

When the type is set to 0x0006, indicates the queuing and scheduling solutions in flow level rate based unbounded category. The data fields and related information may be carried and designed as following shown:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Maximum packet size                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         Service rate                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         Finish time                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 9 Data Fields in Flow Level Rate-based Unbounded Category

Maximum packet size: 32 bits, indicates the maximum packet size of a flow.

Service rate: 32 bits, indicates the allocated service rate of a flow.

Finish time: 32 bits, indicates the required service completion time of a flow.

4.2.7. Date Fields in Flow Level Rate-based Left-bounded Category

In flow level rate based left-bounded category, the latency bound is primarily influenced by the ratio of a flow’s maximum packet size, its allocated service rate, start time and completion time. An example of this queuing solution is N-SCORE [I-D.ietf-detnet-nscore].

When the type is set to 0x0007, indicates the queuing and scheduling solutions in flow level Rate based left-bounded category. The data fields and related information may be carried and designed as following shown:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Maximum packet size                     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         Service rate                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         Finish time                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Eligible time                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 10 Data Fields in Flow Level Rate-based Left-bounded Category

Maximum packet size: 32 bits, indicates the maximum packet size of a flow.

Service rate: 32 bits, indicates the allocated service rate of a flow.

Finish time: 32 bits, indicates the required service completion time of a flow.

Eligible time: 32bits, indicates the required service start time of a flow.

4.3. Aggregation Option

The format of Aggregation Option is shown in Figure 11.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|      Aggregation  Level       |       Flag  |E|   Data Len    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              Aggregation ID                                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              End-to-end Delay Budget                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              End-to-end Delay Variation Budget                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 11 Aggregation Option

Aggregation Level (16 bits): indicates the aggregation level of packet treatment ensuring the deterministic latency as Figure 12 shown. This level can also indicate the aggregated class.

Value	Aggregation Level
0x0000	Reserved
0x0100	Bandwidth guarantee
0x0200	Jitter guarantee
0x0300	Delay guarantee
0x0400	Low delay and jitter guarantee
0x0500	Ultra-low delay and jitter guarantee

Figure 12 Aggregation Level

Flag: 8-bit flags field. When E is set to 1, it indicates the explicit aggregated flow identification.

Data Len:8-bit unsigned integer. Length of option data, in octets.

Aggregation ID: 32bits. It provides explicit and unique identifier for aggregated flow identification. DetNet nodes performing aggregation using aggregation ID.

End-to-end Delay Budget: 32bits. It provides the value of end-to-end delay budget for the aggregated flow.

End-to-end Delay Variation Budget: 32bits. It provides the value of end-to-end delay variation budget for the aggregated flow.

5. Encapsulation Considerations for DetNet Enhanced Data Plane

5.1. Metadata for DetNet Enhanced Data Plane

The packet treatment should indicate the behaviour action ensuring the deterministic latency at DetNet nodes such as queuing-based mechanisms. The deterministic latency type and related parameters such as queuing-based information should be carried as metadata in data plane. And the definitions may follow these polices.

The data plane enhancement must be generic and the format must be applied to all functions and queuing mechanisms. The metadata and definitions should be common among different candidate queuing solutions.

Information and metadata MUST be simplified and limited to be carried in DetNet packets for provided deterministic latency related scheduling along the forwarding path. For example, the queuing-based information should be carried in metadata for coordination between nodes.

The requirement of the flow or service may be not suitable to be carried explicitly in DetNet data plane. The packet treatment should schedule the resources and indicate the behaviour to ensure the deterministic latency in forwarding sub-layer. So the queuing mechanisms could be viewed as a type of deterministic resources. The resources type and queuing type should be explicitly indicated.

5.2. Encoding for DetNet Enhanced Data Plane

5.2.1. Reuse of the Existing DSCP/TC Field

Reusing the DSCP or existing field is reasonable and simple to define and easy to standardize. For example, in IPv4 and traditional MPLS networks, it is not suitable to carry new metadata and it is suggested to reuse the original bits such as DSCP. The mapping from DSCP and the metadata such as queuing information MUST be provided in the controller plane.

DSCP value may be not sufficient and hard to distinguish between the original DiffServ service and the deterministic service. The DetNet-specific metadata can also be encoded as a common data fields such as the DetNet options defined in this document and the definition of these options are independent from the encapsulating protocols. The data fields could be encapsulated into a variety of protocols and headers, such as MPLS MNA, IPv6 options and SRv6 SRH in following sections.

5.2.2. Encapsulation in MPLS MNA

[I-D.ietf-mpls-mna-detnet] specifies formats and mechanisms for MPLS In-Stack and Post-Stack MNA carrying DetNet-specific metadata such as such as flow identification and latency information. The DetNet Deterministic Latency Option as defined in section 4.2 can be inserted to the Ancillary Data with NAS-2 indicating the latency information. The DetNet Aggregation Option as defined in section 4.3 can be inserted to the Ancillary Data when NAS-3 indicates the flow identification information.

5.2.3. Encapsulation in IPv6 Options

The DetNet-specific metadata could also be encapsulated in IPv6 options such as the Hop-by-Hop Options and Destination Options. As per {I-D.xiong-detnet-6man-queuing-option}}, the DetNet Deterministic Latency Option can be carried in an IPv6 Hop-by-Hop Option, that all DetNet forwarding nodes can use the queuing information to achieve the packet forwarding and scheduling. The DetNet Deterministic Latency Option can also be carried in an IPv6 Destination Option, that the DetNet forwarding nodes among SRv6 segment list can use the queuing-based information to achieve the packet forwarding and scheduling.

5.2.4. Encapsulation in SRv6 SRH

The DetNet-specific metadata could also be encapsulated in SRv6 SRH. As per {I-D.xiong-detnet-spring-srh-extensions}}, the DetNet Deterministic Latency Option can be carried in SRH segment list, which enables the ability of SRv6 networks to forward a DetNet flow per segment list.

6. Security Considerations

Security considerations for DetNet are covered in the DetNet Architecture [RFC8655] and DetNet data plane [RFC8938], [RFC8939], [RFC8964] and DetNet security considerations [RFC9055]. The security considerations specified in [I-D.ietf-detnet-scaling-requirements] are also applicable to the procedures defined in this document.

7. IANA Considerations

IANA has defined a registry group named "DetNet Data Fields". This group includes the DetNet Option-Type registry. This registry defines code points for the DetNet Option-Type field for identifying DetNet-Option-Types. The following code points are defined in this document:

TBD1: DetNet Deterministic Latency Option

TBD2: DetNet Aggregation Option

8. Acknowledgements

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