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Export of Segment Routing IPv6 Information in IP Flow Information Export (IPFIX)

Abstract

   This document introduces new IP Flow Information Export (IPFIX)
   information elements to identify the SRv6 Segment Routing Header
   dimensions and SRv6 Control Plane Protocol that traffic is being
   forwarded with.

Status of This Memo

   This Internet-Draft is submitted in full conformance with the
   provisions of BCP 78 and BCP 79.

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   material or to cite them other than as "work in progress."

   This Internet-Draft will expire on 21 September 2022.

Table of Contents

1. Introduction

A new type of Routing Extension Header called Segment Routing Header
(SRH) is defined by [RFC8754] which is used for applying Segment
Routing (SR) on the IPv6 data plane.

Three routing protocol extensions, OSPFv3 Extensions [I-D.li-lsr-
ospfv3-srv6-extensions], IS-IS Extensions [I-D.ietf-lsr-isis-srv6-
extensions], BGP Prefix Segment Identifiers (Prefix-SIDs) [I-D.ietf-
bess-srv6-services] and one Path Computation Element Communication
Protocol (PCEP) Extension [I-D.ietf-pce-segment-routing-ipv6] have
been defined to propagate Segment Identifiers (SIDs) for the IPv6
data plane.

This document defines eight new IPFIX Information Elements (IEs) and
two new subregistries within the "IPFIX Information Elements"
registry [RFC7012], respectively for the new SRH dimensions and
routing protocol and PCEP extensions.

2. IPFIX Information Elements

This section defines and describes the new IPFIX IEs.

ipv6SRHFlags

   8-bit flags defined in the SRH.

ipv6SRHTag

   16-bit tag field defined in the SRH that marks a packet as part
   of a class or group of packets sharing the same set of
   properties.

ipv6SRHSegment

   128-bit IPv6 address that represents an SRv6 segment.

ipv6SRHSegmentBasicList

   Ordered basicList [RFC6313] of zero or more 128-bit IPv6
   addresses in the SRH that represents the SRv6 segment list. The
   Segment List is encoded starting from the active segment of the
   SR Policy.

ipv6SRHSegmentListSection

   Exposes the SRH Segment List as defined in section 2 of [RFC8754]
   as series of n octets.

ipv6SRHSegmentsLeft

   8-bit unsigned integer defining the number of route segments
   remaining to reach the end of the segment list.

ipv6SRHSection

   Exposes the SRH and its TLV's as defined in section 2 of
   [RFC8754] as series of n octets.

ipv6SRHSegmentType

   Name of the routing protocol or PCEP extension from where the
   active SRv6 segment has been learned from.

3. Use Cases

By using ipv6SRHSegmentBasicList(TBD4), ipv6SRHSegmentsLeft (TBD6),
ipv6SRHSegmentType(TBD8) and forwardingStatus(89) it is possible to
identify

  *how many packets are forwarded or dropped

  *if dropped, for which reasons,

  *identify the control plane protocol which defined the active
   segment,

  *the SRv6 segment list and

  *how many SRv6 segments are left.

4. IANA Considerations

This document requests IANA to create new IEs (see table1) and two
new subregistries called "IPFIX IPv6 SRH Flags" (table 2) and "IPFIX
IPv6 SRH Segment type" (table 3) under the "IPFIX Information
Elements" registry [RFC7012] available at [IANA-IPFIX] and assign
the following code initial points.

```
+-------+---------------------------+
|Element|          Name             |
|   ID  |                           |
+-------+---------------------------+
| TBD1  | ipv6SRHFlags              |
|       |                           |
+-------+---------------------------+
| TBD2  | ipv6SRHTag                |
|       |                           |
+-------+---------------------------+
| TBD3  | ipv6SRHSegment            |
|       |                           |
+-------+---------------------------+
| TBD4  | ipv6SRHSegmentBasicList   |
|       |                           |
+-------+---------------------------+
| TBD5  | ipv6SRHSegmentListSection |
|       |                           |
+-------+---------------------------+
| TBD6  | ipv6SRHSegmentsLeft       |
|       |                           |
+-------+---------------------------+
| TBD7  | ipv6SRHSection            |
+-------+---------------------------+
| TBD8  | ipv6SRHSegmentType        |
+-------+---------------------------+
```

Table 1: Creates IEs in the "IPFIX Information Elements" registry

Note to the RFC-Editor:

*Please replace TBD1 - TBD12 with the values allocated by IANA

*Please replace the [RFC-to-be] with the RFC number assigned to
 this document

4.1. ipv6SRHFlags

Name: ipv6SRHFlags ElementID: TBD1 Description: This Information
Element identifies the 8-bit flags defined in the SRH. Values for
this Information Element are listed in the "IPFIX IPv6 SRH Flags"

registry, see [IANA-IPFIX]. Initial values in the registry are
defined by the table below. New assignments of values will be
administered by IANA and are subject to Expert Review Abstract Data
Type: unsigned8 Data Type Semantics: flags Reference: [RFC-to-be],
RFC8754[RFC8126]. Experts need to check definitions of new values
for completeness, accuracy, and redundancy.


```
+--------+------------------+------------------------------------+
| Value  |   Description    |              Reference             |
+--------+------------------+------------------------------------+
| 0-7    | Unassigned       |                                    |
+--------+------------------+------------------------------------+
```

         Table 2: "IPFIX IPv6 SRH Flags" registry

4.2. ipv6SRHTag

   Name: ipv6SRHTag ElementID: TBD2 Description: This Information
   Element identifies the 16-bit tag field defined in the SRH that
   marks a packet as part of a class or group of packets sharing the
   same set of properties. Abstract Data Type: unsigned16 Data Type
   Semantics: identifier Reference: [RFC-to-be], RFC8754

4.3. ipv6SRHSegment

   Name: ipv6SRHSegment ElementID: TBD3 Description: This Information
   Element identifies the 128-bit IPv6 address that represents an SRv6
   segment. Abstract Data Type: ipv6address Data Type Semantics:
   default Reference: [RFC-to-be], RFC8754

4.4. ipv6SRHSegmentBasicList

   Name: ipv6SRHSegmentBasicList ElementID: TBD4 Description: This
   Information Element identifies the Ordered basicList [RFC6313] of
   zero or more 128-bit IPv6 addresses in the SRH that represents the
   SRv6 segment list. The Segment List is encoded starting from the
   active segment of the SR Policy. Abstract Data Type: basicList Data
   Type Semantics: list Reference: [RFC-to-be], RFC8754

4.5. ipv6SRHSegmentListSection

   Name: ipv6SRHSegmentListSection ElementID: TBD5 Description: Exposes
   the SRH Segment List as defined in section 2 of Abstract Data Type:
   octetArray Data Type Semantics: default Reference: [RFC-to-be],
   RFC8754[RFC8754] as series of n octets.

4.6. ipv6SRHSegmentsLeft

Name: ipv6SRHSegmentsLeft ElementID: TBD6 Description: This
Information Element identifies the 8-bit unsigned integer defining
the number of route segments remaining to reach the end of the
segment list. Abstract Data Type: unsigned8 Data Type Semantics:
quantity Reference: [RFC-to-be], RFC8754

4.7. ipv6SRHSection

Name: ipv6SRHSection ElementID: TBD7 Description: This Information
Element exposes the SRH and its TLV's as defined in s ection 2 of
Abstract Data Type: octetArray Data Type Semantics: default
Reference: [RFC-to-be], RFC8754[RFC8754] as series of n octets.

4.8. ipv6SRHSegmentType

Name: ipv6SRHSegmentType ElementID: TBD8 Description: This
Information Element identifies the name of the routing protocol or
PCEP extension from where the active SRv6 segment has been learned
from. Values for this Information Element are listed in the "IPFIX
IPv6 SRH Segment type" registry, see [IANA-IPFIX]. Initial values in
the registry are defined by the table below. New assignments of
values will be administered by IANA and are subject to Expert Review
Abstract Data Type: unsigned8 Data Type Semantics: identifier
Reference: [RFC-to-be][RFC8126]. Experts need to check definitions
of new values for completeness, accuracy, and redundancy.

```
+-------+-------------------+------------------------------------+
| Value |    Description    |              Reference             |
+-------+-------------------+------------------------------------+
| TBD9  | Unknown           | [RFC-to-be]                        |
|       |                   |                                    |
+-------+-------------------+------------------------------------+
| TBD10 | Path Computation  | [RFC-to-be],                       |
|       | Element           | draft-ietf-pce-segment-routing-ipv6|
+-------+-------------------+------------------------------------+
| TB11  | OSPFv3            | [RFC-to-be],                       |
|       | Segment Routing   | draft-li-ospf-ospfv3-srv6-extensions |
+-------+-------------------+------------------------------------+
| TBD12 | IS-IS             | [RFC-to-be]                        |
|       | Segment Routing   | draft-ietf-lsr-isis-srv6-extensions |
+-------+-------------------+------------------------------------+
| TBD13 | BGP Segment       | [RFC-to-be],                       |
|       | Routing Prefix-SID | draft-ietf-bess-srv6-services      |
+-------+-------------------+------------------------------------+
```

Table 3: "IPFIX IPv6 SRH Segment type" subregistry

5. Operational Considerations

The zero or more 128-bit IPv6 addresses in the SRH [RFC8754] can be
exported in two different ways, with two different IPFIX IEs:

   *ipv6SRHSegmentBasicList

   *ipv6SRHSegmentListSection

The ipv6SRHSegmentBasicList encodes the SID list of IPv6 addresses
with a basicList, specified in the IPFIX Structured Data [RFC6313].
This encoding offers the advantage to the data collection that the
different IPv6 addresses are already structured as a list, without
the need of post processing. However, this method requires some
extra processing on the exporter, to realize the BasicList data
mapping.

The ipv6SRHSegmentListSection, on the other hand, encodes the list
of IPv6 addresses as an octetArray. This doesn't impose any data
flow manipulation on the exporter, facilitating the immediate
export. However, the data collection must be able to decode the IPv6
addresses according the SR specifications.

It is not expected that an exporter would support both
ipv6SRHSegmentBasicList and ipv6SRHSegmentListSection at the same
time.

6. Security Considerations

There exists no significant extra security considerations regarding
the allocation of these new IPFIX IEs compared to [RFC7012].

7. Acknowledgements

I would like to thank Pierre Francois, Yao Liu and Paolo Lucente for
their review and valuable comments.

8. References

8.1. Normative References

[RFC6313] Claise, B., Dhandapani, G., Aitken, P., and S. Yates,
           "Export of Structured Data in IP Flow Information Export
           (IPFIX)", RFC 6313, DOI 10.17487/RFC6313, July 2011,
           <https://www.rfc-editor.org/info/rfc6313>.

[RFC7012] Claise, B., Ed. and B. Trammell, Ed., "Information Model
           for IP Flow Information Export (IPFIX)", RFC 7012, DOI
           10.17487/RFC7012, September 2013, <https://www.rfc-
           editor.org/info/rfc7012>.

[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>.

8.2. Informative References

[I-D.ietf-bess-srv6-services]
          Dawra, G., Filsfils, C., Talaulikar, K., Raszuk, R.,
          Decraene, B., Zhuang, S., and J. Rabadan, "SRv6 BGP based
          Overlay Services", Work in Progress, Internet-Draft,
          draft-ietf-bess-srv6-services-13, 19 March 2022,
          <https://www.ietf.org/archive/id/draft-ietf-bess-srv6-
          services-13.txt>.

[I-D.ietf-lsr-isis-srv6-extensions]
          Psenak, P., Filsfils, C., Bashandy, A., Decraene, B.,
          and Z. Hu, "IS-IS Extensions to Support Segment Routing
          over IPv6 Dataplane", Work in Progress, Internet-Draft,
          draft-ietf-lsr-isis-srv6-extensions-18, 20 October 2021,
          <https://www.ietf.org/archive/id/draft-ietf-lsr-isis-
          srv6-extensions-18.txt>.

[I-D.ietf-pce-segment-routing-ipv6]
          Li, C., Negi, M., Sivabalan, S., Koldychev, M.,
          Kaladharan, P., and Y. Zhu, "PCEP Extensions for Segment
          Routing leveraging the IPv6 data plane", Work in
          Progress, Internet-Draft, draft-ietf-pce-segment-routing-
          ipv6-12, 6 March 2022, <https://www.ietf.org/internet-
          drafts/draft-ietf-pce-segment-routing-ipv6-12.txt>.

[I-D.li-lsr-ospfv3-srv6-extensions] Li, Z., Hu, Z., Cheng, D.,
          Talaulikar, K., and P. Psenak, "OSPFv3 Extensions for
          SRv6", Work in Progress, Internet-Draft, draft-li-lsr-
          ospfv3-srv6-extensions-00, 15 January 2020, <https://
          www.ietf.org/archive/id/draft-li-lsr-ospfv3-srv6-
          extensions-00.txt>.

[IANA-IPFIX] "IANA, "IP Flow Information Export (IPFIX) Entities"",
          <https://www.iana.org/assignments/ipfix/ipfix.xhtml>.

[RFC8754] Filsfils, C., Ed., Dukes, D., Ed., Previdi, S., Leddy,
          J., Matsushima, S., and D. Voyer, "IPv6 Segment Routing
          Header (SRH)", RFC 8754, DOI 10.17487/RFC8754, March
          2020, <https://www.rfc-editor.org/info/rfc8754>.

Appendix A. IPFIX Encoding Example

   In this section an example is provided to show the encoding format
   for the newly introduced IEs.

```
+-----+------+-----+--------+------------------------------------|
| SRH | SRH  | SRH | Segment|            Segment List            |
| Nr  | Flags| Tag | Type   |                                    |
+-----+------+-----+--------+------------------------------------+
| 1   | 0    | 123 | IS-IS  | 2001:db8::1, 2001:db8::2, 2001:db8::3 |
+-----+------+-----+--------+------------------------------------+
| 2   | 0    | 456 | IS-IS  | 2001:db8::4, 2001:db8::5           |
+-----+------+-----+--------+------------------------------------+
| 3   | 0    | 789 | IS-IS  | 2001:db8::6                        |
+-----+------+-----+--------+------------------------------------+
```

           Table 4: 3 observed SRH headers and their routing protocol

A.1. Template Record

```
  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
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |          SET ID = 2           |          Length = 41          |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |       Template ID = 256       |        Field Count = 4        |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |0|     ipv6SRHFlags = TBD1     |        Field Length = 1       |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |0|      ipv6SRHTag = TBD2      |        Field Length = 2       |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |0|  ipv6SRHSegmentType = TBD8  |        Field Length = 1       |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |0|    ipv6SRHSegment = TBD3    |        Field Length = 16      |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |0|ipv6SRHSegmentBasicList= TBD4|      Field Length = 0xFFFF    |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

               Table 4: Template Record Encoding Format

   In this example, the Template ID is 256, which will be used in the
   Data Record. The field length for ipv6SRHSegmentBasicList is 0xFFFF,
   which means the length of this IE is variable, and the actual length
   of this IE is indicated by the List Length field in the basicList
   format as per [RFC6313].

A.2. Data Set

The data set is represented as follows:

```
  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
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |         SET ID = 256          |          Length = 136         |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 | ipv6SRHFlags  |      ipv6SRHTag = 123         | ipv6SRHSegment|
 | = 0           |                               | Type = TBD12  |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |     255       |       List Length = 53        |semantic=      |
 |               |                               |ordered        |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |     ipv6SRHSegment = TBD4     |       Field Length = 16       |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |            Segment List[0] = 2001:db8::1  (16 bytes)          |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |            Segment List[1] = 2001:db8::2  (16 bytes)          |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |            Segment List[2] = 2001:db8::3  (16 bytes)          |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 | ipv6SRHFlags  |      ipv6SRHTag = 456         | ipv6SRHSegment|
 | = 0           |                               | Type = TBD12  |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |     255       |       List Length = 37        |semantic=      |
 |               |                               |ordered        |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |     ipv6SRHSegment = TBD4     |       Field Length = 16       |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |            Segment List[0] = 2001:db8::4  (16 bytes)          |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |            Segment List[1] = 2001:db8::5  (16 bytes)          |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 | ipv6SRHFlags  |      ipv6SRHTag = 789         | ipv6SRHSegment|
 | = 0           |                               | Type = TBD12  |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |     255       |       List Length = 21        |semantic=      |
 |               |                               |ordered        |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |     ipv6SRHSegment = TBD4     |       Field Length = 16       |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |            Segment List[0] = 2001:db8::6  (16 bytes)          |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

                 Table 5: Data Set Encoding Format

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