

# Export of Segment Routing IPv6 Information in IPFIX

draft-ietf-opsawg-ipfix-srv6-srh-03

Enabling insights in SRv6 forwarding plane  
by adding Segment Routing dimensions

thomas.graf@swisscom.com  
benoit.claise@huawei.com  
pierre.francois@insa-lyon.fr

06. November 2022

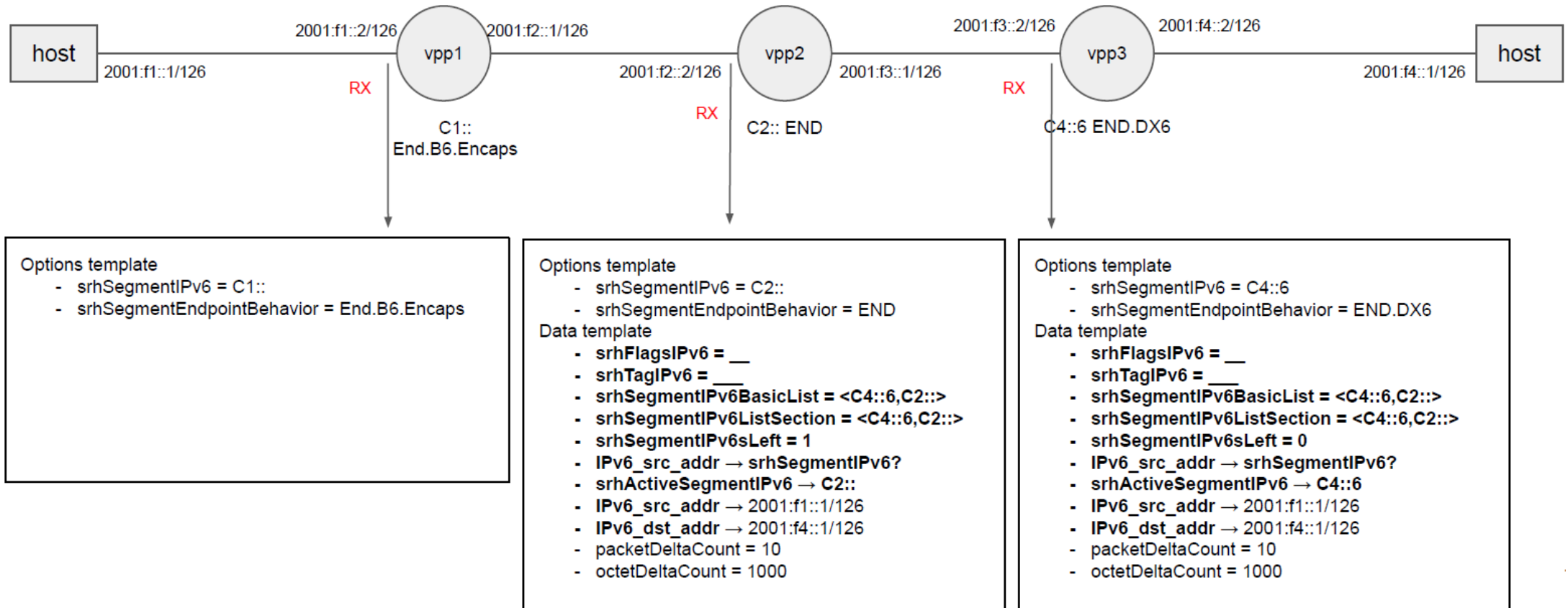
# SRv6 @ IPFIX

## Draft Status

- Received comments from SPRING, OPSAWG and network vendors working on implementations.
- **Addressed all open issues.** Verified with IANA how to manage the `srhFlagsIPv6` and `srhSegmentEndpointBehavior` registries. Outcome is to have a reference to the "Segment Routing Header" registry instead of listing the entries in the IPFIX registry.
- Expanded the terminology section to have a consolidated view on which terms are inherited from which RFC.
- Added "Segment Routing Policy" in the `srhActiveSegmentIPv6Type` registry.
- Added "Multiple Segment Routing Headers" in the "Operational Considerations" section.
- Corrected "Template Record and Data Set with SRH Section" example.
- Added the "Implementation Status" to document the current implementations.

# IETF 115 Hackathon – VPP Implementation Status

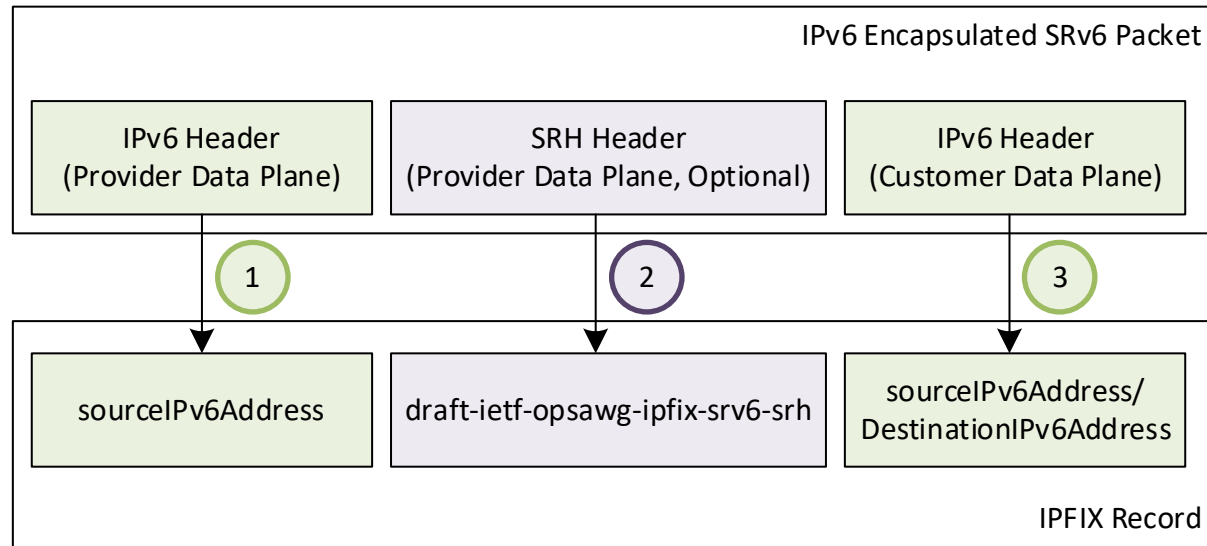
## Lab topology



- FD.io VPP Open Source Code published: <https://github.com/insa-unyte/vpp-srh-onpath-telemetry>

# IETF 115 Hackathon - VPP Implementation Status

## Record order matters



- Shows an IPFIX data-template example for a IPv6 encapsulated SRv6 Packet. **IPFIX entity sourceIPv6Address appears twice.**
- Order of the data records matter as described in Section 8 of [RFC7011].** Distinguishes between the tunneled Customer Data Plane and the Provider Data Plane.

```
> Ethernet II, Src: 02:fe:8e:15:ec:19 (02:fe:8e:15:ec:19), Dst: 76:d6:24:24:bf:67 (76:d6:24:24:bf:67)
> Internet Protocol Version 4, Src: 22.22.22.22, Dst: 10.11.4.1
> User Datagram Protocol, Src Port: 4739, Dst Port: 4739
> Cisco NetFlow/IPFIX
  Version: 10
  Length: 72
  Timestamp: Oct 12, 2022 12:17:43.000000000 W. Europe Daylight Time
  FlowSequence: 2
  Observation Domain Id: 1
  Set 1 [id=2] (Data Template): 256
    FlowSet Id: Data Template (V10 [IPFIX]) (2)
    FlowSet Length: 56
  Template (Id = 256, Count = 12)
    Template Id: 256
    Field Count: 12
    > Field (1/12): IPV6_SRC_ADDR
    > Field (2/12): Unknown(503)
      0... .. = Pen provided: No
      .000 0001 1111 0111 = Type: Unknown (503)
      Length: 16
    > Field (3/12): Unknown(510)
      0... .. = Pen provided: No
      .000 0001 1111 1110 = Type: Unknown (510)
      Length: 2
    > Field (4/12): Unknown(506)
      0... .. = Pen provided: No
      .000 0001 1111 1010 = Type: Unknown (506)
      Length: 1
    > Field (5/12): Unknown(500)
      0... .. = Pen provided: No
      .000 0001 1111 0100 = Type: Unknown (500)
      Length: 1
    > Field (6/12): Unknown(501)
      0... .. = Pen provided: No
      .000 0001 1111 0101 = Type: Unknown (501)
      Length: 2
    > Field (7/12): Unknown(505)
      0... .. = Pen provided: No
      .000 0001 1111 1001 = Type: Unknown (505)
      Length: 128
    > Field (8/12): Unknown(504)
      0... .. = Pen provided: No
      .000 0001 1111 1000 = Type: Unknown (504)
      Length: 65535 [i.e.: "Variable Length"]
    > Field (9/12): IPV6_SRC_ADDR
    > Field (10/12): IPV6_DST_ADDR
    > Field (11/12): PKTS
    > Field (12/12): BYTES
```

# IETF 115 Hackathon - VPP Implementation Status

## Records exposed

### (1) **srhActiveSegmentIPv6**

128-bit IPv6 address that represents the active SRv6 segment.

### (2) **srhSegmentEndpointBehavior**

16-bit unsigned integer that represents a SRv6 Endpoint behavior as per Section 4 of [RFC8986].

### (3) **srhSegmentIPv6sLeft**

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

### (4) **srhFlagsIPv6**

8-bit flags defined in the SRH.

### (5) **srhTagIPv6**

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.

### (6) **srhSegmentIPv6ListSection**

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

### (7) **srhSegmentIPv6BasicList**

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.

```
> Ethernet II, Src: 02:fe:8e:15:ec:19 (02:fe:8e:15:ec:19), Dst: 76:d6:24:24:bf:67 (76:d6:24:24:bf:67)
> Internet Protocol Version 4, Src: 22.22.22.22, Dst: 10.11.4.1
> User Datagram Protocol, Src Port: 4739, Dst Port: 4739
< Cisco NetFlow/IPFIX
  Version: 10
  Length: 72
  Timestamp: Oct 12, 2022 12:17:43.000000000 W. Europe Daylight Time
  FlowSequence: 2
  Observation Domain Id: 1
  Set 1 [id=2] (Data Template): 256
    FlowSet Id: Data Template (V10 [IPFIX]) (2)
    FlowSet Length: 56
    Template (Id = 256, Count = 12)
      Template Id: 256
      Field Count: 12
        > Field (1/12): IPV6_SRC_ADDR
        > Field (2/12): Unknown(503)
          0... .. = Pen provided: No
          .000 0001 1111 0111 = Type: Unknown (503)
          Length: 16
        > Field (3/12): Unknown(510)
          0... .. = Pen provided: No
          .000 0001 1111 1110 = Type: Unknown (510)
          Length: 2
        > Field (4/12): Unknown(506)
          0... .. = Pen provided: No
          .000 0001 1111 1010 = Type: Unknown (506)
          Length: 1
        > Field (5/12): Unknown(500)
          0... .. = Pen provided: No
          .000 0001 1111 0100 = Type: Unknown (500)
          Length: 1
        > Field (6/12): Unknown(501)
          0... .. = Pen provided: No
          .000 0001 1111 0101 = Type: Unknown (501)
          Length: 2
        > Field (7/12): Unknown(505)
          0... .. = Pen provided: No
          .000 0001 1111 1001 = Type: Unknown (505)
          Length: 128
        > Field (8/12): Unknown(504)
          0... .. = Pen provided: No
          .000 0001 1111 1000 = Type: Unknown (504)
          Length: 65535 [i.e.: "Variable Length"]
        > Field (9/12): IPV6_SRC_ADDR
        > Field (10/12): IPV6_DST_ADDR
        > Field (11/12): PKTS
        > Field (12/12): BYTES
```

1

2

3

4

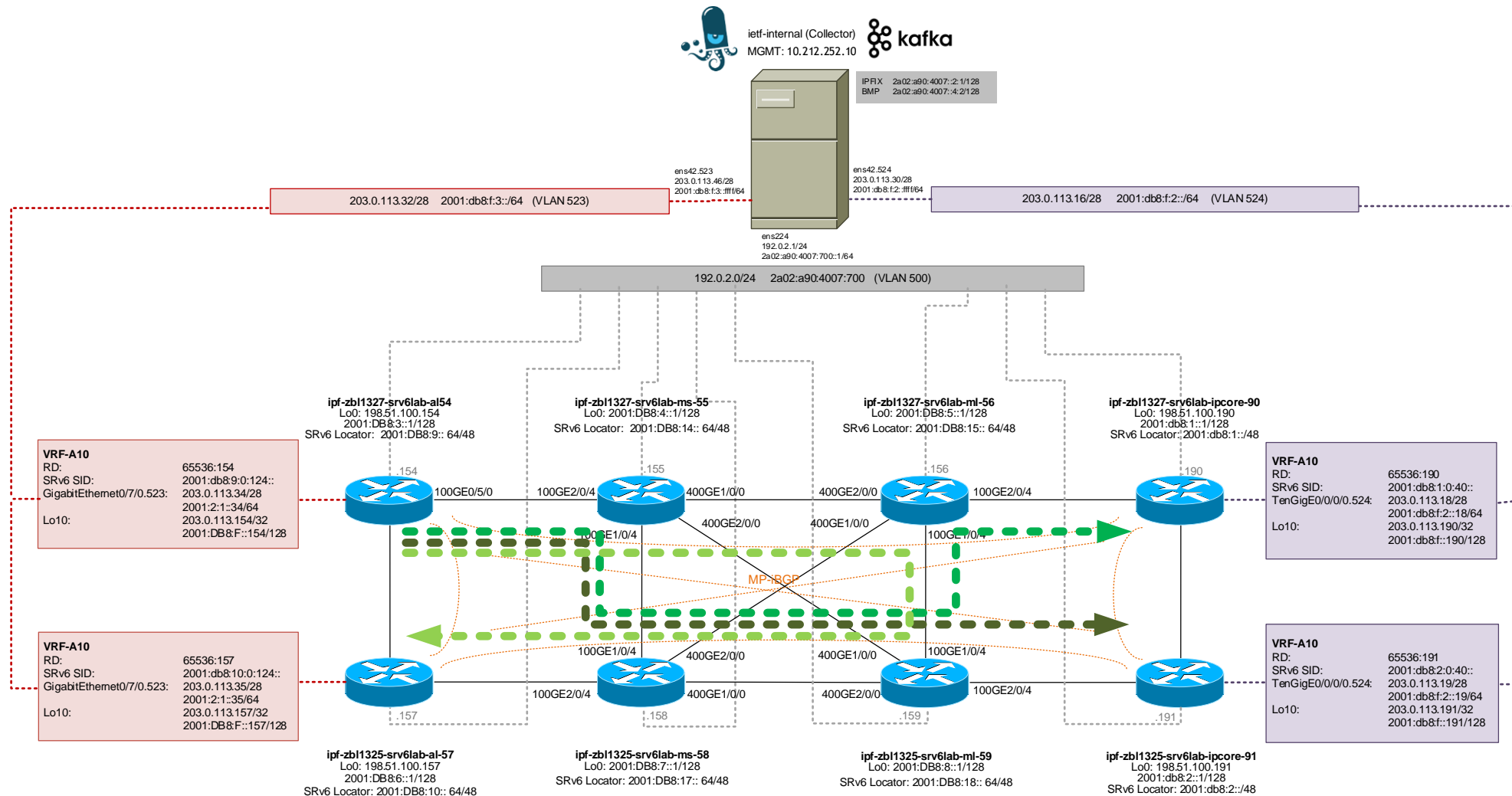
5

6

7

# IETF 115 Hackathon - Huawei Implementation Status

## Lab topology



- SRv6 network topology with two vendors and IPFIX data processing pipeline.
- Huawei with four P and two PE nodes exposing SRH provider data-plane as described in draft-ietf-opsawg-ipfix-srv6-srh.
- Cisco with two PE nodes exposing customer data-plane.

# IETF 115 Hackathon - Huawei Implementation Status

## Records exposed

### (1) **srhFlagsIPv6**

8-bit flags defined in the SRH.

### (2) **srhTagIPv6**

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.

### (3) **srhActiveSegmentIPv6**

128-bit IPv6 address that represents the active SRv6 segment.

### (4) **srhSegmentIPv6ListSection**

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

### (5) **srhSegmentIPv6sLeft**

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

According to A.1.2. Template Record and Data Set with Segment List Section

```
> Field (10/33): INPUT_SNMP
> Field (11/33): OUTPUT_SNMP
> Field (12/33): SRC_AS
> Field (13/33): DST_AS
> Field (14/33): L4_SRC_PORT
> Field (15/33): L4_DST_PORT
> Field (16/33): SRC_VLAN
> Field (17/33): DST_VLAN
> Field (18/33): 232 [pen: HUAWEI Technology Co.,Ltd]
> Field (19/33): TCP_FLAGS
> Field (20/33): PROTOCOL
> Field (21/33): IP_TOS
> Field (22/33): IPV6_SRC_MASK
> Field (23/33): IPV6_DST_MASK
> Field (24/33): DIRECTION
> Field (25/33): FORWARDING_STATUS
> Field (26/33): FLOW_LABEL
> Field (27/33): FlowEndReason
> Field (28/33): 501 [pen: HUAWEI Technology Co.,Ltd]
  1... .. = Pen provided: Yes
  .000 0001 1111 0101 = Type: 501 [pen: HUAWEI Technology Co.,Ltd]
  Length: 1
  PEN: HUAWEI Technology Co.,Ltd (2011)
> Field (29/33): 502 [pen: HUAWEI Technology Co.,Ltd]
  1... .. = Pen provided: Yes
  .000 0001 1111 0110 = Type: 502 [pen: HUAWEI Technology Co.,Ltd]
  Length: 2
  PEN: HUAWEI Technology Co.,Ltd (2011)
> Field (30/33): 503 [pen: HUAWEI Technology Co.,Ltd]
  1... .. = Pen provided: Yes
  .000 0001 1111 0111 = Type: 503 [pen: HUAWEI Technology Co.,Ltd]
  Length: 16
  PEN: HUAWEI Technology Co.,Ltd (2011)
> Field (31/33): 504 [pen: HUAWEI Technology Co.,Ltd]
  1... .. = Pen provided: Yes
  .000 0001 1111 1000 = Type: 504 [pen: HUAWEI Technology Co.,Ltd]
  Length: 1
  PEN: HUAWEI Technology Co.,Ltd (2011)
> Field (32/33): paddingOctets
> Field (33/33): 505 [pen: HUAWEI Technology Co.,Ltd]
  1... .. = Pen provided: Yes
  .000 0001 1111 1001 = Type: 505 [pen: HUAWEI Technology Co.,Ltd]
  Length: 65535 [i.e.: "Variable Length"]
  PEN: HUAWEI Technology Co.,Ltd (2011)
```

1

2

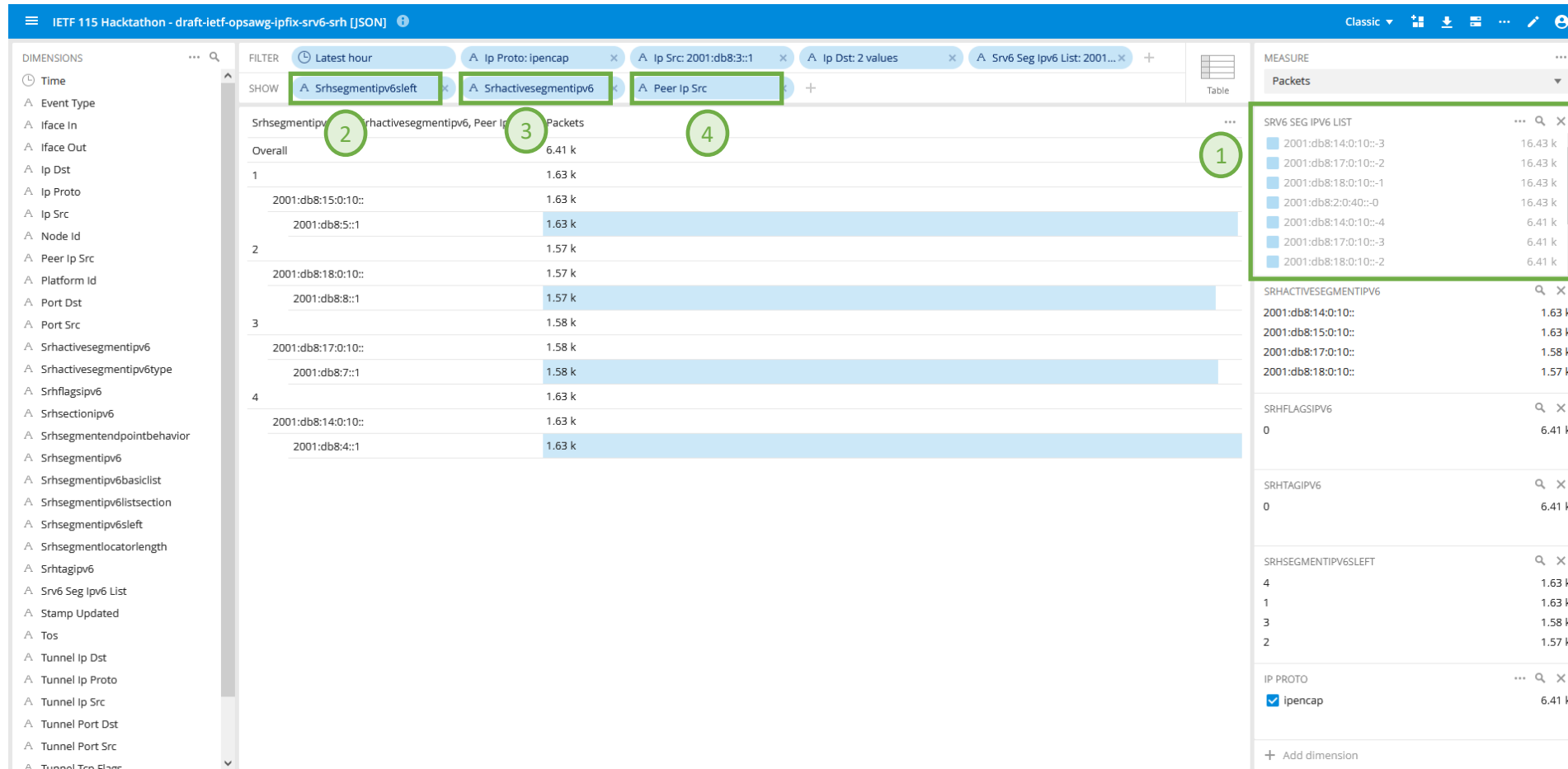
3

4

5

# IETF 115 Hackathon – Monitoring your neighbor desk

## When all puzzle pieces fall together for the very first time



- (1) With Segment List Section we can **select the traffic engineered path.**
- (2) Segments Left shows **where we are** in the forwarding path.
- (3) Active Segment **where we forward next to.**
- (4) Peer IP Src from where the metrics where **exporter from.**



# SRv6 @ IPFIX

## Next Steps

- **Missing SRv6 data-plane visibility is a recognized problem.**
- **Open-source running code published on <https://github.com/insa-unyte/vpp-srh-onpath-telemetry>.**
- **First commercial vendor implementations will be public end of Q1 and Q3 2023.**
- **The authors would like to ask the OPSAWG working group wherever they belief that the document is in stable state to request early code point allocation at IANA or not.**

thomas.graf@swisscom.com  
benoit.claise@huawei.com  
pierre.francois@insa-lyon.fr

6. November 2022