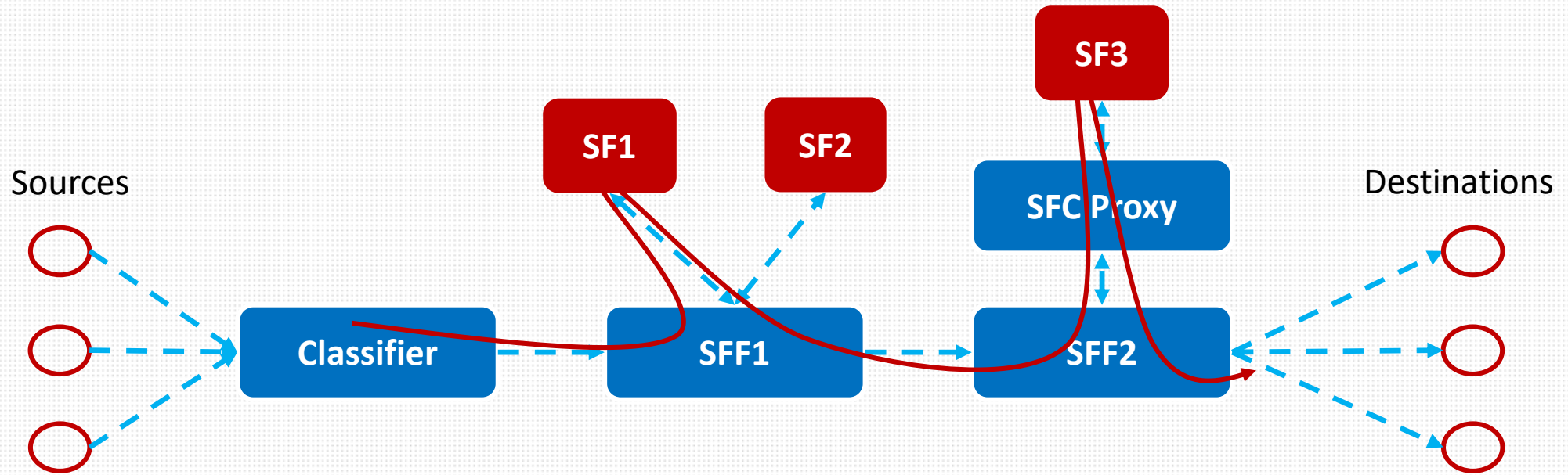# Leveraging SR to Realize Transport-Independent Service Function Chaining
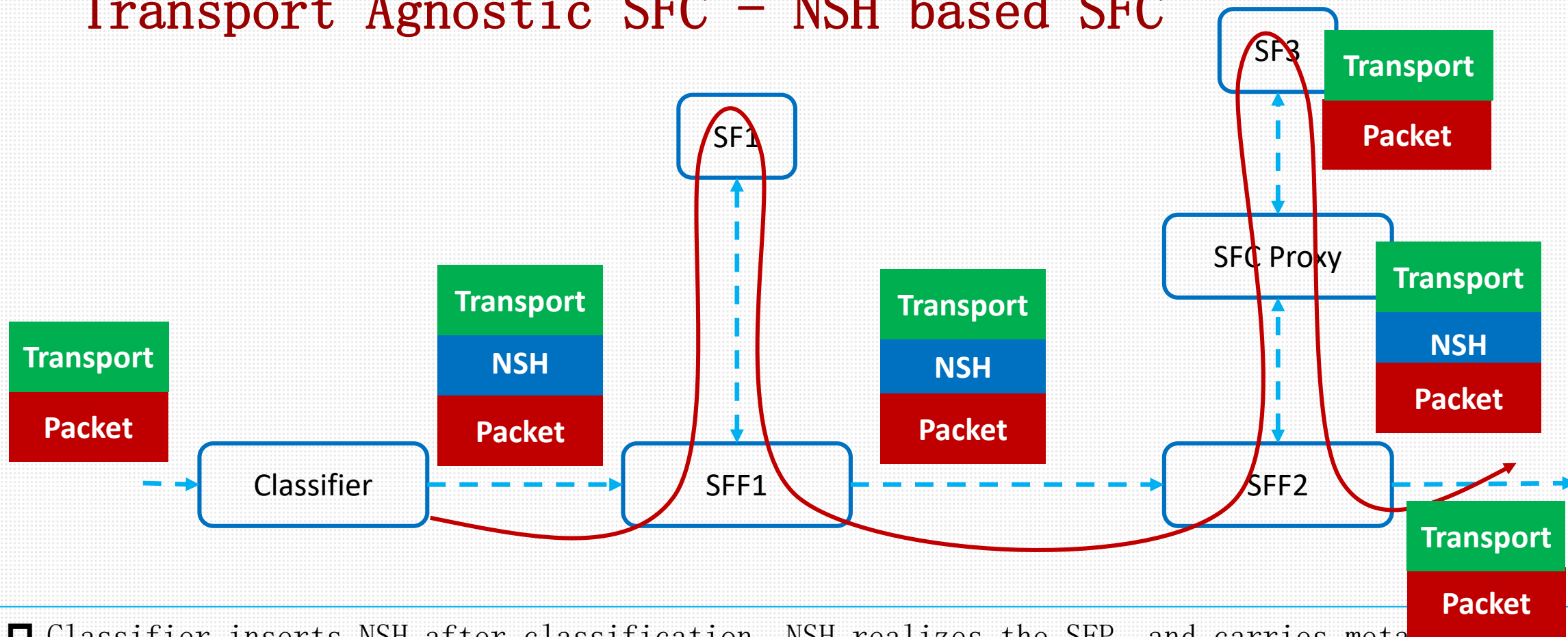
- Mach Chen
- mach.chen@huawei.com

www.huawei.com

An Overview of SFC Architecture
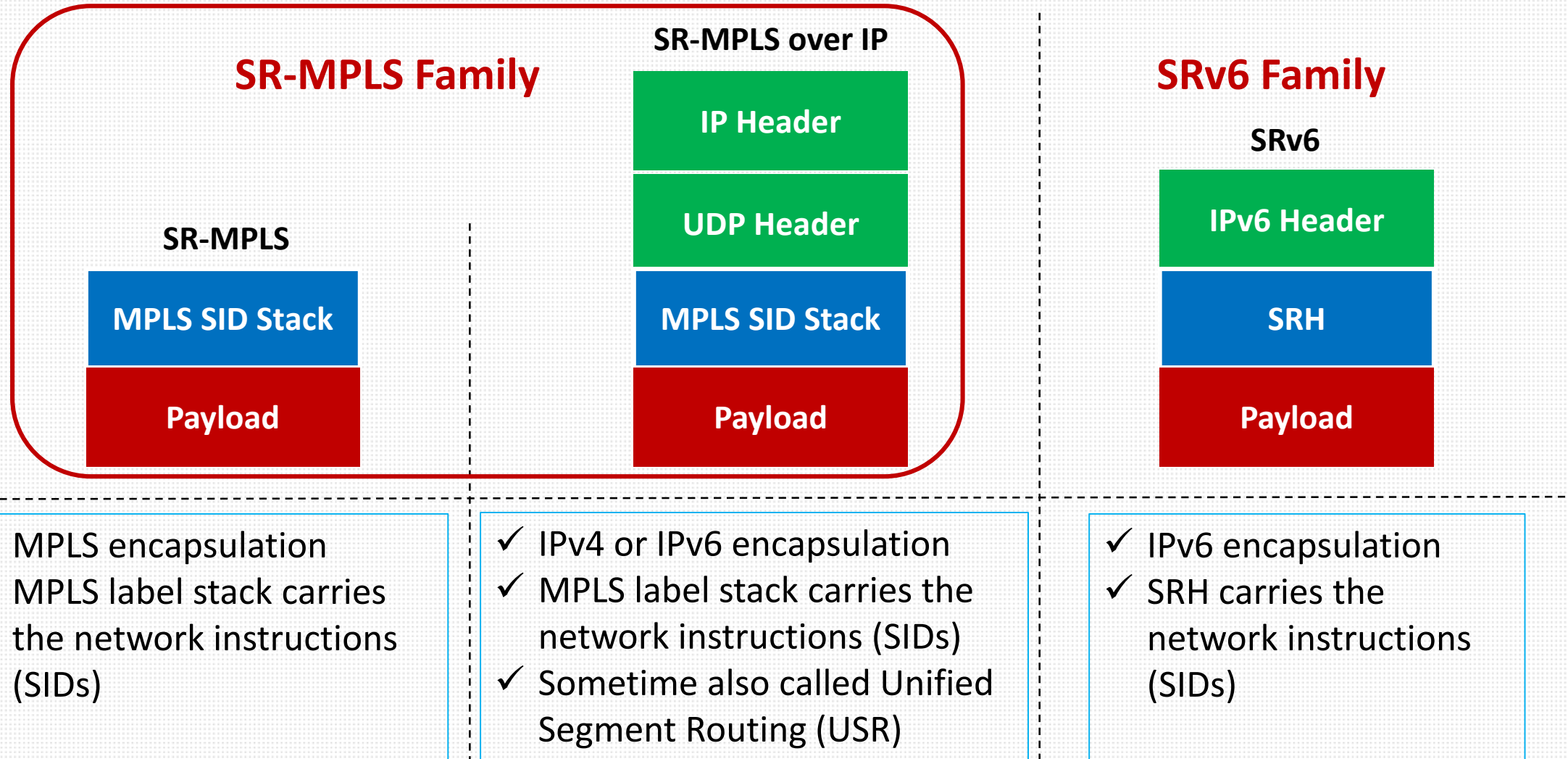

- ☐ Given an SFC
  - ✓ SFC: <SF1, SF3>
- ☐ Packets are classified onto a Service Function Path (SFP)
  - ✓ SFP: <SFF1, SF1, SFF2, SF3>
- ☐ Service Function Forwarder (SFF) determines packets to SF or to next SFF
- ☐ SFC proxy may be placed between SFF and SF to support SFC-unware SF

HUAWEI

Transport Agnostic SFC – NSH based SFC
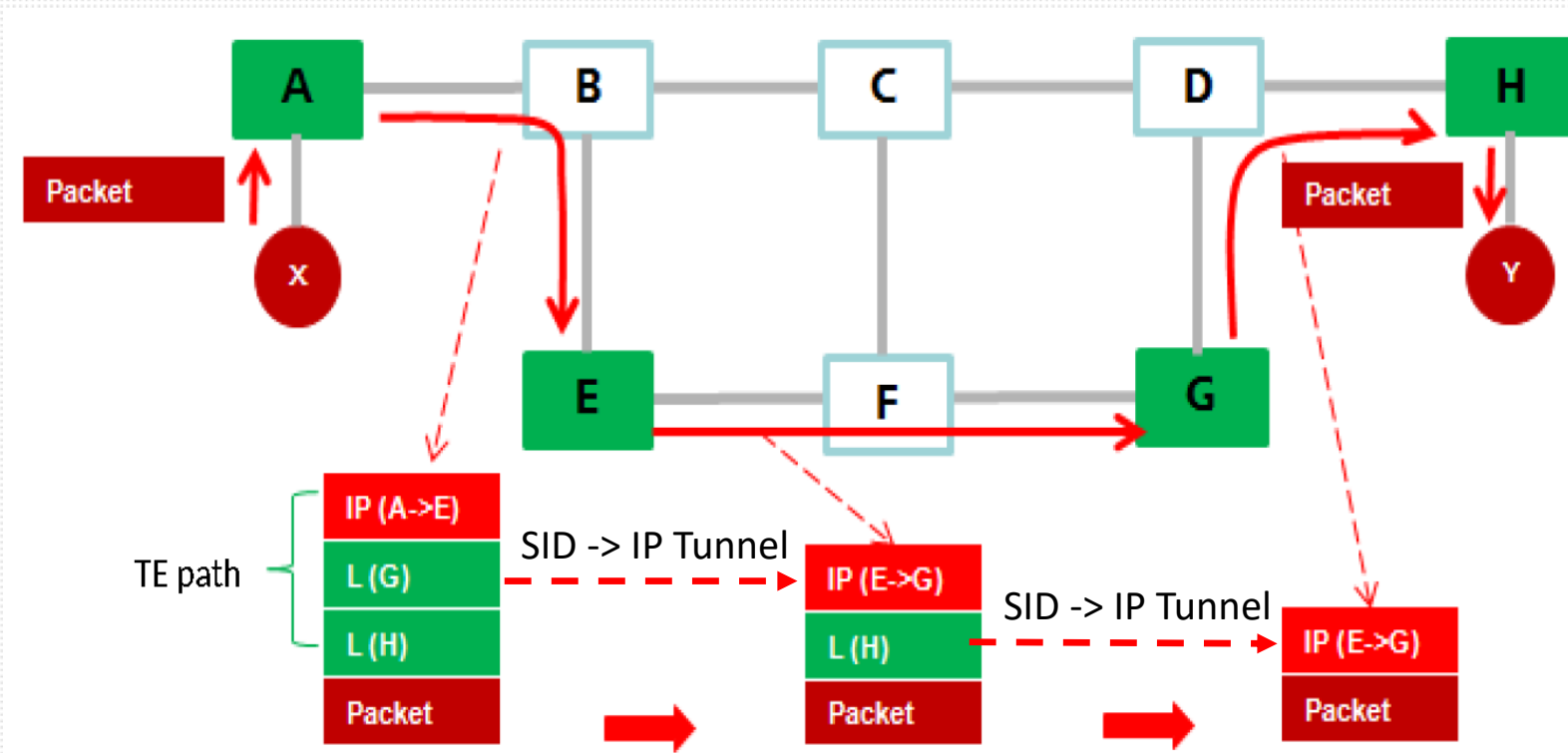

- ☐ Classifier inserts NSH after classification, NSH realizes the SFP and carries metadata
  - ✓ SFP: <SFF1, SF1, SFF2, SF3>
- ☐ SFFs maintain per-SFP states and determine (based NSH) to deliver packet to SF or to next SFF;
- ☐ SFC Proxy strips NSH when sending to NSH-unaware SF, puts the NSH back when sending back to SFF
- ☐ NSH based SFC is transport agnostic, the transport can be Ethernet, GRE, VXLAN-GPE, SR, etc.

HUAWEI

A Recall of Segment Routing Family

SR-MPLS Family

SR-MPLS over IP

SR-MPLS

MPLS SID Stack
Payload

IP Header
UDP Header
MPLS SID Stack
Payload

SRv6 Family

SRv6

IPv6 Header
SRH
Payload

- ✓ MPLS encapsulation
- ✓ MPLS label stack carries the network instructions (SIDs)

- ✓ IPv4 or IPv6 encapsulation
- ✓ MPLS label stack carries the network instructions (SIDs)
- ✓ Sometime also called Unified Segment Routing (USR)

- ✓ IPv6 encapsulation
- ✓ SRH carries the network instructions (SIDs)
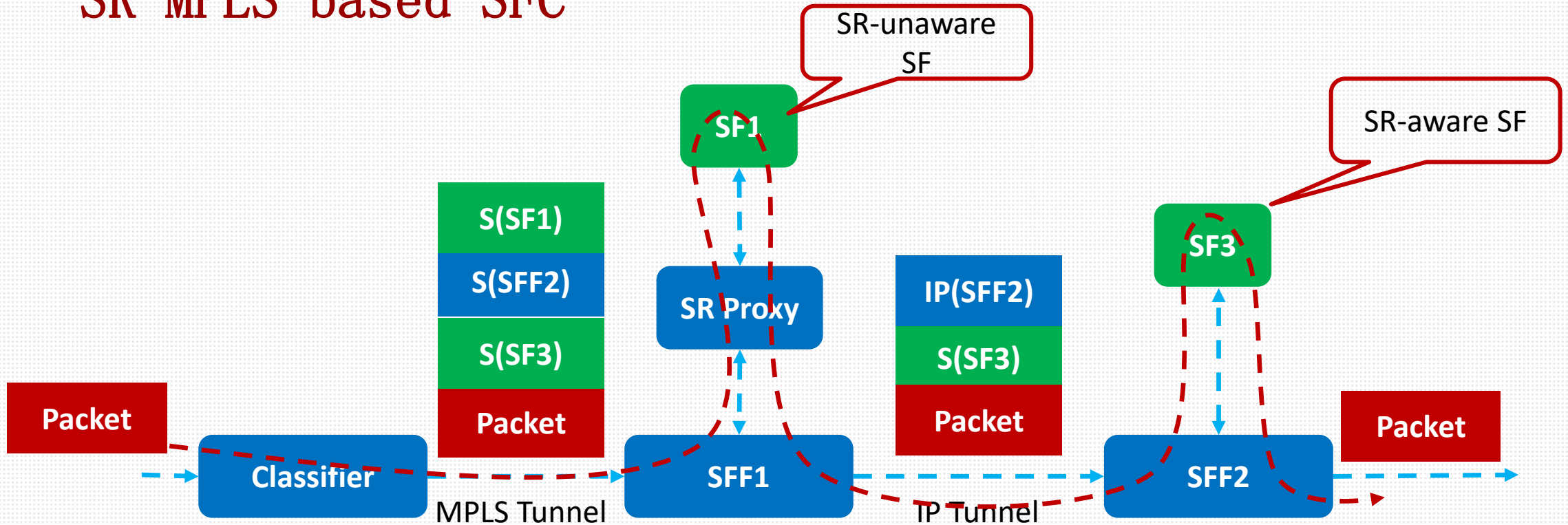
HUAWEI

What's SR-MPLS over IP?

- ✓ Encapsulate a "normal" SR-MPLS packet in UDP in IP
- ✓ Each SID of the MPLS SID Stack maps to an IP tunnel
- ✓ Packets tunneled to next SR-capable node in the SR path by the IP tunnel
- ✓ UDP destination port indicates "MPLS below"
- ✓ UDP source port can be used to carry entropy for ECMP purpose

Tunnel SR-MPLS over an IP network, enable SR in legacy networks by tactically introducing SR-capable nodes at strategic points in the network.
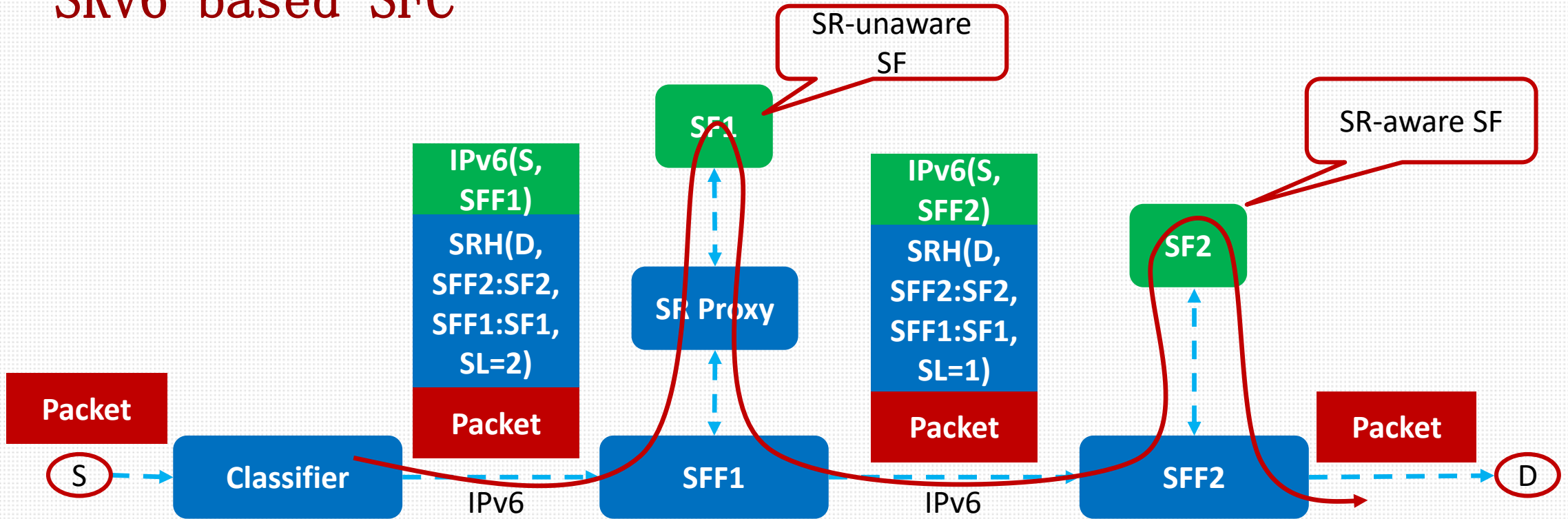
HUAWEI

Leverage SR to Realize SFC

- SR-MPLS based SFC
  - › Services encoded as stack of MPLS labels
  - › No good way to carry metadata
- SRv6 based SFC
  - › Services encoded as SRH list
  - › SRH TLV to carry metadata
- NSH-based SFC with SR as the transport tunnel
  - › SR tunnels connect SFF
  - › SFF uses NSH to determine packets to SF or to next SFF
- SR-based SFC with integrated NSH service plane
  - › SR is responsible for steering traffic through the necessary SFFs
  - › NSH is responsible for maintaining the service plane, and holding the SFC instance context and associated metadata

HUAWEI

SR-MPLS based SFC

SR-unaware SF

SR-aware SF

SF1

S(SF1)

S(SFF2)

SR Proxy

IP(SFF2)

SF3

S(SF3)

S(SF3)

Packet

Packet

Packet

Packet
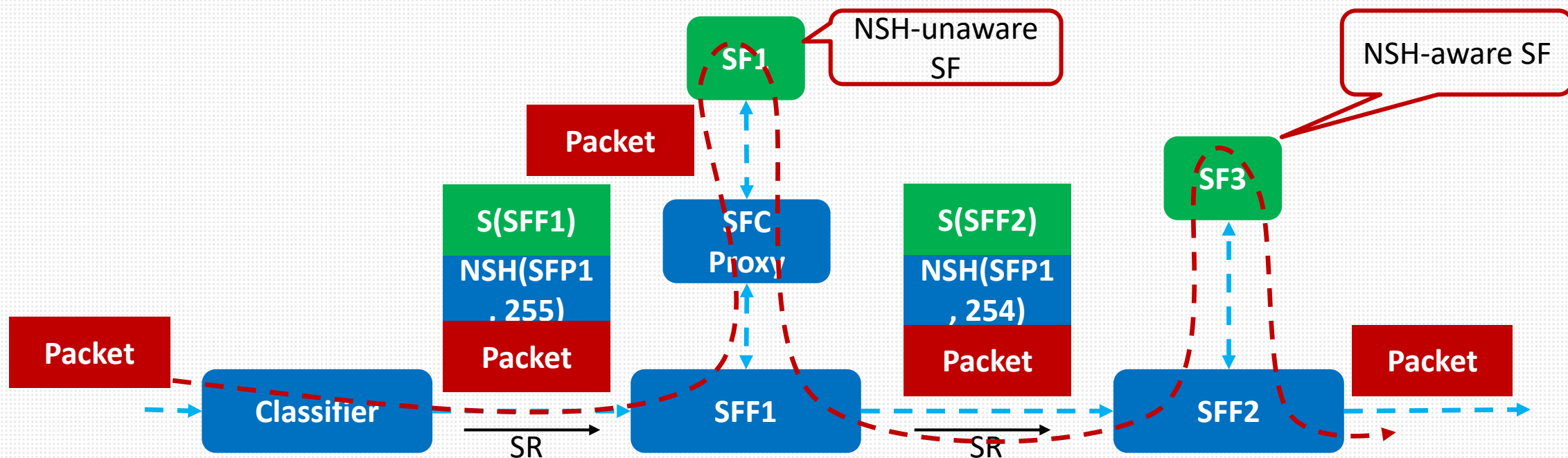
Packet

Classifier

SFF1

SFF2

MPLS Tunnel

IP Tunnel

- ✓ Each SFF and SF will be allocated an SID, an SFP is realized by a SID list (MPLS label stack)
- ✓ SF can be either SR-aware or SR unaware, SR unaware needs the help of an SR Proxy
- ✓ SR Proxy strips the SR header when send to SF, and put the SR header back when send packet to SFF
- ✓ Underneath tunnel could be MPLS, IPv4 or IPv6;
- ✓ No per-path state maintained at SFF;
- ✓ No good way to carry metadata;

HUAWEI

SRv6 based SFC

SR-unaware SF

SR-aware SF

IPv6(S, SFF1)

SRH(D, SFF2:SF2, SFF1:SF1, SL=2)

Packet

SF1

SR Proxy

IPv6(S, SFF2)

SRH(D, SFF2:SF2, SFF1:SF1, SL=1)

Packet

SF2

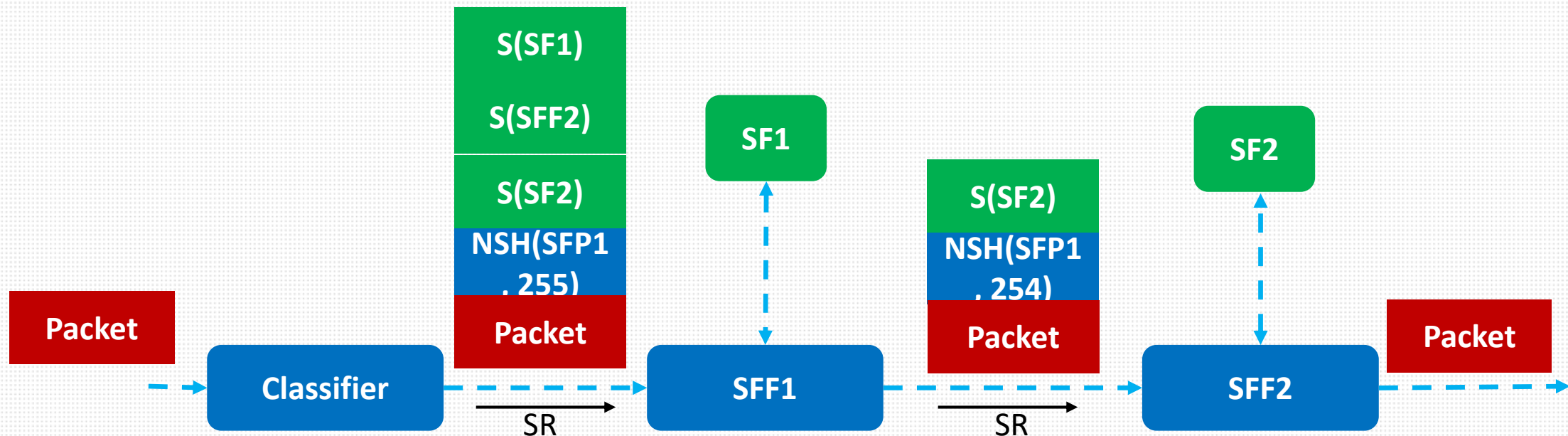Packet

Packet

S

Classifier

IPv6

SFF1

IPv6

SFF2

Packet

D

✓ Each SFF and SF will be allocated an SID, an SFP is realized by a SID list (SRH)
✓ SF can be either SR-aware or SR unaware, SR unaware needs the help of an SR Proxy
✓ SR Proxy strips the SR header when send to SF, and put the SR header back when send packet to SFF; SR proxy needs a to correlate a packet to an SRH (e.g., interface id, not perfect)
✓ Use SRH TLV to carry metadata;
✓ No per-path state maintained at SFF;
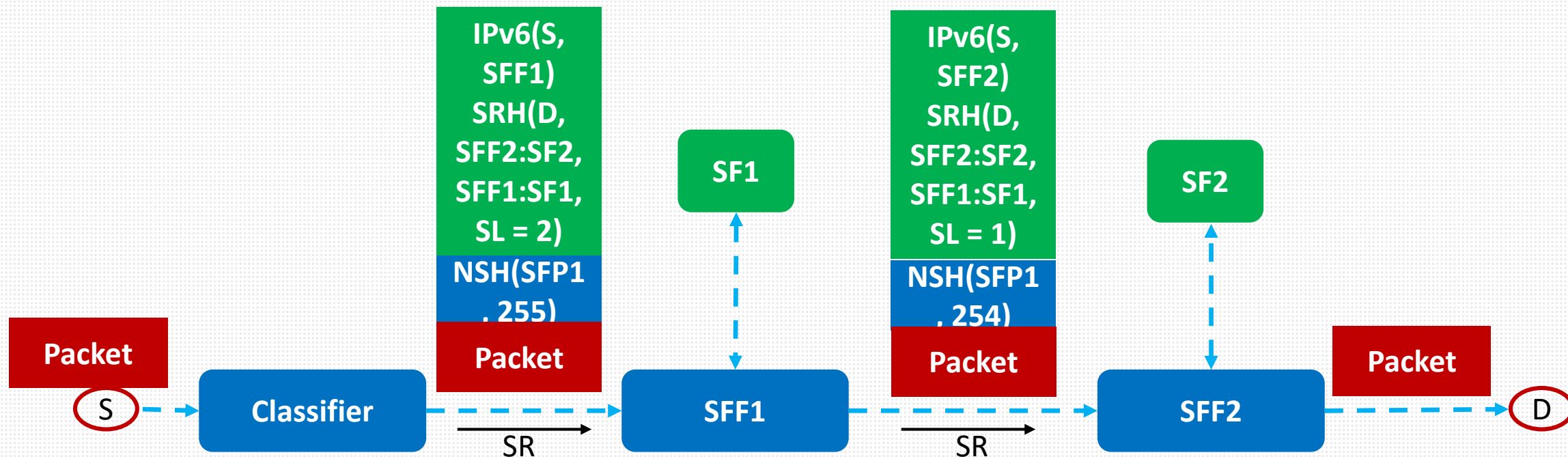
HUAWEI

NSH-based SFC with SR as the Transport Tunnel

- Classifier inserts NSH header and determines (based on NSH) whether SR tunnel will be used;
- If so, put SR header and tunnel it to next SFF;
- When packet arrived SFF, strip the SR header, send the packet to SF;
- For NSH-unaware SF, an SFC proxy will be placed between SFF and SF, the proxy responsible for strip/add NSH header;
- Totally decouple SFC layer and the transport layer, keep all merits of NSH; it can also leverage SR for Traffic steering between SFFs

SR-MPLS based SFC with Integrated NSH Service Plane

```
S(SF1)

S(SFF2)

S(SF2)
NSH(SFP1
, 255)
Packet
```

SF1

```
S(SF2)
NSH(SFP1
, 254)
Packet
```

SF2

Packet

Packet

Classifier ---- SR ----> **SFF1** ---- SR ----> **SFF2**

✓ Classifier inserts NSH header and put the SR header that realize the SFP(e.g., <SFF1, SF1, SFF2, SF2>);
✓ SFF strips the SR header before sending the packet the SF;
✓ SR header cached at SFF by using SPI as the index;
✓ When received packet from SF, using the SPI to correlate the cached SR header and put the SR header back to the packet;
✓ Still transport agnostic, keep all the merits of NSH and SR, maintain fewer states at SFFs

HUAWEI

SRv6 based SFC with Integrated NSH Service Plane

IPv6(S, SFF1) SRH(D, SFF2:SF2, SFF1:SF1, SL = 2)

NSH(SFP1, 255)

Packet

SF1

IPv6(S, SFF2) SRH(D, SFF2:SF2, SFF1:SF1, SL = 1)

NSH(SFP1, 254)

Packet

SF2

Packet

Packet

S

Classifier

SR

SFF1

SR

SFF2

D

- ✓ Classifier inserts NSH header and put the SRH header that realize the SFP(e.g., ⟨SFF1, SF1, SFF2, SF2⟩);
- ✓ SFF strips the SRH header before sending the packet the SF;
- ✓ SRH header cached at SFF by using SPI as the index;
- ✓ When received packet from SF, using the SPI to correlate the cached SRH header and put the SRH header back to the packet;
- ✓ Transport agnostic, keep all the merits of NSH and SRv6, maintain fewer states at SFFs

HUAWEI

A Summary of SR based SFC

- SR based SFC has several options, each has its own pros and cons
- NSH is designed to be transport agnostic, NSH based SFC is more and more accepted by the industry.
- Segment Routing(SR) provides an efficient way to steering traffic without requiring intermediates to maintain per-flow states
- Combine with SR and NSH, a transport-independent SFC can be realized.
- A solution that keeps merits of both NSH and SR is attractive.

HUAWEI

Thank you

www.huawei.com