SFC Technology and Standards

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Security Level:

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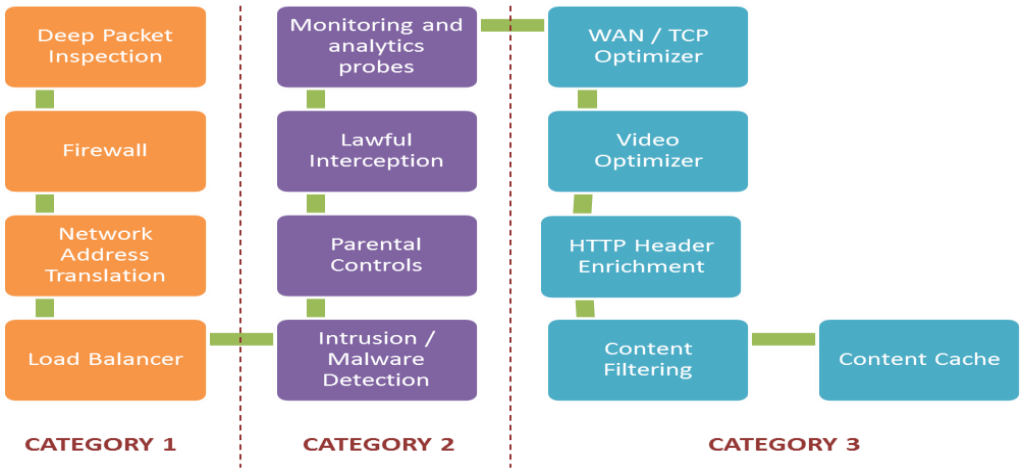
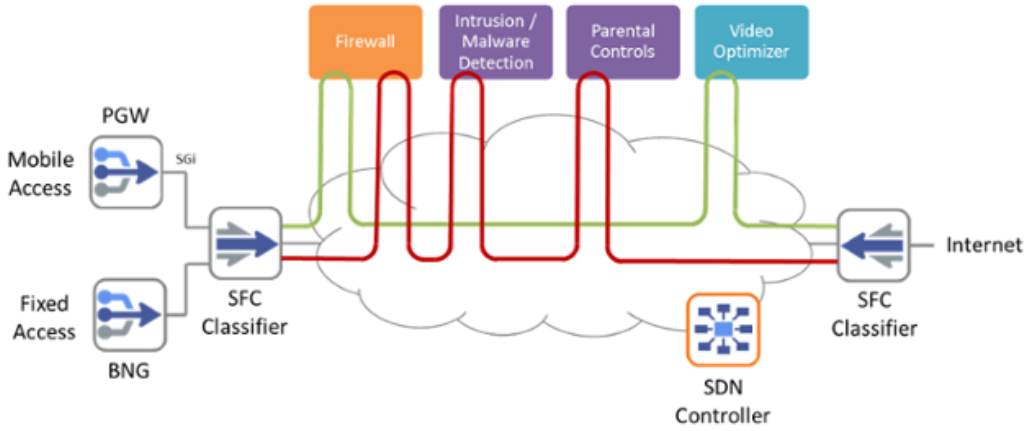
Contents

- SFC Architecture
- SFC Data Plane
- SFC Control Plane

Requirements for Service Chaining

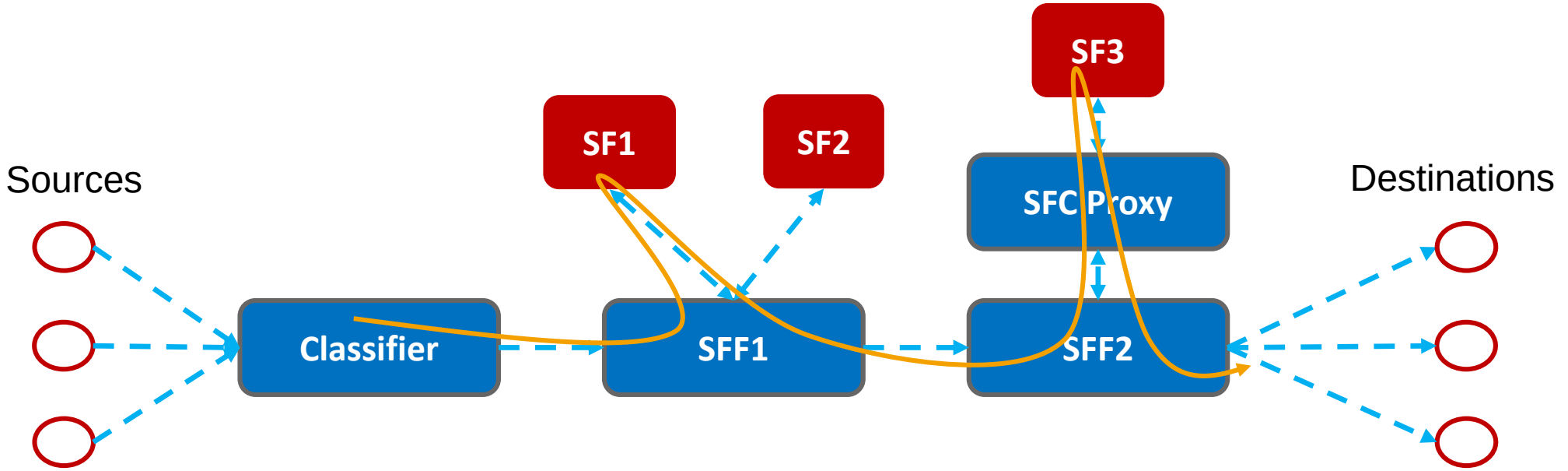
- Requirements for performance, flexibility, programmability and new service types
  - Network services become distributed and virtualized, and are driven down to close to the users for optimal performance
  - Mobile, fixed, edge computing, and enterprise networks all require SFC to support the emerging new services





- Key point: service instantiation is end-to-end and must be flexible enough to deploy no matter the underlay/overlay

An Overview of SFC Architecture



- Given an SFC
  - SFC: <SF1, SF3>
- Packets are classified by Classifier 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
- Metadata may be carried for additional context information

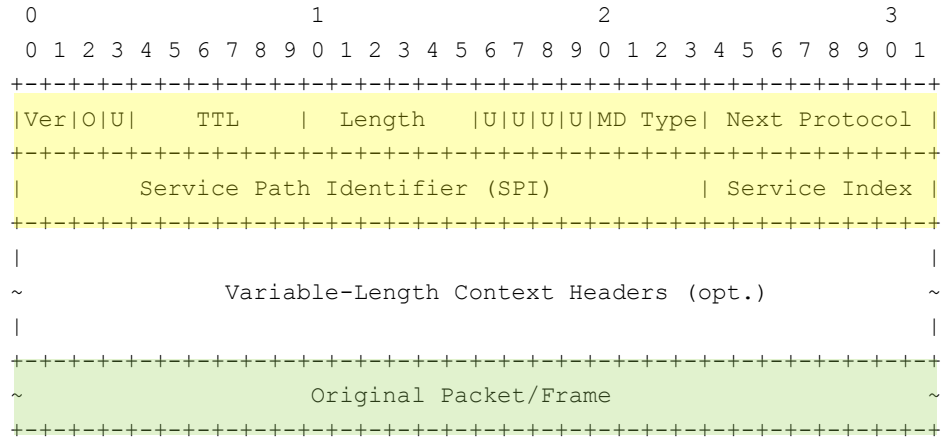
https://tools.ietf.org/html/rfc7665

SFC Data Plane Overview

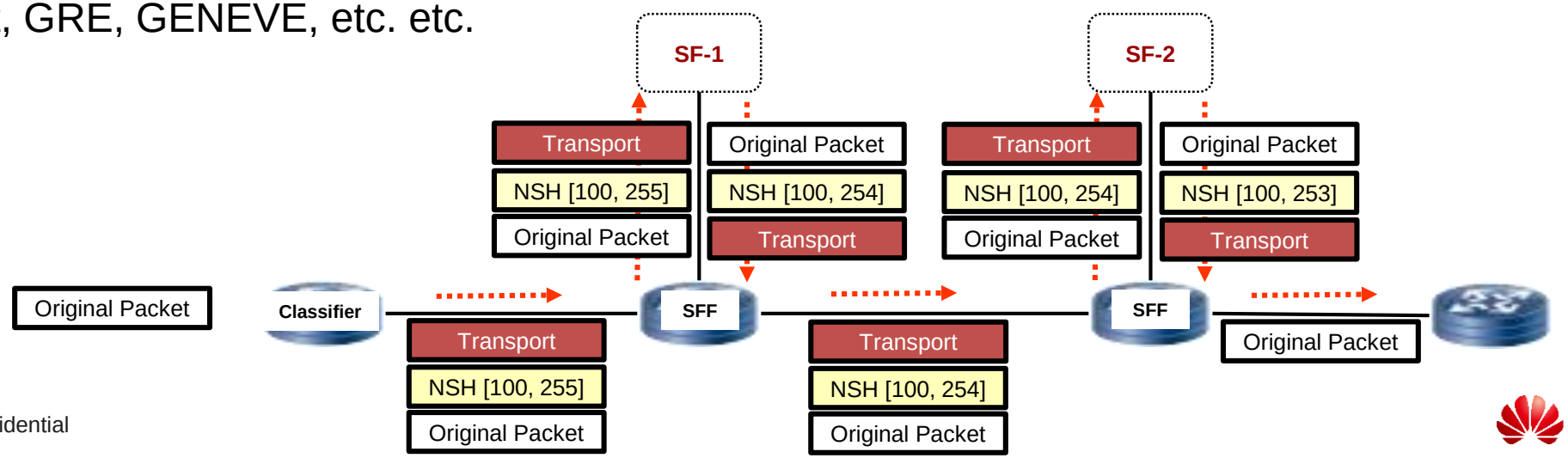
- Current focus in IETF SFC standards
- Two major flavors
  - NSH based service chaining
  - SR based service chaining
    - SR-MPLS based SFC
    - SRv6 based SFC
- Integration of SR and NSH for SFC

Transport Agnostic SFC – NSH-based Service Chaining

- Network Service Header (NSH) is a data plane header inserted between the original payload and the outer transport
- It's primary purpose is to provide a service plane which carries path identification
  - Service Path ID & Service Index
  - Fixed or variable length metadata
- It's independent of the transport
  - Can be carried in MPLS, SR, UDP/IP, Native Ethernet, GRE, GENEVE, etc. etc.



https://datatracker.ietf.org/doc/rfc8300/



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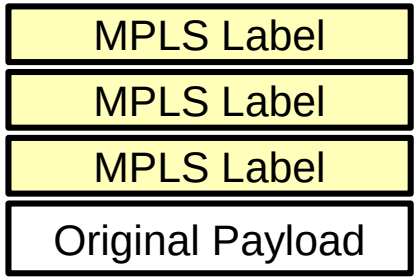
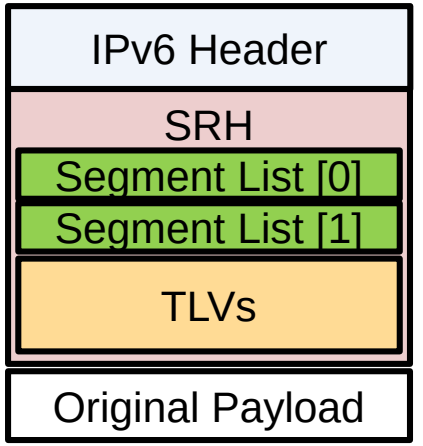
Segment Routing – a quick recap

SR-MPLS



- MPLS encapsulation
- MPLS label stack carries the network instructions (SIDs)
- No good way to carry metadata

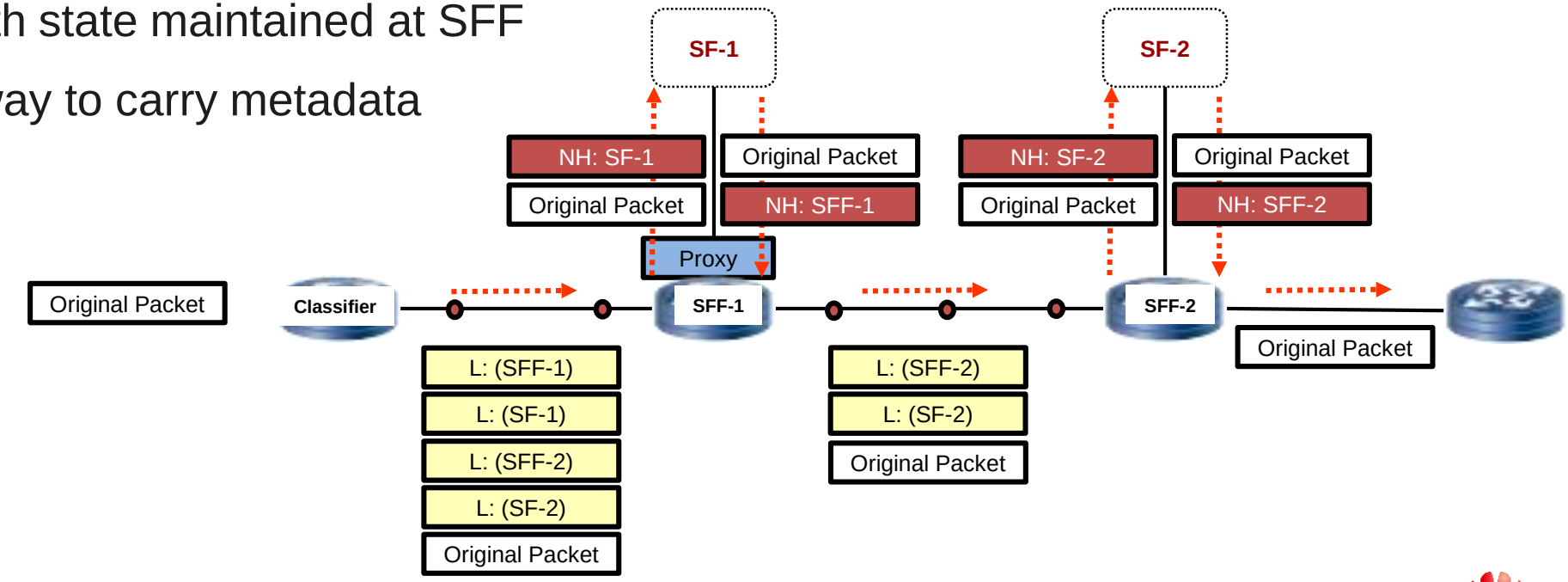
SRv6



- IPv6 encapsulation
- Segment Routing Header (SRH) carries the network instructions (SRv6 SIDs)
- Metadata can be carried in SRH TLVs

SR-MPLS Service Chaining

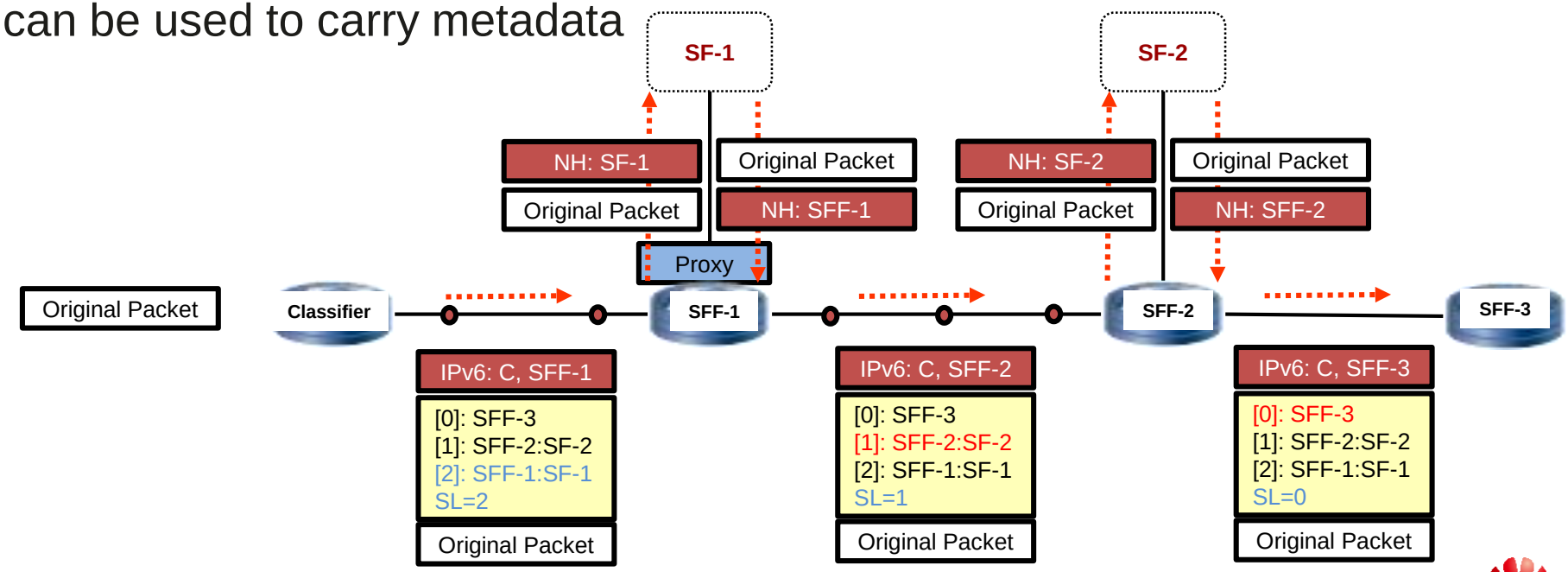
- Each SFF and SF is allocated an MPLS SID (label)
  - An SFP is realized as a SR SID list (MPLS label stack)
- SF can be SR-aware or SR-unaware
  - SR-unaware case requires the help of an proxy
  - SR proxy strips the label stack before sending packet to SF, and reapplied the label stack on packet received from SF
- No per-path state maintained at SFF
- No good way to carry metadata



https://tools.ietf.org/html/draft-xuclad-spring-sr-service-programming

SRv6 Service Chaining

- Each SFF/SF is allocated a SRv6 SID
  - An SFP is realized as a SRv6 SID list (carried in SRH)
- SF can be either SR-aware or SR-unaware, SR-unaware requires an SR proxy
  - SR proxy strips (and caches) the SRH before sending packets to an SF, and puts the SRH back on packets received from SF
  - SR proxy needs to correlate a packet to an SRH on return from an SF (based upon interface ID)
- No per-path state maintained at SFF
- SRH TLV can be used to carry metadata



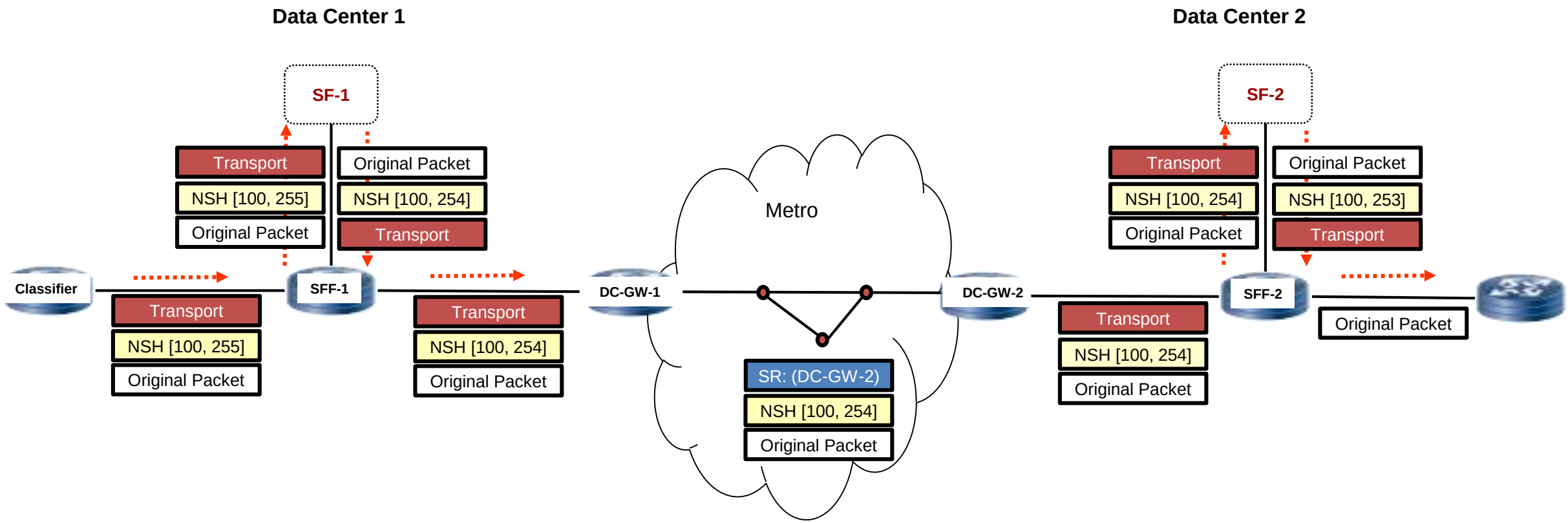
https://tools.ietf.org/html/draft-xuclad-spring-sr-service-programming

Integration of SR and NSH for SFC

Solutions	Characteristics
NSH based SFC	**Pros**: Mature in standard, implementation available in SF **Cons**: Per SFP-state maintained on SFF
SR-MPLS based SFC	Pros: No per-path state on SFF **Cons**: Does not have good way to carry metadata
SRv6 based SFC	Pros: No per-path state on SFF Pros: Metadata can be carried in SRH TLV **Cons**: SFs needs to upgrade to handle SRH, or SR proxy is needed

- Can we leverage merits of both technologies to address immediate market needs?
  - NSH-based SFC with SR-based transport tunnel
  - SR-based SFC with integrated NSH service plane

NSH-based SFC with SR as the Transport Tunnel



Totally decouple service & transport layers; leverage SR for traffic steering capabilities

https://tools.ietf.org/html/draft-guichard-spring-nsh-sr

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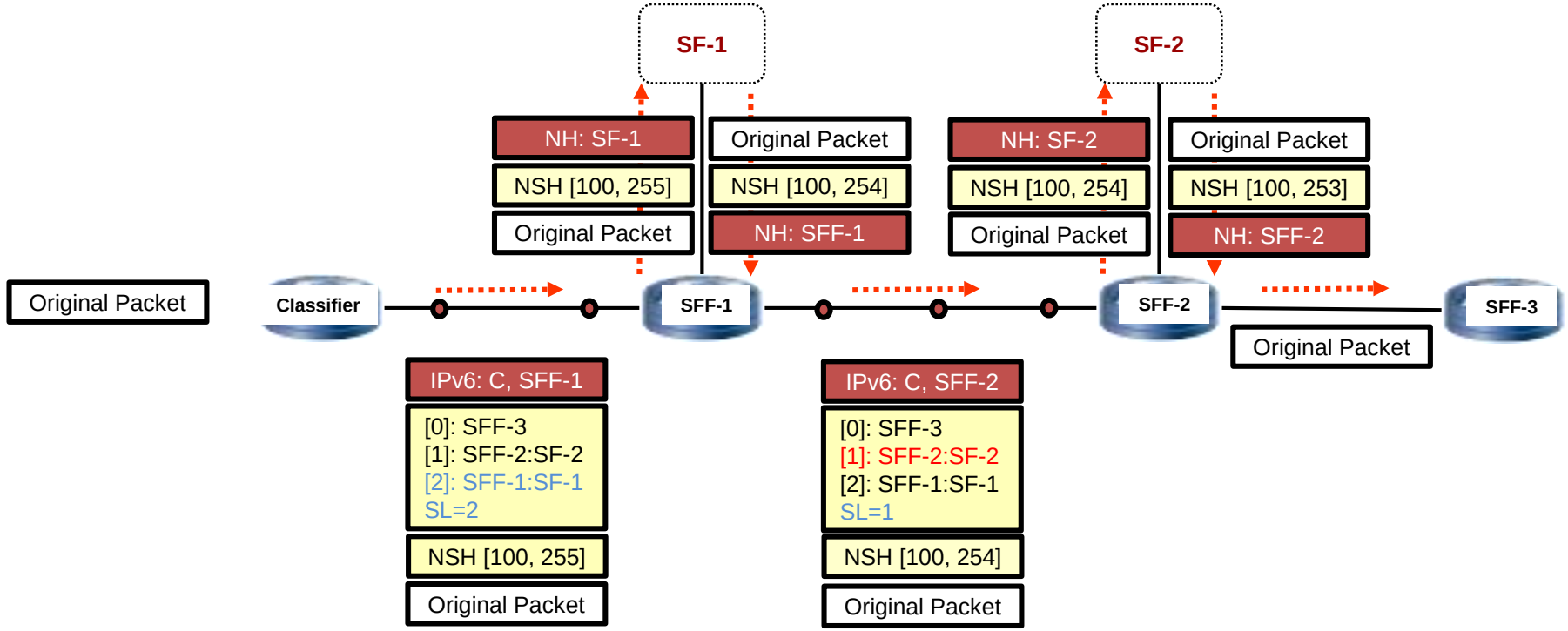
SR-based SFC with Integrated NSH Service Plane



- Keep all the merits of SR and NSH
  - SFF does not need to maintain per-SFP state
  - SF does not need to support SR

https://tools.ietf.org/html/draft-guichard-spring-nsh-sr

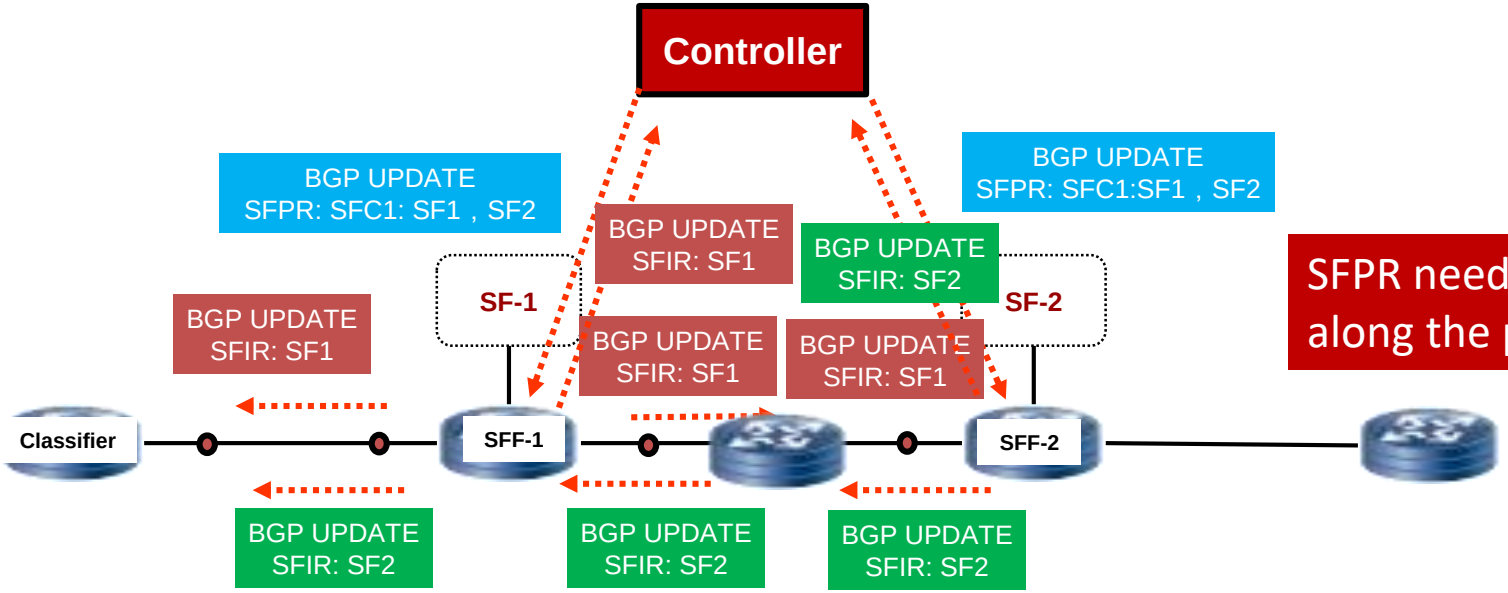
SFC Control Plane Overview

	Topic	Draft	Status
NSH based SFC	**Architecture**	draft-ietf-sfc-control-plane	Informational WG document No update since 2016.10
	BGP	draft-ietf-bess-nsh-bgp-control-plane	WG document
	PCEP	draft-wu-pce-traffic-steering-sfc	Individual draft Steering traffic to SFC
SR based SFC	**Architecture**	draft-li-spring-sr-sfc-control-plane-framework	Initial version draft will be submitted soon
	BGP-LS	draft-dawra-idr-bgp-ls-sr-service-segments	Individual document
	IGP	• draft-xu-isis-service-function-adv • draft-xu-ospf-service-function-adv	Individual documents, plan to update recently

Will focus on SR Based SFC control plane due to its simplicity

BGP Based NSH Control Plane

- New BGP address family (SFC AFI/SAFI) with two route types:
  - SFIR (Service Function Identifier Route)
    - SFFs advertise information of service function instance to network
  - SFPR (Service Function Path Route):
    - Originated by controller for each Service Function Path
    - Contains SPI, sequence of SFs, and SI of each SF



SFPR needs to be provisioned on each SFF along the path, which is complicated

https://tools.ietf.org/html/draft-ietf-bess-nsh-bgp-control-plane

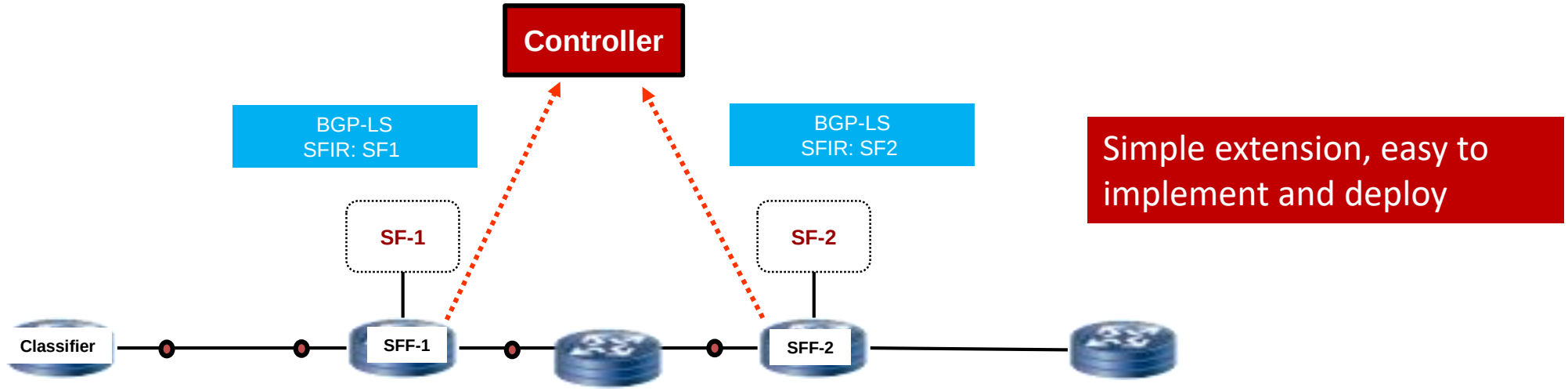
SR-based SFC Control Plane Framework

		SFIR Distribution	SFPR Distribution	Steering to SFC
SR based Stateless SFC		• BGP • BGP-LS (Recommended) • IGP	• BGP (existing solution) • PCEP (existing solution)	• BGP (existing solution) • PCEP(existing solution)
SR based Stateful SFC	**NSH over SR tunnel**	• BGP (Complicated)	• BGP (Complicated) • PCEP	• BGP • PCEP
	Integrated Mode	• For further study	• BGP • PCEP	• BGP • PCEP

A framework document on SR based SFC Control Plane will be submitted soon

BGP-LS for SR based SFC Control Plane

- Extensions to BGP-LS for distribution of service segments information
  - Enables service paths programming using Segment Routing.
  - Encoded in SRv6 Node SID TLV and SR-MPLS SID/Label TLV
- Information to be shared with SR Controller via BGP-LS:
  - Service SID value, Function Identifier, Service Type, Traffic Type, Opaque data
- SFP is encoded as SR SID list, existing SR Policy mechanism is used to push the path to classifier, no need to provision SFC path on SFFs.



Simple extension, easy to implement and deploy

https://tools.ietf.org/html/draft-dawra-idr-bgp-ls-sr-service-segments

Progress of SFC Standards

James Guichard

- Chair of SFC working group
- Technical VP of IP Innovation & Standards, Huawei

Topics	RFC/Drafts	Vendors	Operators	Status
SFC Architecture	RFC 7665	Ericsson /Cisco		RFC published
NSH	RFC 8300	Cisco/Intel		RFC published
BGP control plane for NSH SFC	draft-ietf-bess-nsh-bgp-control-plane	Juniper	AT&T/Verizon	WG document
SR for SFC	draft-xuclad-spring-sr-service-programming	Cisco /Huawei/ Juniper /Nokia	Bell Canada/ Orange/AT&T	WG adoption in process
SR + NSH for Stateful SFC	draft-guichard-spring-nsh-sr	Huawei /Ericsson/ Nokia/Cisco	Orange	WG adoption in process
SR SFC Control Plane	draft-li-spring-sr-sfc-control-plane-framework	Huawei	TBD	In preparation

Comments and collaboration on highlighted drafts are welcome

Conclusion

- NSH-based service chaining and segment routing are complimentary technologies
- Segment Routing(SR) provides an efficient way for service chaining without requiring intermediate nodes to maintain per-flow state
- Integration of NSH and SR could leverage merits of both mechanisms
  - A candidate solution when SFs do not support SRv6
- SRv6 based SFC is promising for its scalability, simplicity and programmability

Thank you.

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