



Deployment & Technology Update

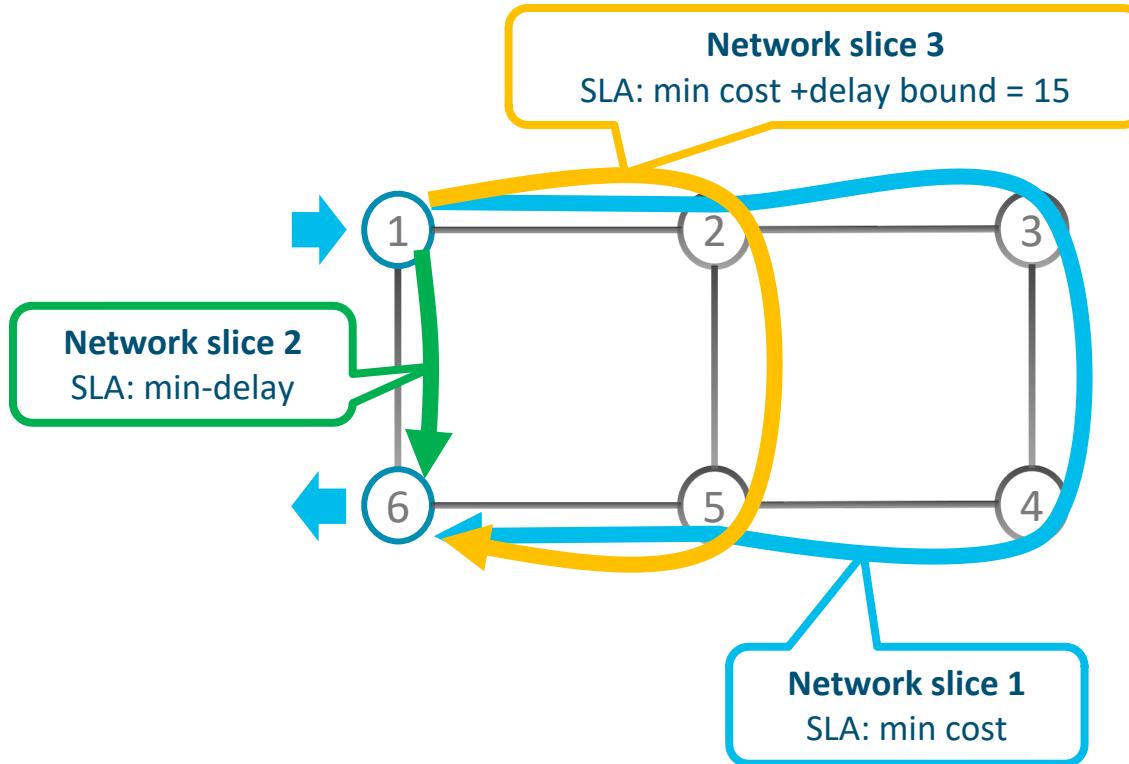
Clarence Filsfils

Cisco Fellow – cf@cisco.com

SR-MPLS

SR Powering Network Slicing For 5G Networks

Three-tiered Delay Service with SR-TE and Flex-Algo

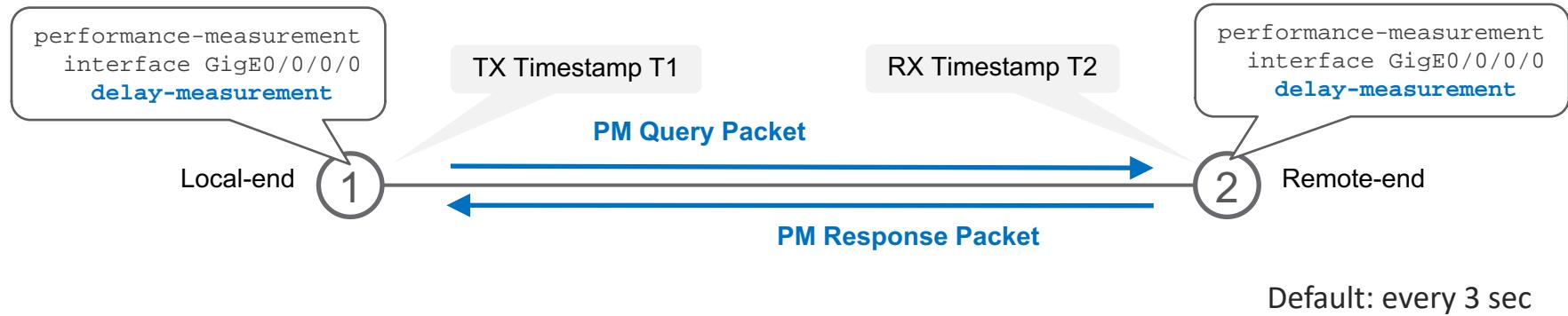


Showcased at Cisco Live
Barcelona



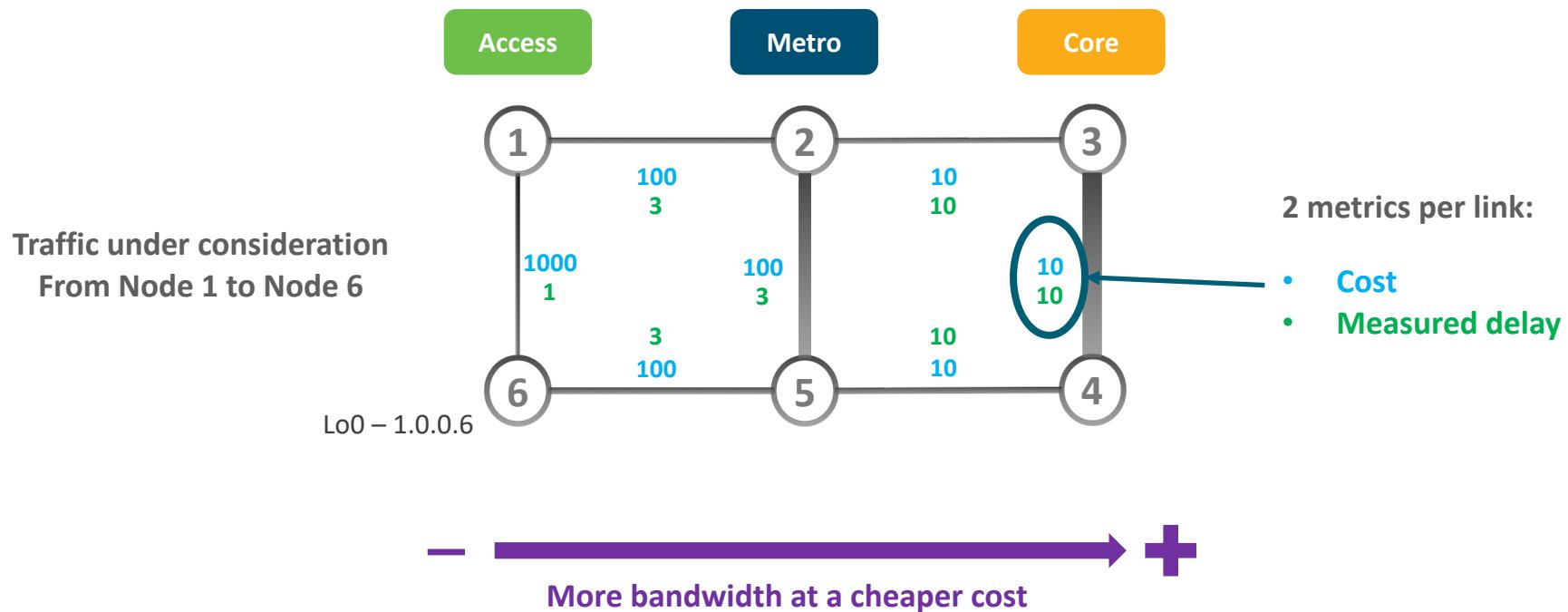
How To Quantify Delay?

Probe Measurement



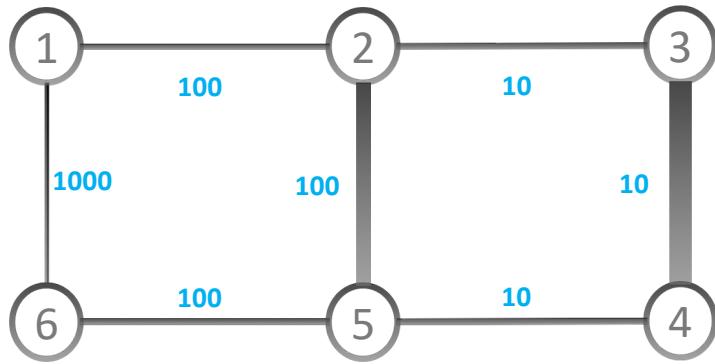
- One Way Delay = $(T2 - T1)$
- Timestamps added in hardware
- PM Query format: RFC 6374 (MPLS/GAL) or RFC 5357 (IP/UDP/TWAMP)

Reference Network Diagram

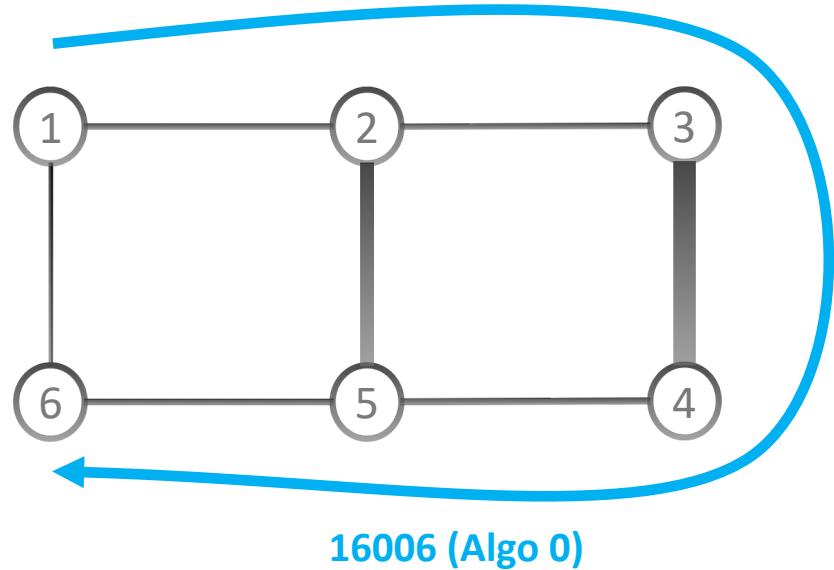


Minimizing Routing Cost Metric

Low Cost Network Slice



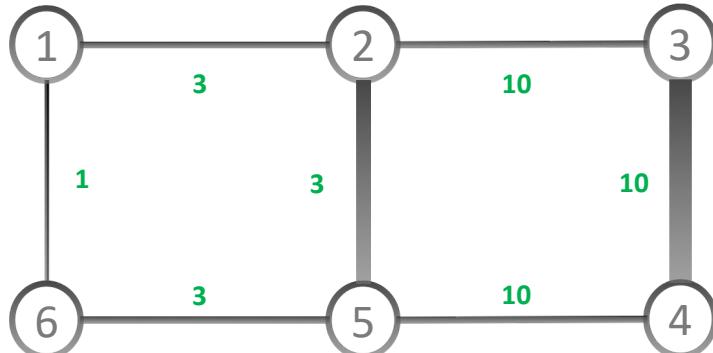
Lo0 – 1.0.0.6
16006 (Algo 0)



ISIS Shortest-path according to
the per-link ISIS **cost** metric

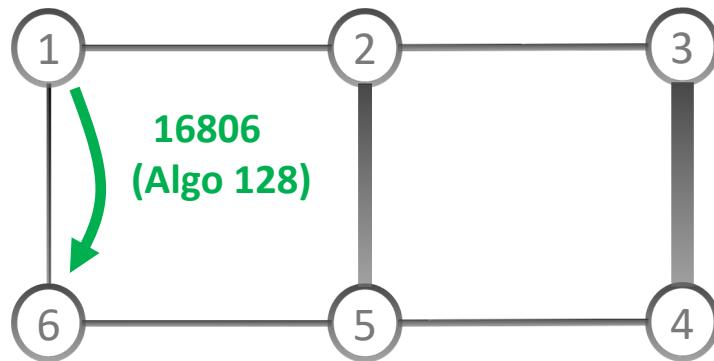
Minimizing Delay

Low Delay Network Slice



Lo0 – 1.0.0.6

16806 (Algo 128)



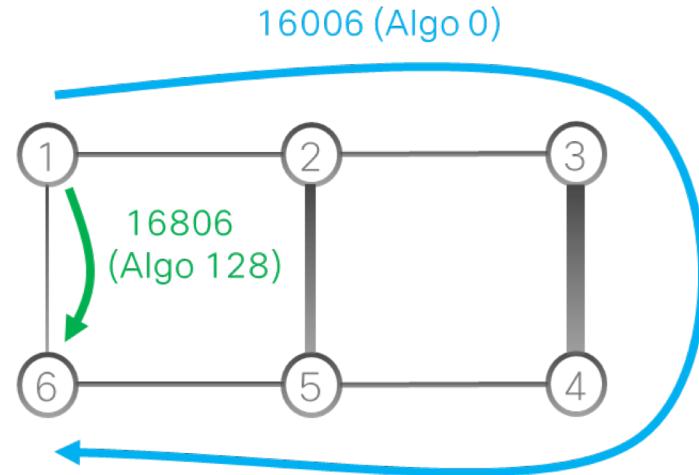
- Operator customizes its ISIS Flex-Algo 128
- Shortest-path according to the per-link **delay**

Benefits

Two independent network slices

Low cost

Low delay



Automated
ISIS

Flexible
Algo customization

Simple
No LDP, No RSVP-TE

Efficient
One single Label

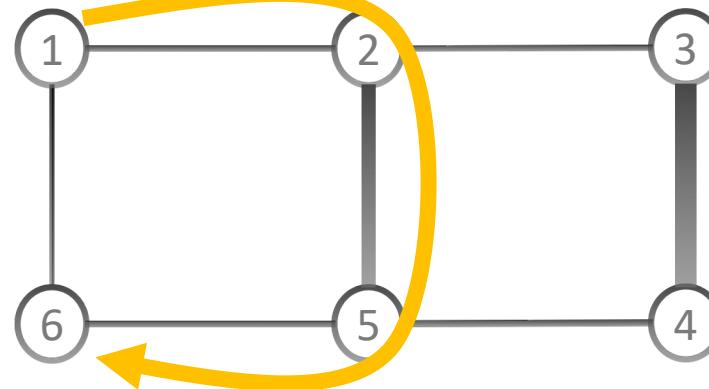
Stateless
No N^2 RSVP-TE state

5G ready
Slicing

Adding A 3rd Network Slice

Minimum Cost with Maximum Delay Bound

Low-Cost
with $\leq 15\text{msec}$



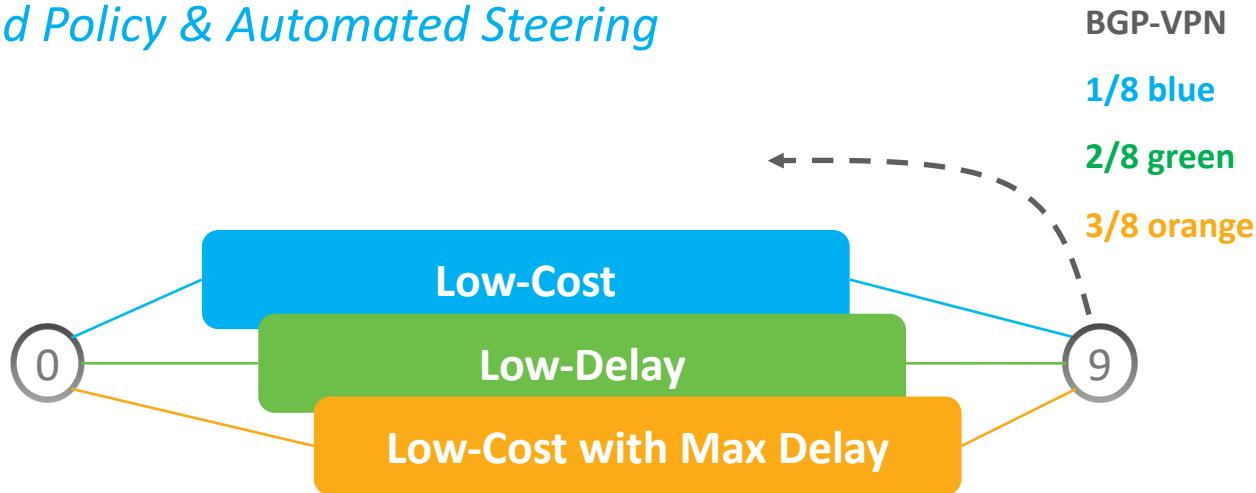
SR TE Policy

SR Native Algorithm

Business Traffic
with Delay constraint

Automated TE

On-Demand Policy & Automated Steering



Operator colors VPN routes

On-Demand Policy

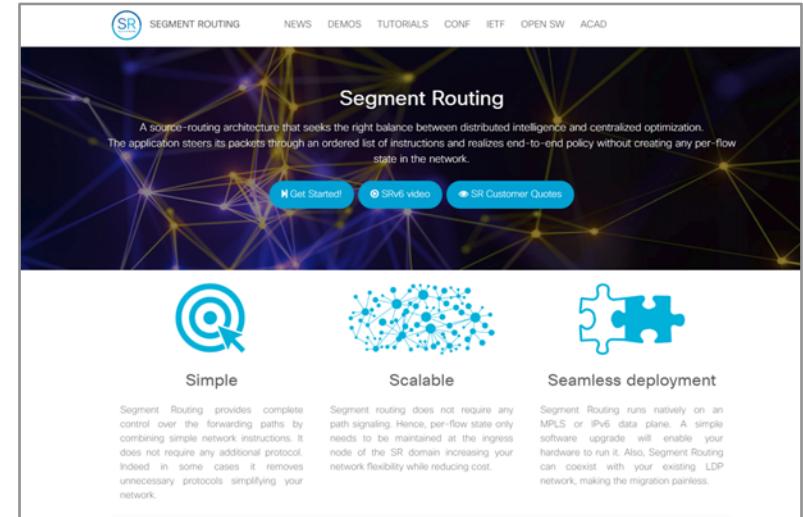
Auto Steering into Slice

To continue the discussion

- SD-WAN benefiting from slicing differentiation
- Delay Performance Monitoring
- Dataplane Monitoring
- Per-Flow Steering



segment-routing.net



The screenshot shows the homepage of the Segment Routing website. At the top, there's a navigation bar with links for NEWS, DEMOS, TUTORIALS, CONF, IETF, OPEN SW, and ACAD. The main title "Segment Routing" is prominently displayed, along with a subtitle explaining it's a source-routing architecture balancing distributed intelligence and centralized optimization. Below this are three key benefits: "Simple" (represented by a target icon), "Scalable" (represented by a network cloud icon), and "Seamless deployment" (represented by a puzzle piece icon). Each benefit has a brief description and a link to more information.

SR SEGMENT ROUTING

NEWS DEMOS TUTORIALS CONF IETF OPEN SW ACAD

Segment Routing

A source-routing architecture that seeks the right balance between distributed intelligence and centralized optimization. The application steers its packets through an ordered list of instructions and realizes end-to-end policy without creating any per-flow state in the network.

Get Started! SRv6 video SR Customer Quotes

Simple

Segment Routing provides complete control over the forwarding paths by combining simple network instructions. It does not require any additional protocol. Indeed in some cases it removes unnecessary protocols simplifying your network.

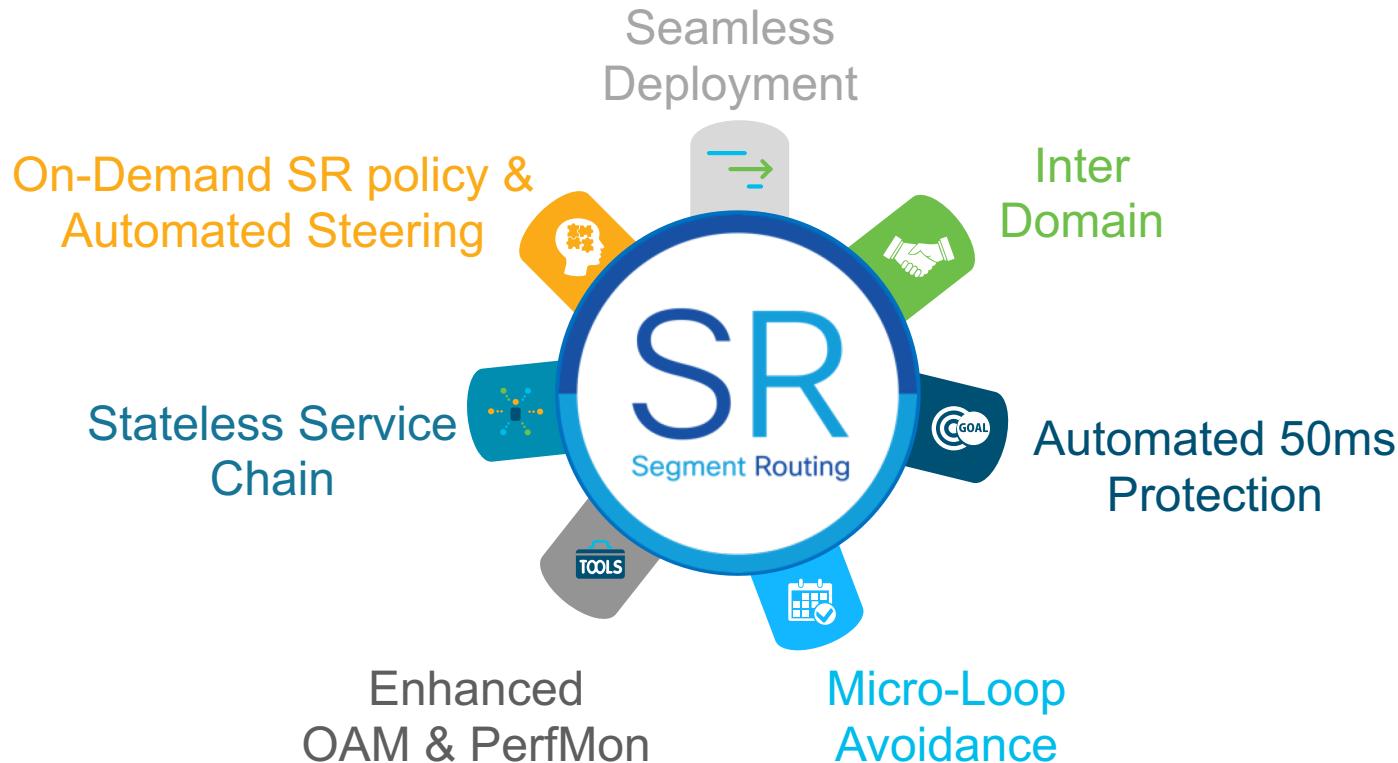
Scalable

Segment routing does not require any path signaling. Hence, per-flow state only needs to be maintained at the ingress node of the SR domain increasing your network flexibility while reducing cost.

Seamless deployment

Segment Routing runs natively on an MPLS or IPv6 data plane. A simple software upgrade will enable your hardware to run it. Also, Segment Routing can coexist with your existing LDP network, making the migration painless.

SR Unified Fabric Attributes



SRv6

Cisco Supports SoftBank on First Segment Routing IPv6 Deployment in Prep for 5G

Link to PR - <https://newsroom.cisco.com/press-release-content?type=webcontent&articleId=1969030>



Thanks to SRv6 network programming capabilities, Iliad is set to further disrupt the mobile market by delivering truly innovative service offerings

Iliad's NodeBox is SRv6 enabled

<https://newsroom.cisco.com/press-release-content?hyper=webcontent&articleId=1978361>

iliad

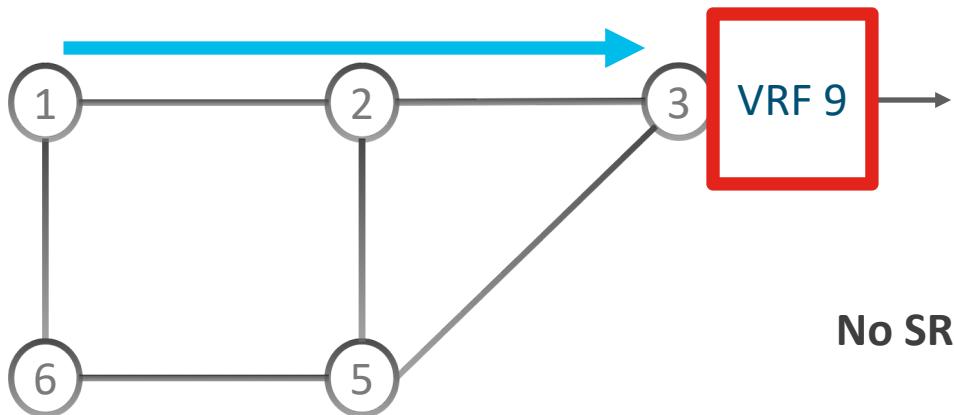
CISCO



Best-Effort VPN

Network Program: B:3:V(9)

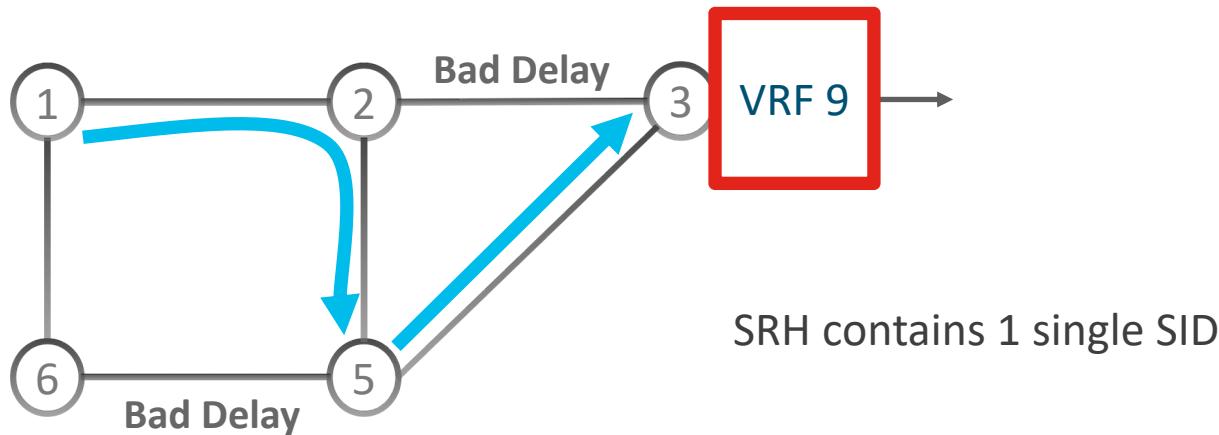
B: locator block is associated with ISIS base algo (Low Cost)



Low-Delay VPN

Network Program: B:2:C5 then B:3:V(9)

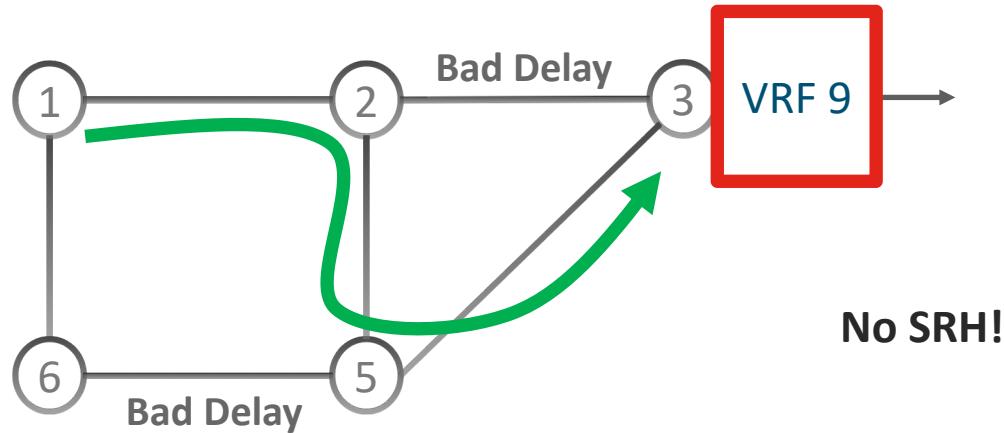
B: locator block is associated with ISIS base algo (Low Cost)



Low-Delay VPN

Network Program: D:3:V(9)

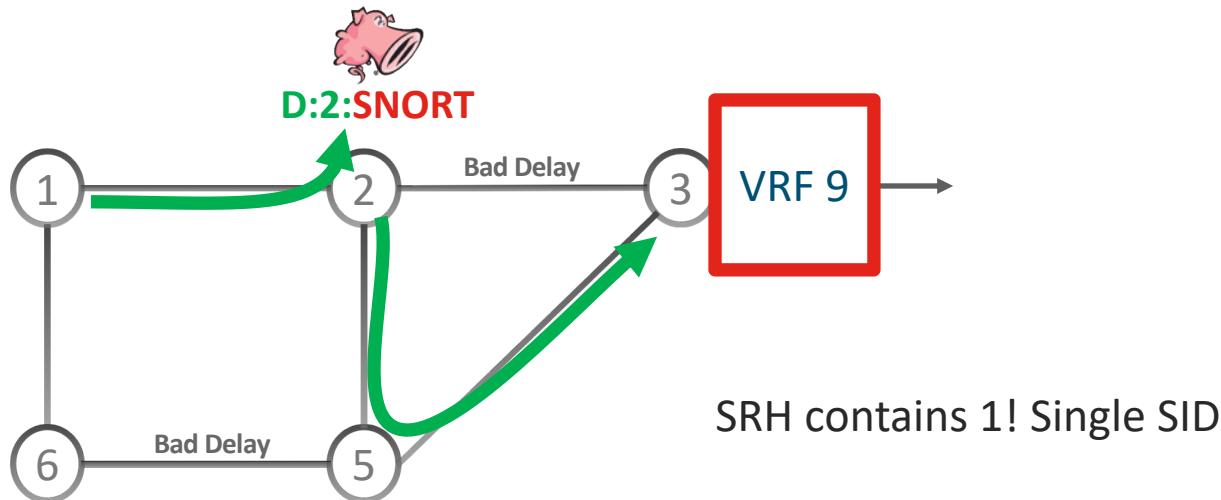
D: locator block is associated with Low Delay Flex-Algo



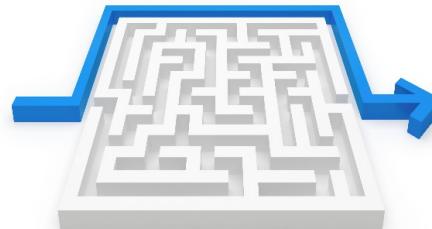
SNORT & Low-Delay VPN

Network Program: D:2:SNORT then D:3:V(9)

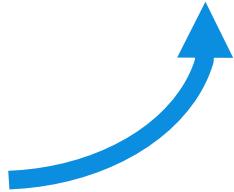
D: locator block is associated with Low Delay Flex-Algo



Simplicity Always Prevails



Furthermore with more scale and functionality



Conclusion

Industry At Large Backs Up SR



Strong customer adoption
WEB, SP, EN
Core, Metro, Access, DC



De-facto SDN Architecture



Standardization
IETF



Multi-vendor Consensus



Open Source
Linux, VPP



Google

Bell

China
unicom
中国联通

SoftBank

SHENTEL[®]
Always connected to you

vodafone

alibaba.com

Telefonica

Walmart

colt

airtel

Stay Up-To-Date

Social media



twitter.com/SegmentRouting



facebook.com/SegmentRouting/

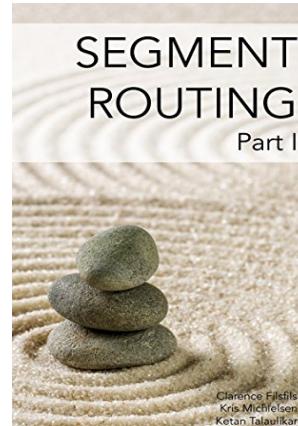


segment-routing.net

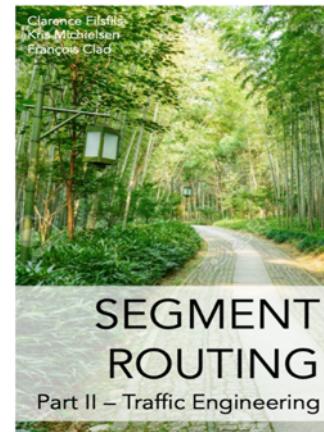


linkedin.com/groups/8266623

Books



amzn.com/B01I58LSUO



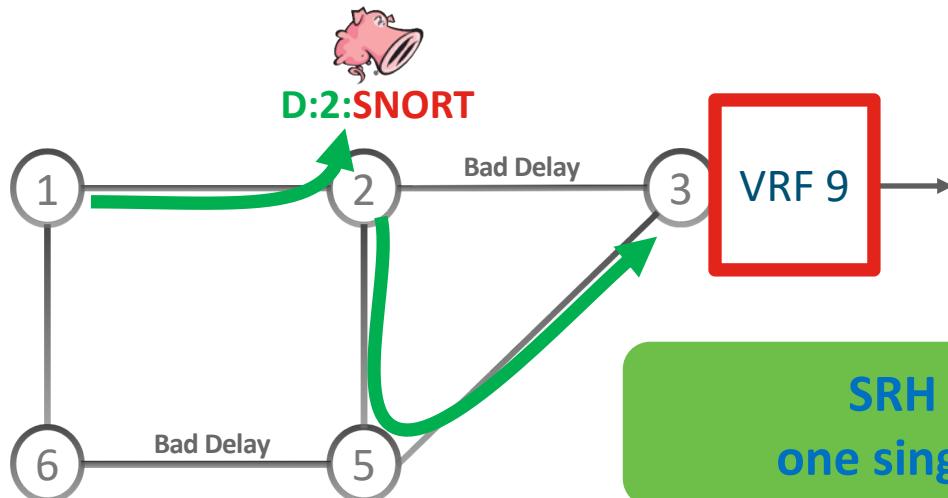
amazon.com/dp/B07N13RDM9

SRv6 Backup

SNORT & Low-Delay VPN

Network Program: D:2:SNORT then D:3:V(9)

D: locator block is associated with Low Delay Flex-Algo



Rich consensus and Eco-system

Implementation

*Cisco
Linux
VPP FD.IO
Barefoot
Broadcom
UniStarcom
Huawei
Free Node
SmartNIC1
SmartNIC2
NFV Apps
Kubernetes*

Multiple Interop's

*Sigcomm 2017
EANTC 2018
EANTC 2019
Deployments*

Record Velocity
< 2 years !

Deployment's

*Softbank
Free Telecom
China Telecom
#4 on its way*



SRH

1st: 2014-03

WG: 2015-12

Last-Called: 2019-04

26 revisions

NET PGM

1st: March 2017

WG: 2019-04

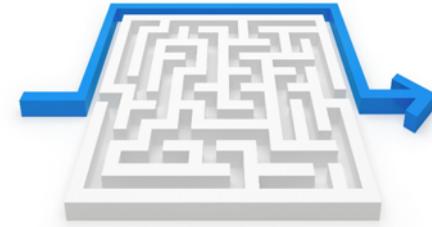
Rev7 (26)

Scale

- Network Programming model
 - Locator, Function, Argument
 - Function can be anything we want, huge opportunity for scale
 - Locator + function already expresses at least two MPLS labels
- IP
 - Summarization
 - Route Leaking
- Flex-Algo
 - end-to-end Slices with one single locator
- Binding SID

Simplicity

- Protocol elimination
 - No LDP
 - No RSVP-TE
 - No MPLS dataplane
 - No L2TPv3/GRE/UDP-VxLAN
 - No GTP
 - No NSH
- **IP finally strong to handle the networking task itself**



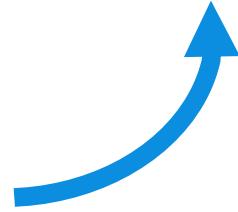
Scale

	# of SID's	SRH presence	Below IPv4 MPLS Label Stack	Above IPv4
Best-Effort VPN	1	No	1	UDP/VxLAN
Low-Delay VPN (SR-TE)	2	Yes (1 single SID)	3	UDP/VxLAN
Low-Delay VPN (Flex-Algo)	1	No	1	UDP/VxLAN
Snort & Low-Delay VPN	2	Yes (1 single SID)	4	UDP/VxLAN

- Stateless Fabric
 - The state is in the packet header, not in the fabric

Further Scale

- IP summarization for inter-domain
- Anycast IP
- ... 😊



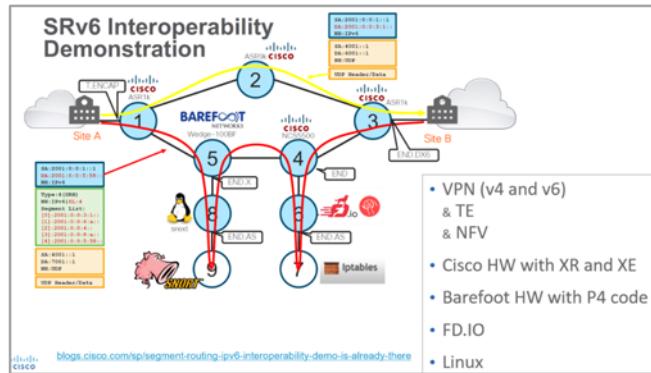
Further Functionality



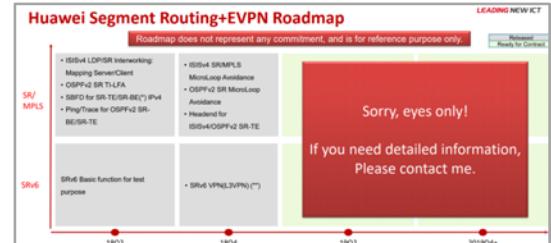
- Just program the network
- SRv6 is Turing Complete
 - Metadata is part of the solution: Tag and TLV

Other HW

- Jericho1 and above
 - We have proven applicability by shipping it
- Barefoot
 - Interoperability shown @ Sigcomm 2017
- Huawei
 - Strong interest and declared product plan
- SmartNic



blogs.cisco.com/sp/segment-routing-ipv6-interoperability-demo-is-already-there



Other SW

- Linux Kernel since 4.10
 - Extensive implementation supported by Cisco Research
- FD.io VPP
 - Extensive implementation supported by Cisco
- Container Networking



Cisco FCS and in deployment

- SRv6 ISIS
 - SRv6 TILFA
 - SRv6 BGP L3-VPNv4
 - SRv6 OAM
-
- More coming in CY19... ask us



Also in the DC - with linerate SRv6 @ 400G

- Amazing set of SRv6 network instructions @ 400G !

