



# Deployment & Technology Update

Clarence Filsfils

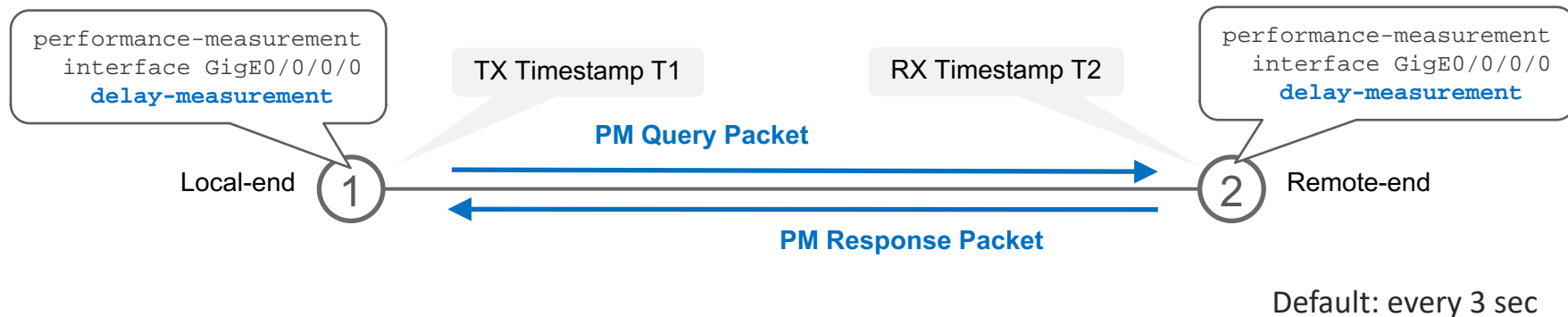
Cisco Fellow – [cf@cisco.com](mailto:cf@cisco.com)

SR-MPLS



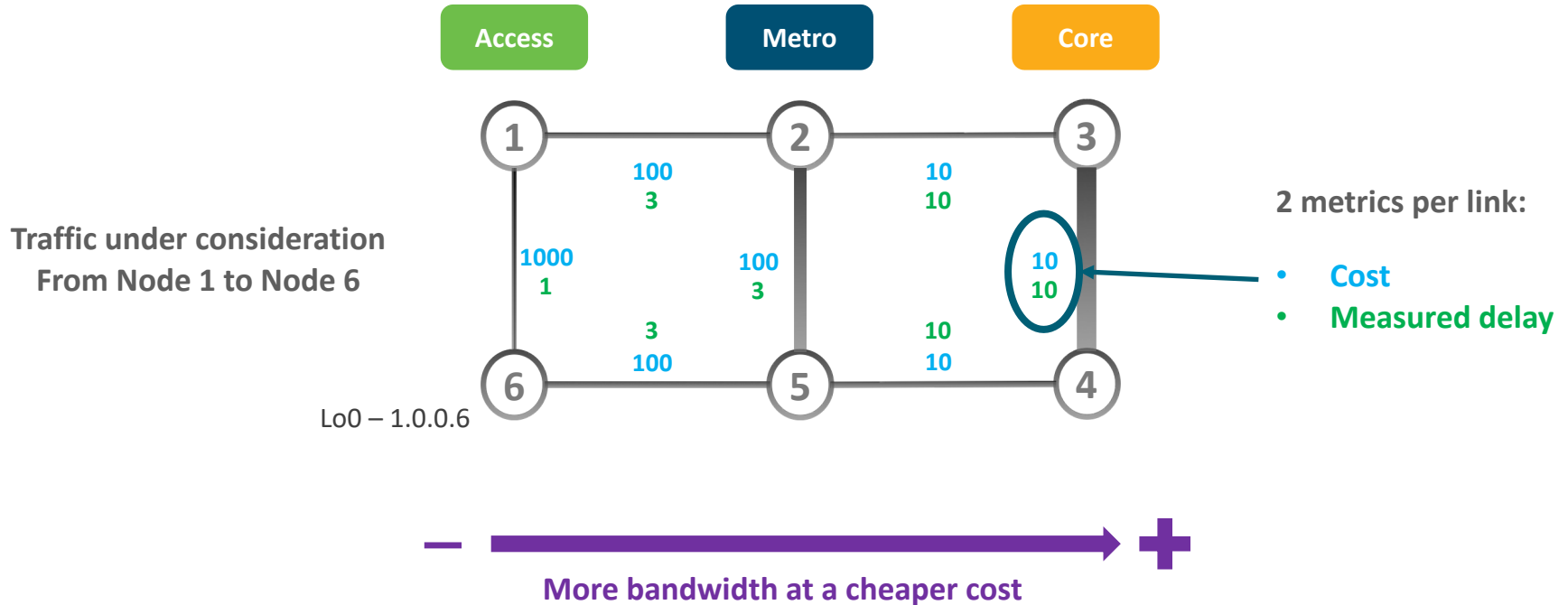
# How To Quantify Delay?

## Probe Measurement



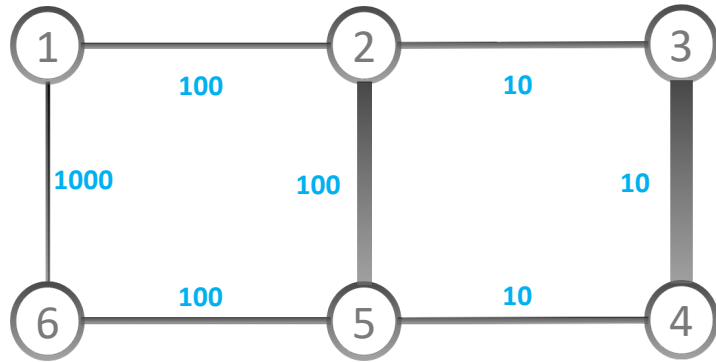
- One Way Delay =  $(T2 - T1)$
- Timestamps added in hardware
- PM Query format: RFC 6374 (MPLS/GAL) or RFC 5357 (IP/UDP/TWAMP)

# Reference Network Diagram



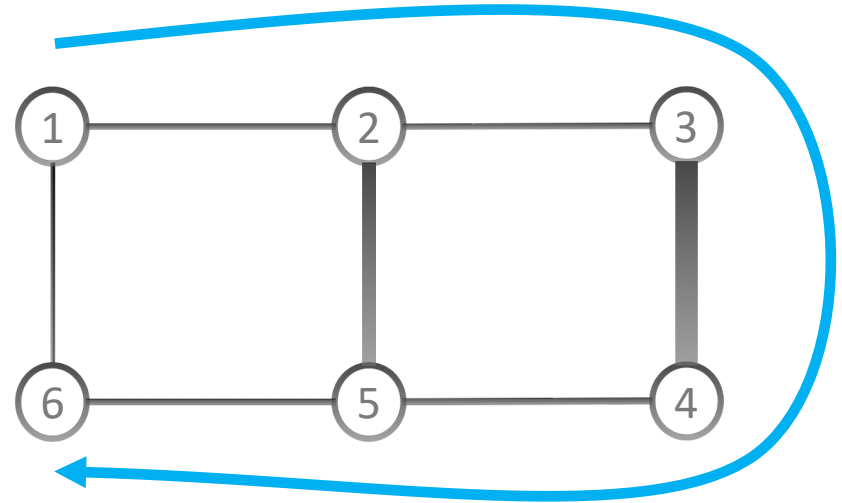
# Minimizing Routing Cost Metric

## Low Cost Network Slice



Lo0 – 1.0.0.6

16006 (Algo 0)

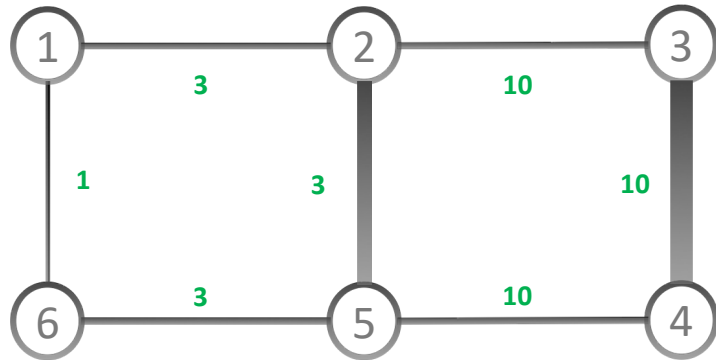


16006 (Algo 0)

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

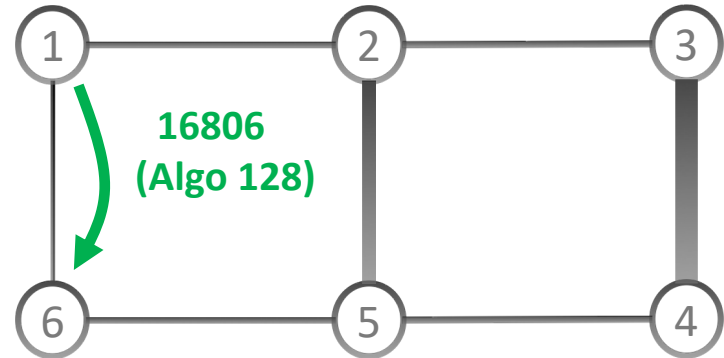
# Minimizing Delay

## Low Delay Network Slice



Lo0 – 1.0.0.6

16806 (Algo 128)



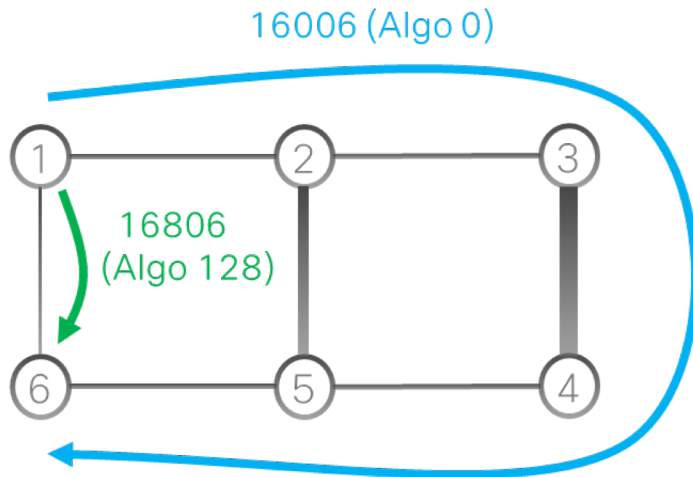
- Operator customizes its ISIS Flex-Algo 128
- Shortest-path according to the per-link **delay**

# 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*

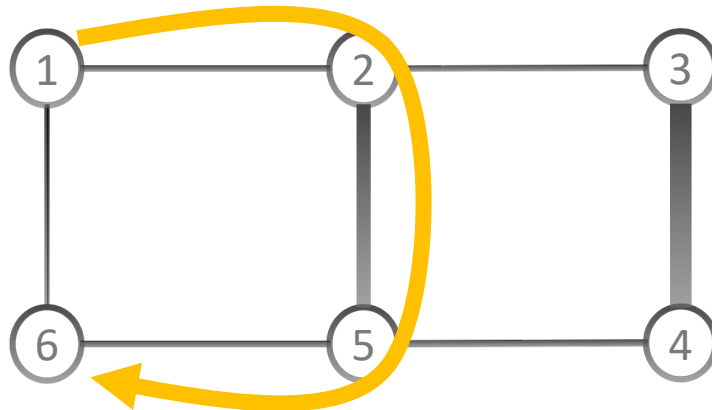
**5G ready**  
*Slicing*



# Adding A 3rd Network Slice

*Minimum Cost with Maximum Delay Bound*

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



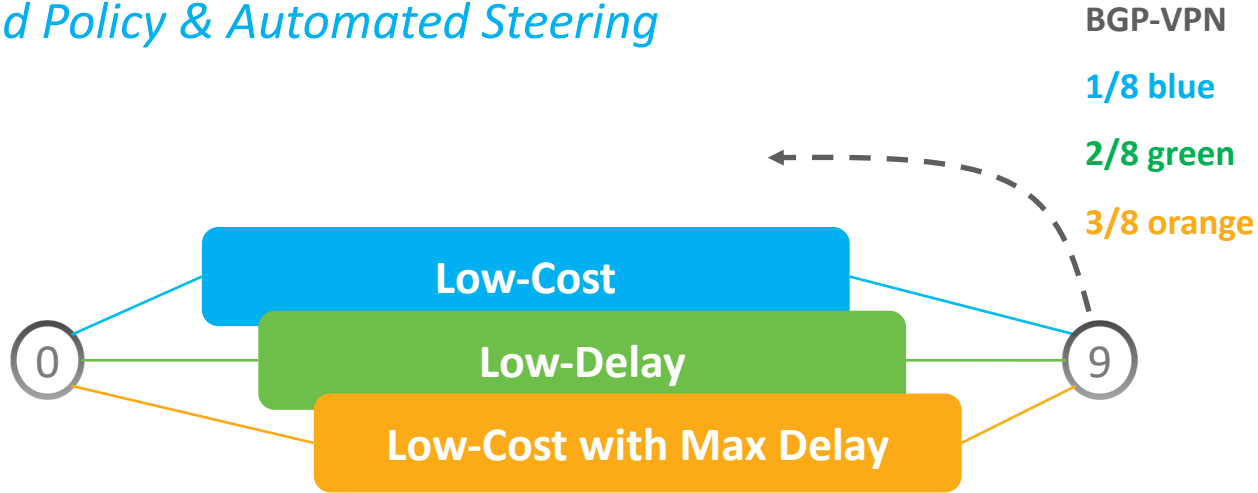
SR TE Policy

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](https://segment-routing.net)


The screenshot shows the Segment Routing website homepage. At the top is a navigation bar with the SR logo and links for NEWS, DEMOS, TUTORIALS, CONF, IETF, OPEN SW, and ACAD. The main header features the title 'Segment Routing' and a descriptive paragraph: '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.' Below this are three buttons: 'Get Started!', 'SRv6 video', and 'SR Customer Quotes'. The content area is divided into three columns, each with an icon and a title: 'Simple' (target icon), 'Scalable' (network graph icon), and 'Seamless deployment' (puzzle pieces icon). Each column contains a short paragraph explaining the benefit.

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](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?type=webcontent&articleid=5718361>

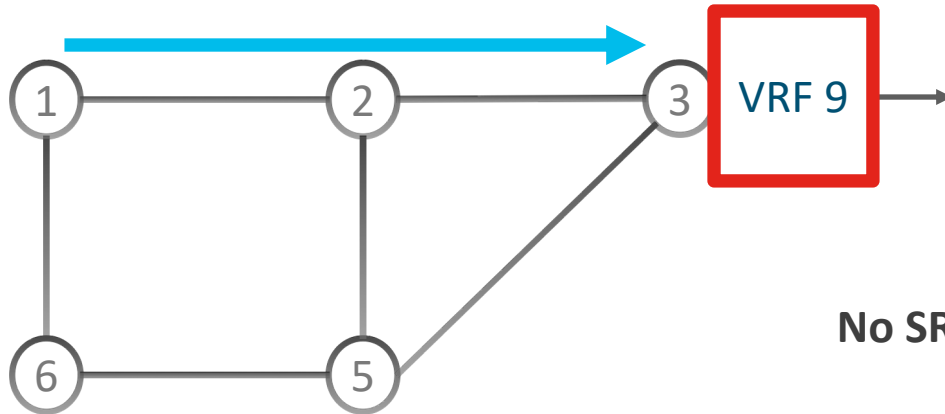
iliad



# Best-Effort VPN

Network Program: B:3:V(9)

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

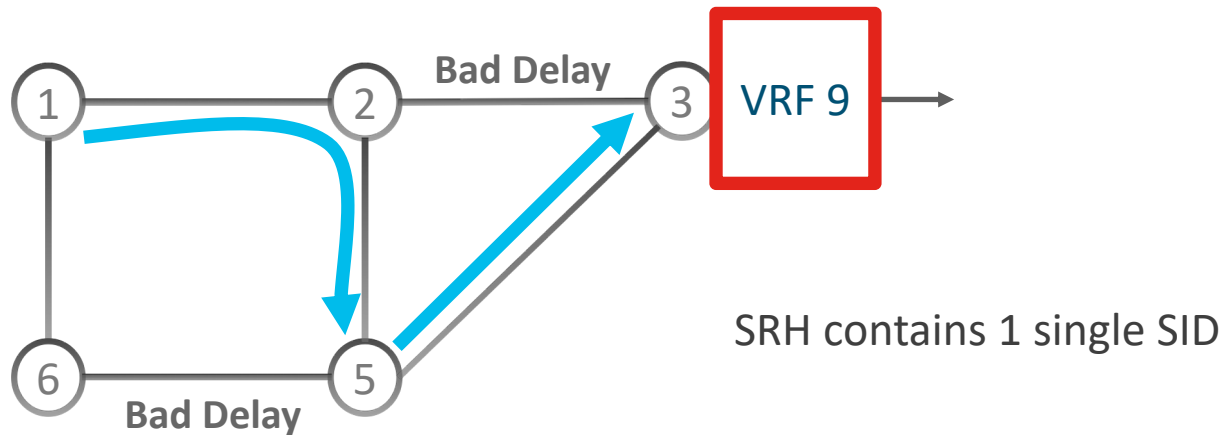




# Low-Delay VPN

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

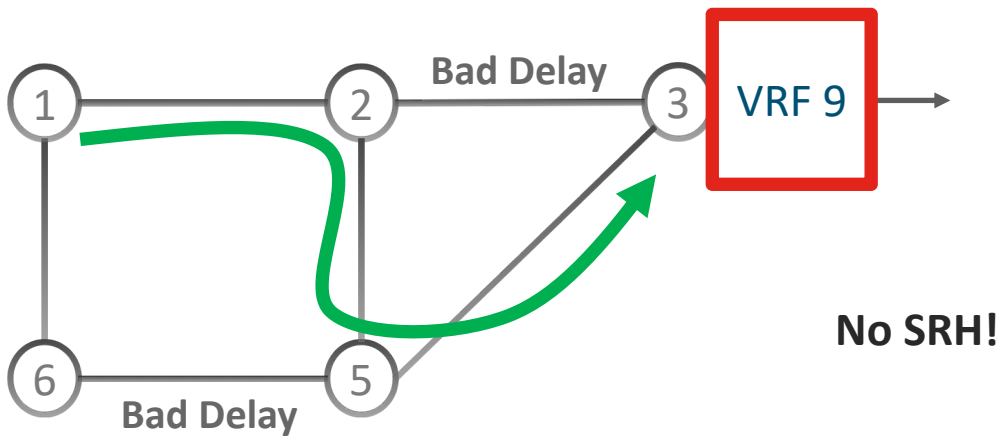
*B: locator block is associated with ISIS base algo (Low Cost)*



# Low-Delay VPN

Network Program: D:3:V(9)

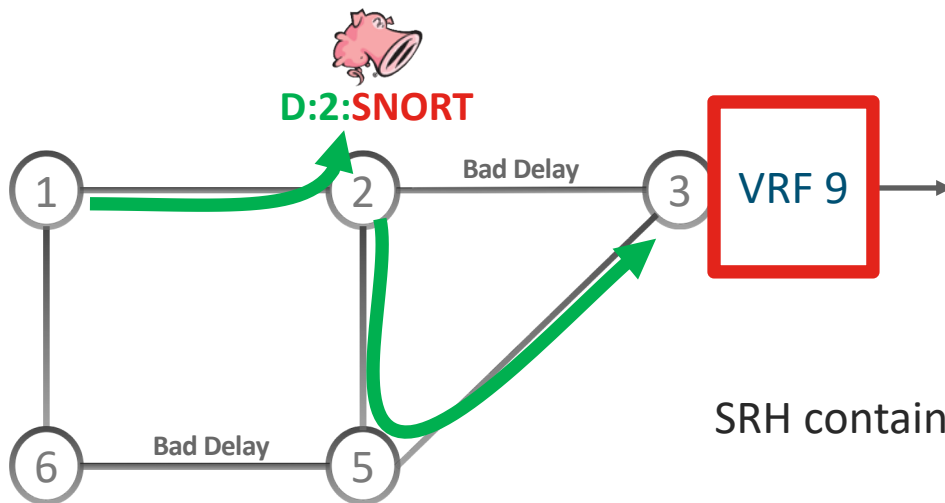
*D: locator block is associated with Low Delay Flex-Algo*



# SNORT & Low-Delay VPN

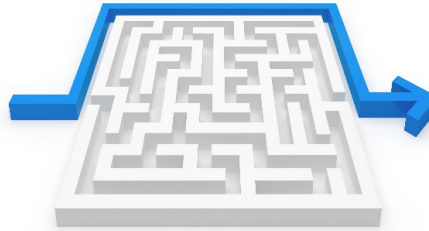
Network Program: D:2:SNORT then D:3:V(9)

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



SRH contains 1! Single SID

# 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



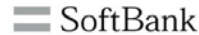
## Standardization IETF



## Multi-vendor Consensus



## Open Source Linux, VPP



# Stay Up-To-Date

## Social media



[twitter.com/SegmentRouting](https://twitter.com/SegmentRouting)



[facebook.com/SegmentRouting/](https://facebook.com/SegmentRouting/)

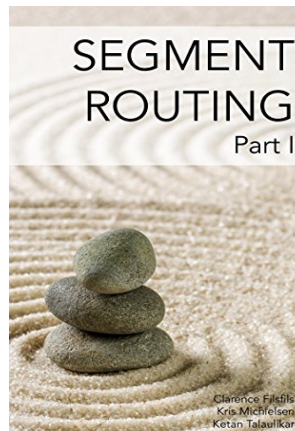


[segment-routing.net](https://segment-routing.net)



[linkedin.com/groups/8266623](https://linkedin.com/groups/8266623)

## Books



[amzn.com/B01I58LSUO](https://amzn.com/B01I58LSUO)



[amazon.com/dp/B07N13RDM9](https://amazon.com/dp/B07N13RDM9)

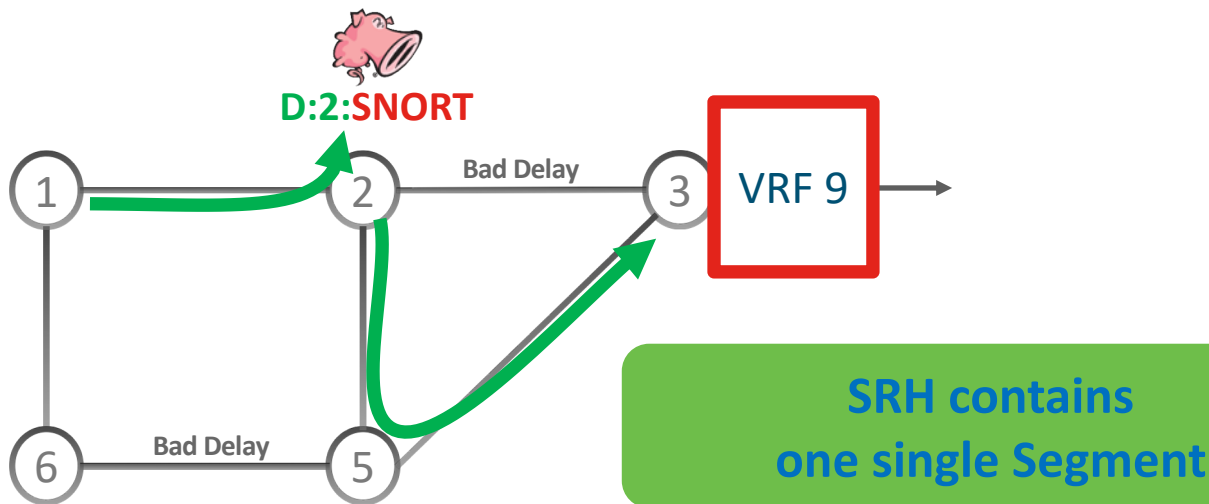
# SRv6 Backup



# 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*



SPRING  
Internet-Draft  
Intended status: Informational  
Expires: September 25, 2019

S. Matsushima  
Softbank  
C. Filsfils  
Z. Ali  
Cisco Systems  
Z. Li  
Huawei Technologies  
March 24, 2019

SRv6 Implementation and Deployment Status  
draft-matsushima-spring-srv6-deployment-status-00

## SRH

*1<sup>st</sup>: 2014-03*

*WG: 2015-12*

*Last-Called: 2019-04*

*26 revisions*

## NET PGM

*1<sup>st</sup>: 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**



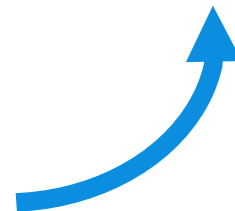
# Scale

	# 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

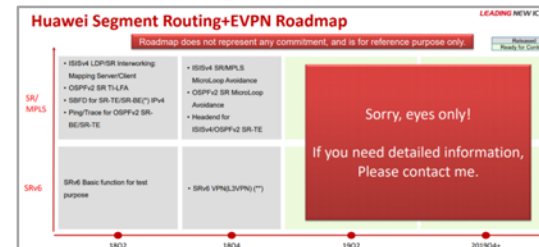
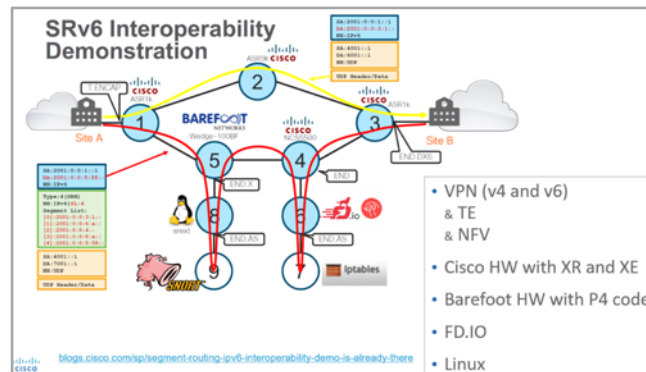
- Just program the network
- SRv6 is Turing Complete
  - Metadata is part of the solution: Tag and TLV





## 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



## Other SW

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



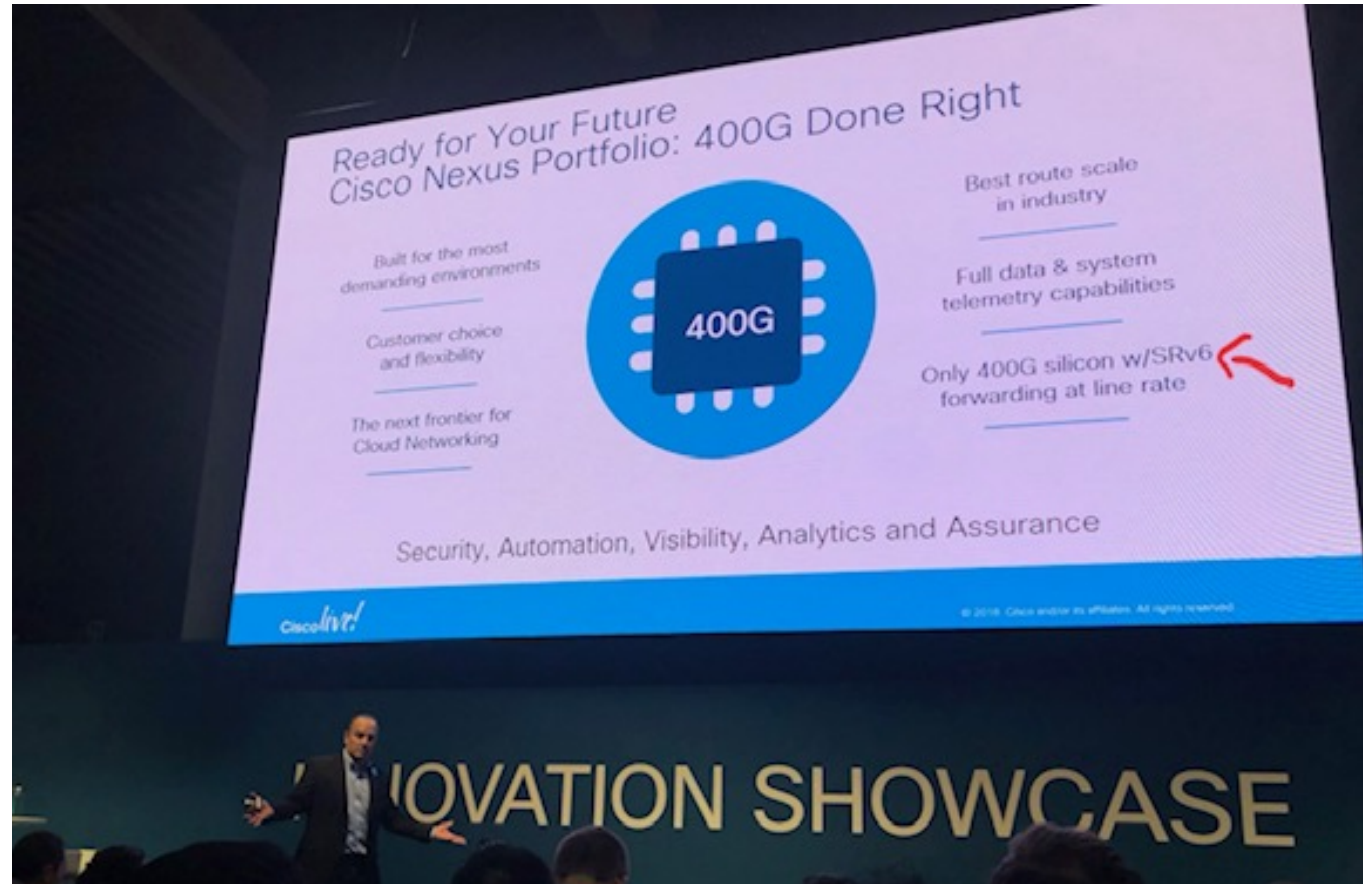
# Cisco FCS and in deployment

- 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 !



Ready for Your Future  
Cisco Nexus Portfolio: 400G Done Right

Built for the most demanding environments

Customer choice and flexibility

The next frontier for Cloud Networking

400G

Best route scale in industry

Full data & system telemetry capabilities

Only 400G silicon w/SRv6 forwarding at line rate

Security, Automation, Visibility, Analytics and Assurance

CiscoLive!

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INNOVATION SHOWCASE

A presentation slide for the Cisco Nexus Portfolio, titled "400G Done Right". The slide features a central graphic of a blue circle containing a black square with "400G" and white dots representing pins. To the left of the graphic are three bullet points: "Built for the most demanding environments", "Customer choice and flexibility", and "The next frontier for Cloud Networking". To the right are three bullet points: "Best route scale in industry", "Full data & system telemetry capabilities", and "Only 400G silicon w/SRv6 forwarding at line rate", with a red arrow pointing to the last one. At the bottom, it lists "Security, Automation, Visibility, Analytics and Assurance" and includes the CiscoLive! logo and copyright notice. The slide is part of an "INNOVATION SHOWCASE" presentation, with a speaker visible at the bottom.

