Segment Routing

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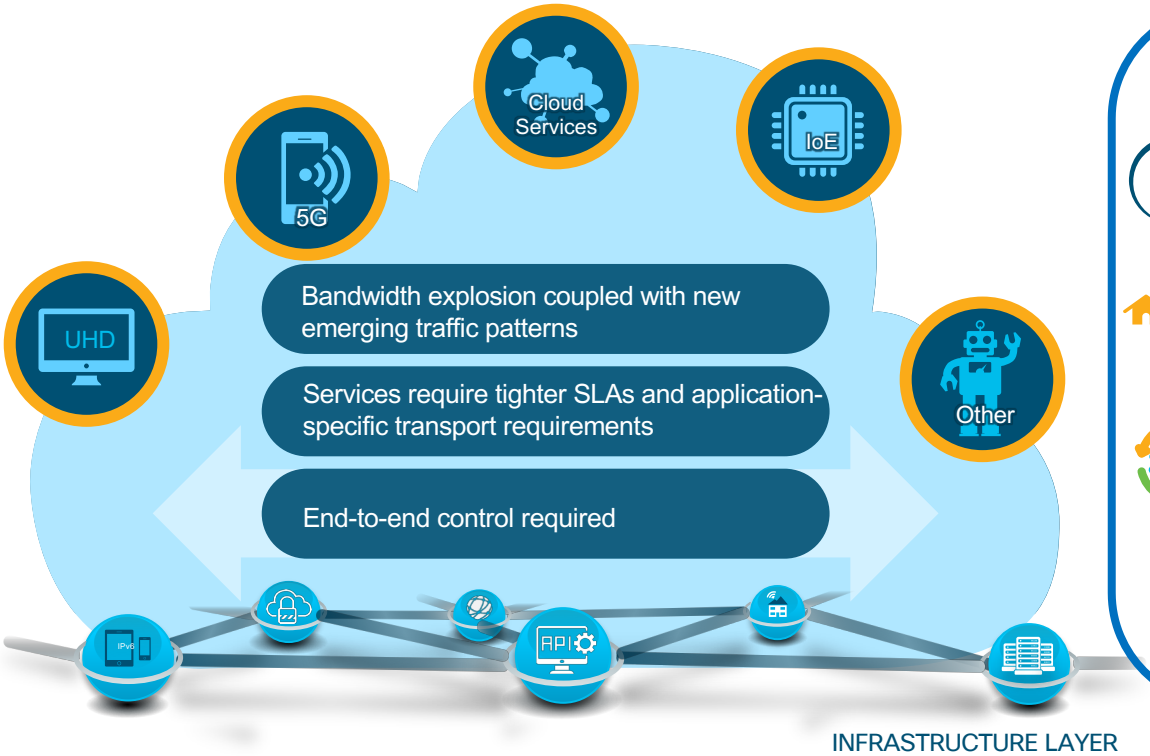
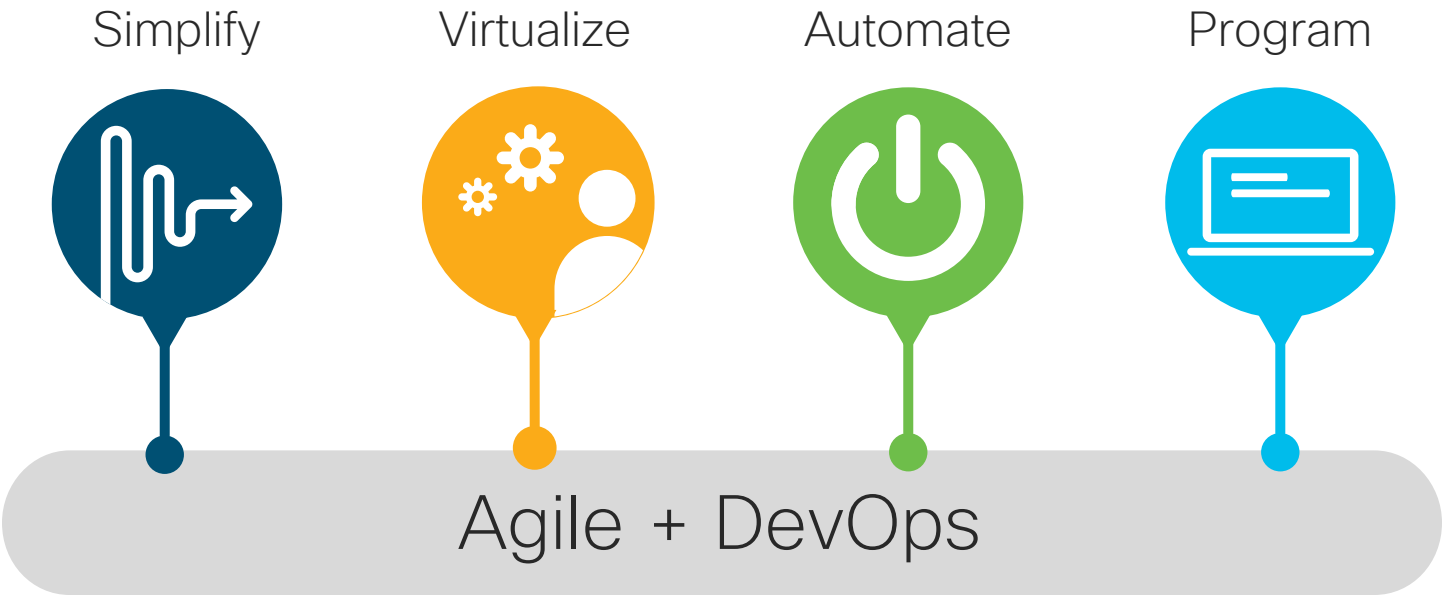
Service Provider networks are facing challenges



Remaining profitable while

- Average broadband speed increase
- Explosion of devices connected to IP networks
- Upcoming 5G rollouts
- Relatively flat revenues

Cisco's Networking Strategy



New business capabilities built on the network as the platform;
Enabling customers to achieve business outcomes faster with ruthless ease

Segment Routing: Value Proposition

Create New Revenue Streams

- Differentiate Services with SR Policies
- Intent-Based Value-Add Services

Deploy with Ease

- Seamless Brownfield Integration
- Single Control for Inter Domain Implementations

Monitor Health

- Data Path Validation Including ECMP
- Real Time Per-Link Performance Monitoring with Telemetry

Increase Availability

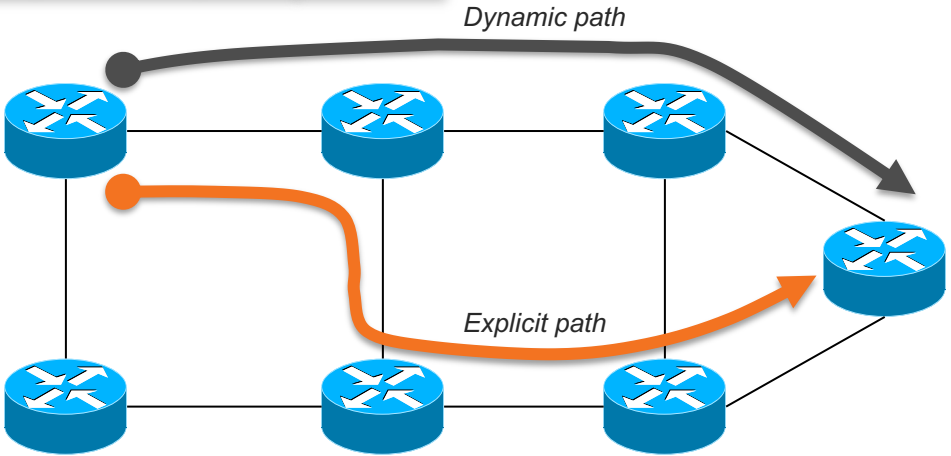
- Automated 50ms Protection
- Assured Loop-free Convergence upon Recovery

Multi-vendor consensus – Designed and built with network operators

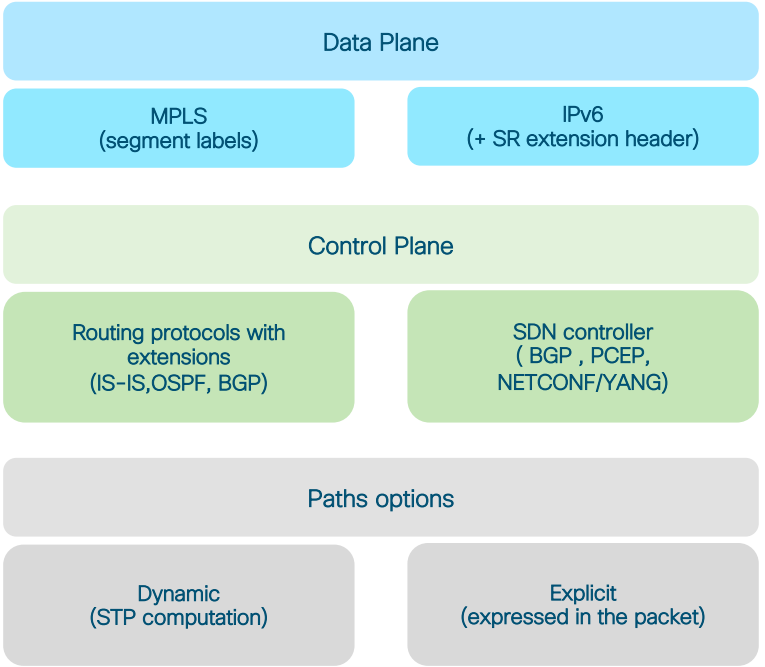
How Segment Routing Works?

Segment Routing – Source Routing

SID List (ex. Label Stack)



Segment = any instruction
SID = Segment IDs
Global SIDs and Local SIDs



SR Benefits

- Simplified control plane
- Sub-50ms convergence (TI-LFA)
- Microloop avoidance
- Simplified tactical TE
- Centralized optimization
- Scalability
- Interworking with brownfield
- De-facto architecture for SDN
- Standardized

- Multi-vendor consensus
- Defined closely with operators
- Addresses unsolved problems (TI-LFA, cross-domain policies)
- Cost optimizations
- Impact beyond infrastructure (IPv6 – SRv6)

Use-Cases

Driving Simplicity, Scale and Automation

Seamless Deployment

Problem

Perceived complexity of inserting in existing network (LDP)

Solution

Segment Routing: Simple, automatic and seamless
Co-existence and/or interworking with LDP/MPLS

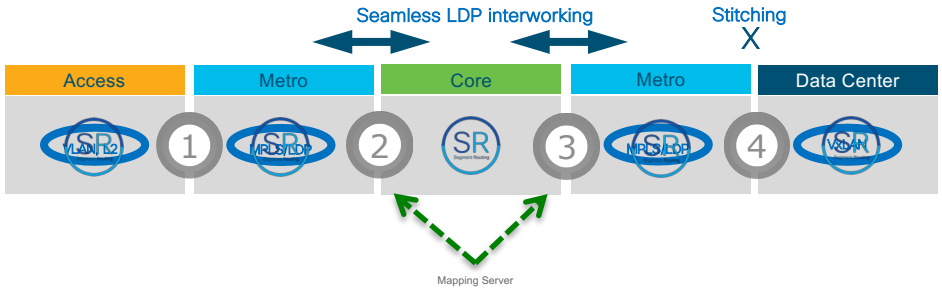
Mapping Server to advertise prefix-SIDs on behalf of non-SR nodes

Benefits

Straightforward
No complex rip and replace strategy needed

Foundational to Enable SR use-cases and reap its benefits

Investment Protection
Enabled by Software-Only upgrade



Start by enabling SR in a strategic place in the network
co-existence and/or interworking

Extend SR to remove complex protocols and reclassification at domain boundaries

Extend even more to achieve end-to-end simplicity, scalability and SDN-readiness

Interested? Segment Routing and LDP co-existence on segment-routing.net

Protect with automatic TI LFA FRR

Problem

Incomplete coverage, topology **dependent** coverage of classical LFA

Solution

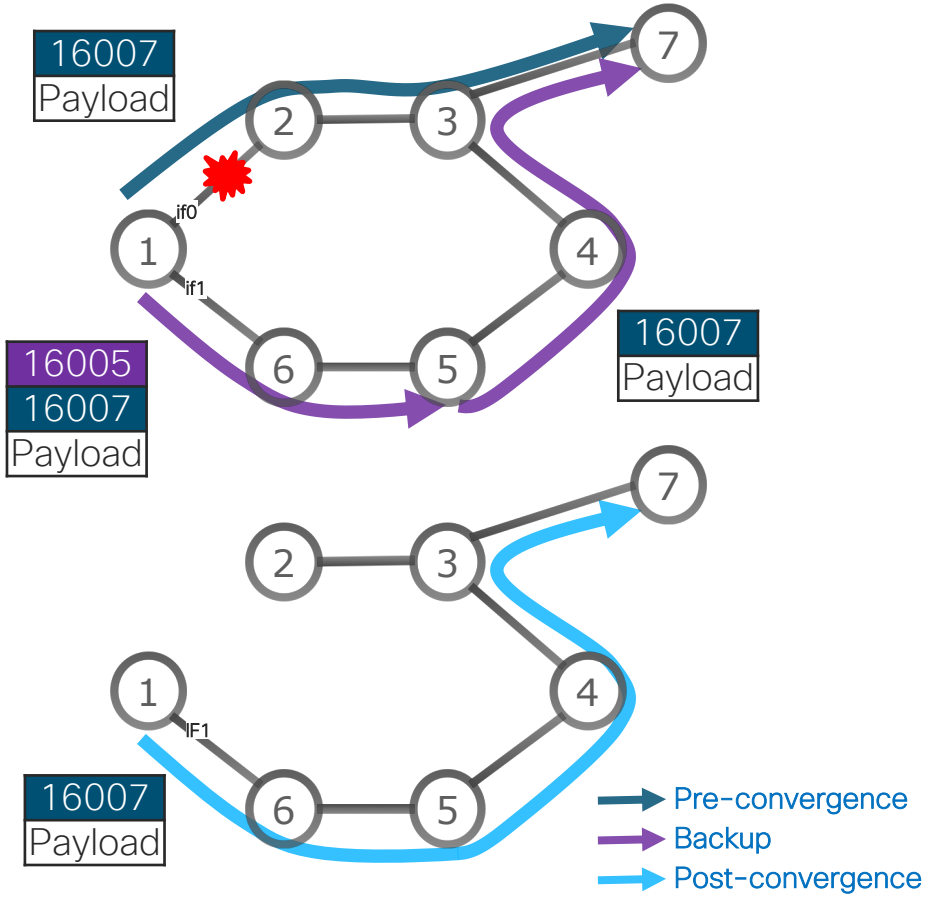
Automated Topology **Independent** with guaranteed sub-50ms per-prefix protection

Benefits

Simple and Automated
IGP computed / No midpoint backup state

Optimal
Backup path following post-convergence path

Scalable
Cisco's TI-FLA algorithm – **optimized for scalability**
Post-convergence path computation and SID-list encoding



Stabilize with Microloop Avoidance

Problem

Micro-loops: a day-one IP drawback

Micro-loops are transient packet loops that occur during network convergence (link up/down)

Mostly due to nodes on the path reaching convergence at different times

These micro-loops are causing packet loss and out of order packets

Solution

IF micro-loops are possible on post-convergence path to a destination

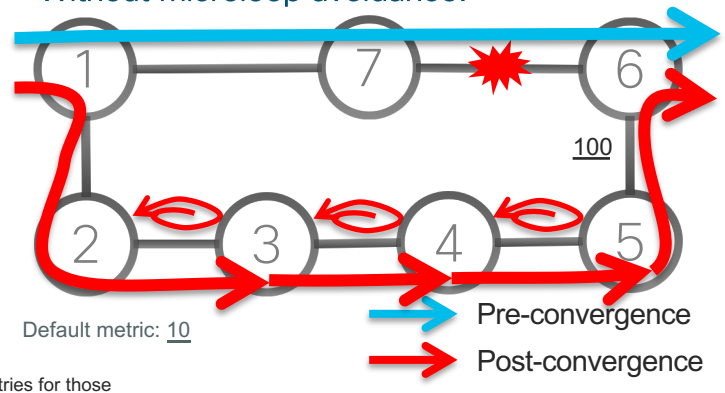
THEN node automatically computes a SID-list to steer traffic to that destination loop-free over the post-convergence path

Benefits

Robust network convergence from link up/down events

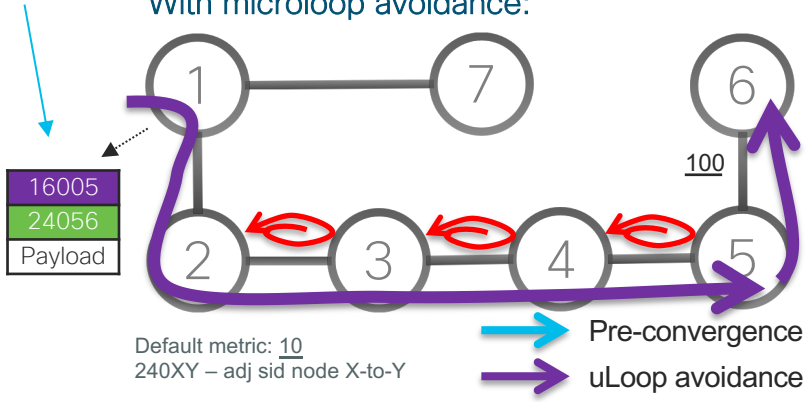
Zero packet loss or out-of-order

Without microloop avoidance:



SID-list imposition entries for those destinations with possible microloops, such as destination Node 6

With microloop avoidance:



Simplified planning: SR Traffic Matrix

Applicability Examples

Capacity Planning

Traffic Patterns

Network Optimization

IP or Optical

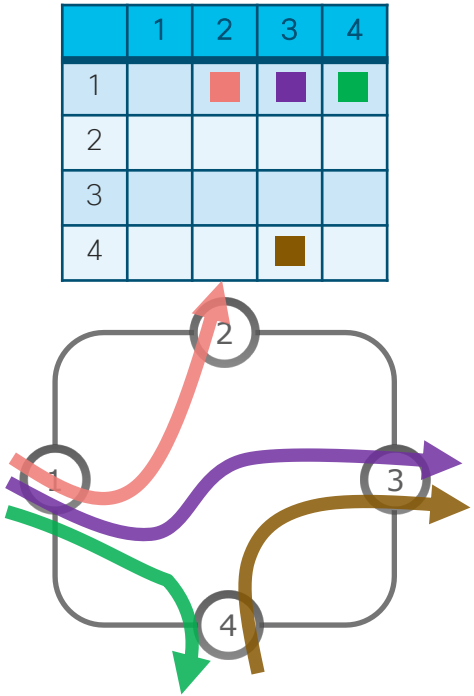
Solution

With Cisco Segment Routing, the traffic/demand matrix collection is automated

No extra off-box tooling required

Benefits

Capacity planning
Centralized traffic engineering
IP/Optical optimization



Interested? Segment Routing Traffic Matrix on segment-routing.net

Use Cases

Traffic Engineering with Simplicity, Scale and Automation

SR Native path computation algorithms

Limitations of RSVP-TE

RSVP-TE is non-ECMP by nature
- Sub-optimal use of Network Bandwidth (CSPF)

RSVP-TE has limited scalability
- Core states in k × n2 (head/mid/tail)

RSVP-TE is complex to operate
- Pre-configured full-mesh point-to-point tunnels
- Difficult to maintain and troubleshoot
- No inter-domain
- Complex steering: PBR, autoroute

Solution

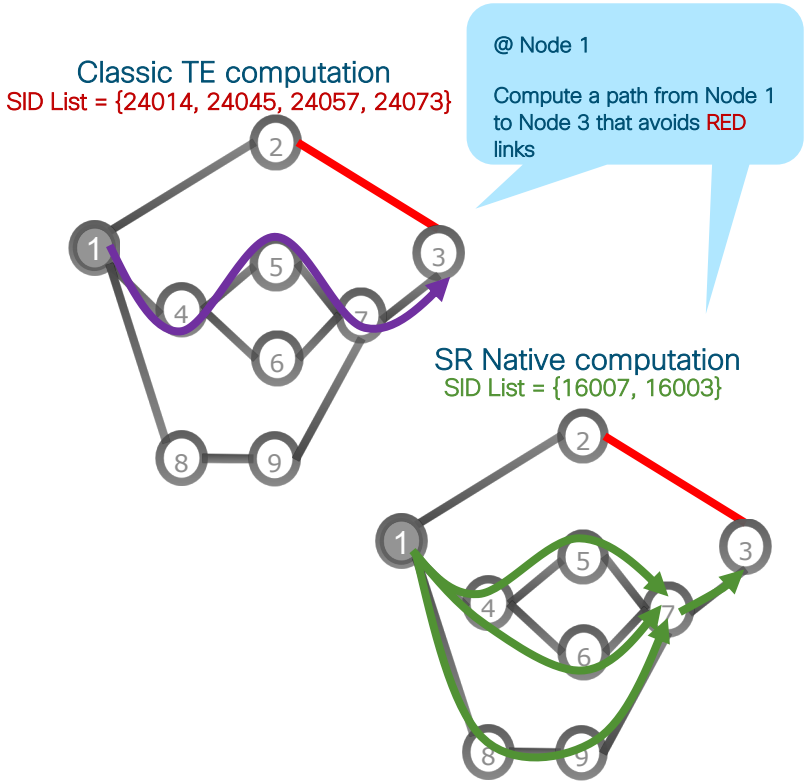
New algorithms designed with SR principles to
- Minimize SID List
- Maximize ECMP
- Optimize use of resources

Benefits

Simplicity and Automation
- Native computation without maintaining state
- No tunnel interface: SR policy

Effective use of bandwidth: Native ECMP

Scalability with the use of binding SIDs



Recognized Innovation - Sigcomm 2015

Interested? Segment Routing Traffic Engineering (SRTE) on segment-routing.net

SR Path Computation Element (SR-PCE)

SRTE Head-End

Distributed Mode – SR-TE Head-End

Visibility is limited to its own IGP domain

Solution

Multi-Domain SRTE Visibility

Centralized SR-PCE for Multi-Domain Topology view

Integration with Applications

North-bound APIs for topology/deployment

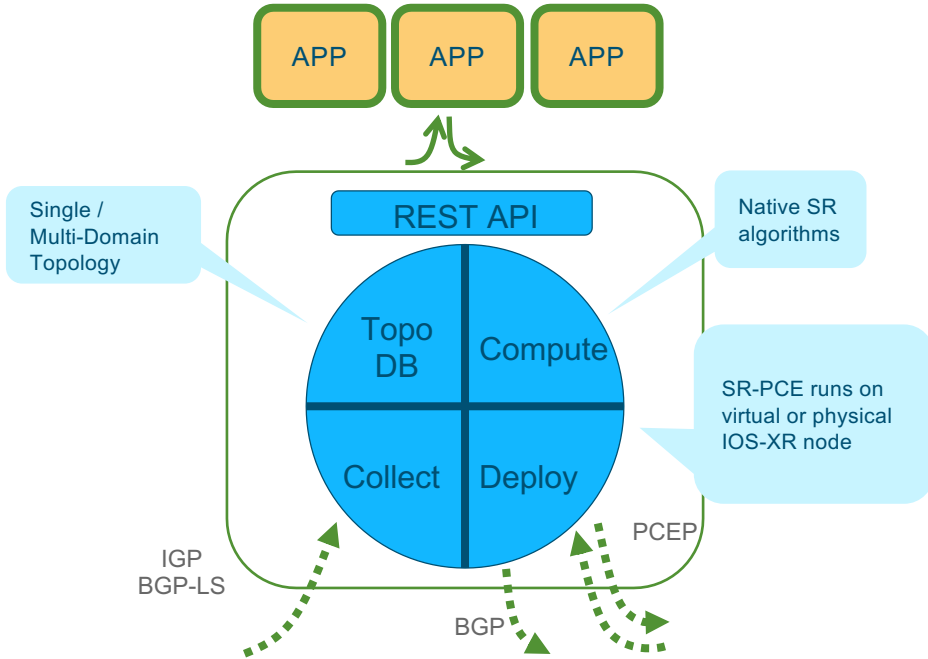
Delivers **across the unified SR Fabric** the SLA requested by the service

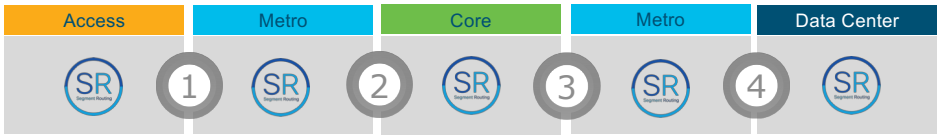
Benefits

Simplicity and Automation

End-to-End network topology awareness

SLA-aware path computation across network domains





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Intent-based SRTE
SR On-Demand Next Hops (ODN)

Applicability Examples

Service Portal

Pay as you Go

Application Awareness

SLA fulfillment

Solution

Edge router **automatically computes** or **requests SR PCE** a path to the remote service endpoint

The path can either be for simple best effort reachability or for reachability with **SLA contract**

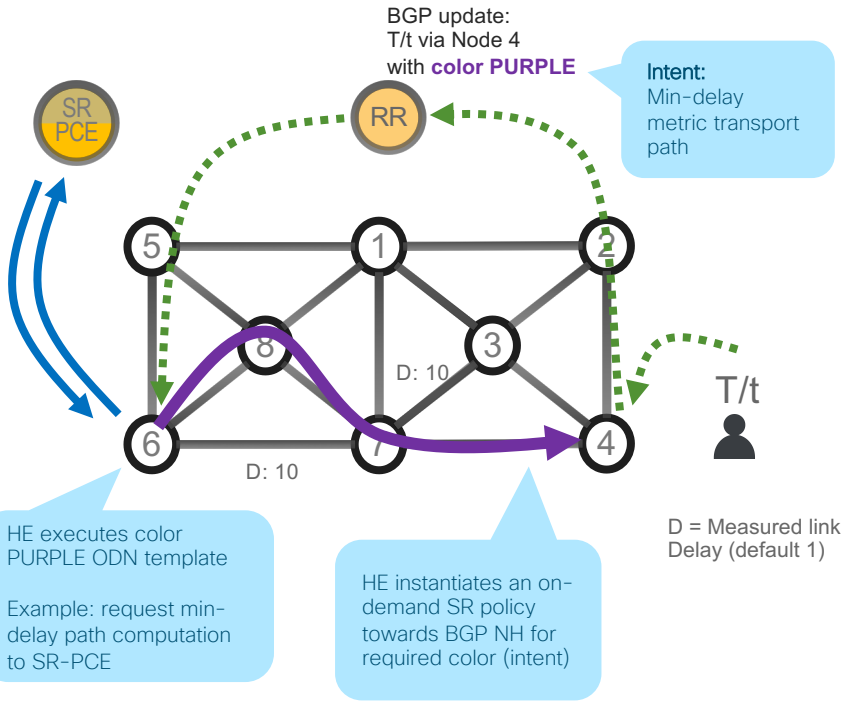
Benefits

Intent-based

SLA-aware BGP service
Decoupled service and transport provisioning

Scalability

No a-priori full-mesh of connectivity



Interested? Segment Routing Traffic Engineering (SRTE) on segment-routing.net

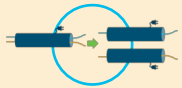
SR IGP Flexible Algorithms

Applicability Examples

Sensitive Data

Financial Transactions

Transport Redundancy



Different Fiber Conduits

Scalability

Low-End Platforms

Solution

Customized IGP algorithms defined by operator for **intent-based instantiation of traffic Engineering**

- Minimization of metrics: IGP, delay
- Exclusion of properties: link-affinity, SRLG

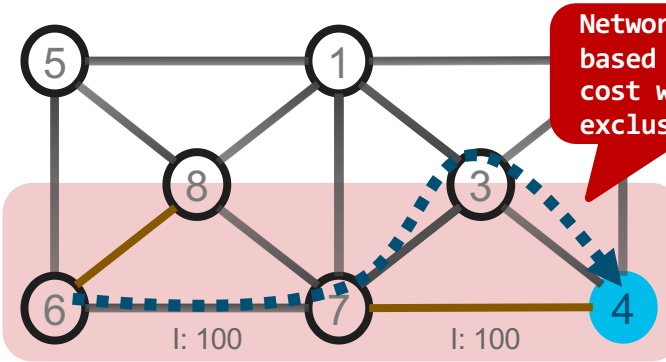
Benefits

Simplicity and Automation

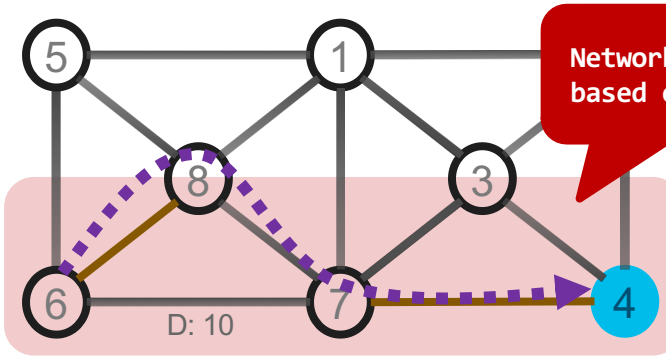
- IGP-computed TE-path from anywhere to anywhere
- Sub-50msec protection (TILFA) optimized per Flex-Algorithm plane

Scalability

- Single SID (instead of label stack) to enforce TE path
- Single prefix segment can participate in many Flex-Algos



Default IGP link metric: I:10



Measured link Delay: D:1

Interested? SR IGP Flexible Algorithm on segment-routing.net

Intent-based Network Slicing with Delay Opt.

Applicability Examples

Service Portal
Pay as you Go

Sensitive Data
Financial Transactions

Transport Redundancy
Different Fiber Conduits

Application Awareness
SLA fulfillment

Solution

SR Flex Algo part of SRTE solution

Leverages ODN and automated steering building SRTE solution blocks to deliver revolutionary traffic engineering

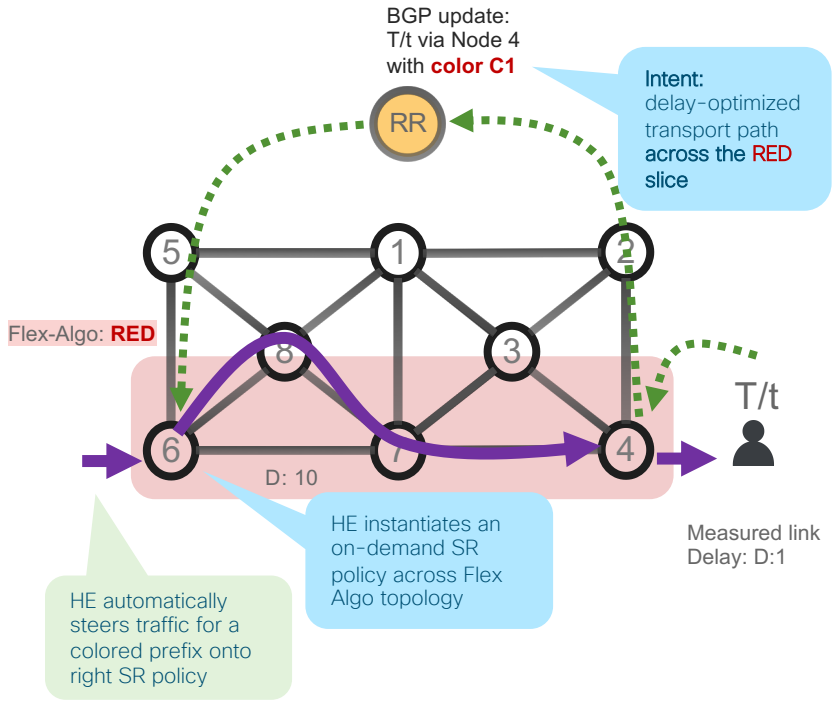
Benefits

Simplicity, automation and scalability

Combined benefits of an integrated SRTE solution across Flex Algo topologies

No a-priori full-mesh of connectivity

Optimal use of resources with end-to-end SLA awareness



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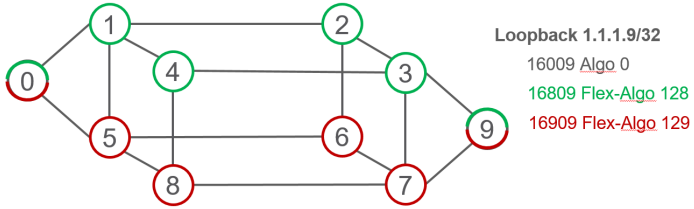
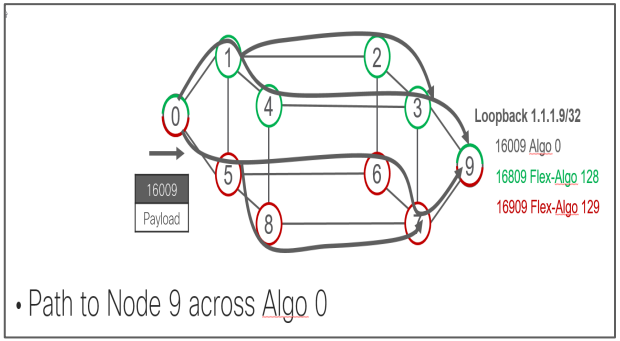
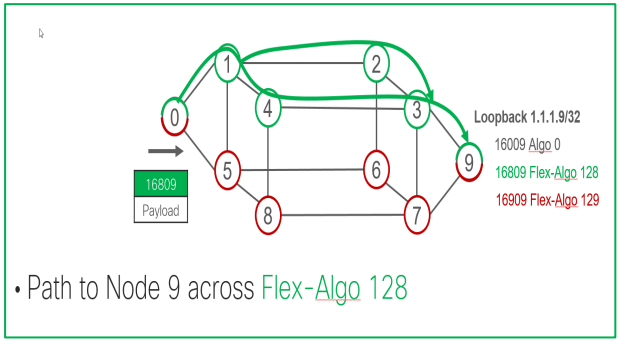
Multi-Plane Networks

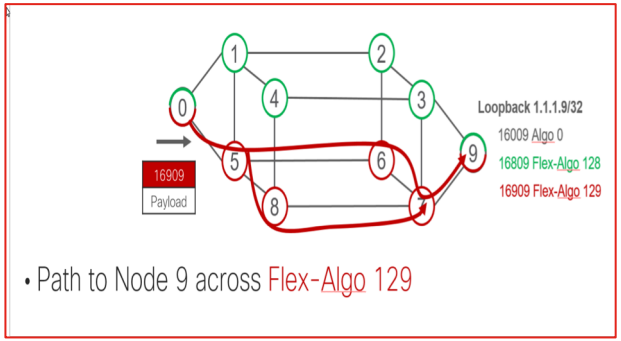
Powered by SR IGP Flex Algo



- All the nodes support Algo 0: minimize IGP metric
- Green nodes also support 128: minimize IGP metric
- Red nodes also support 129: minimize Delay







SRv6

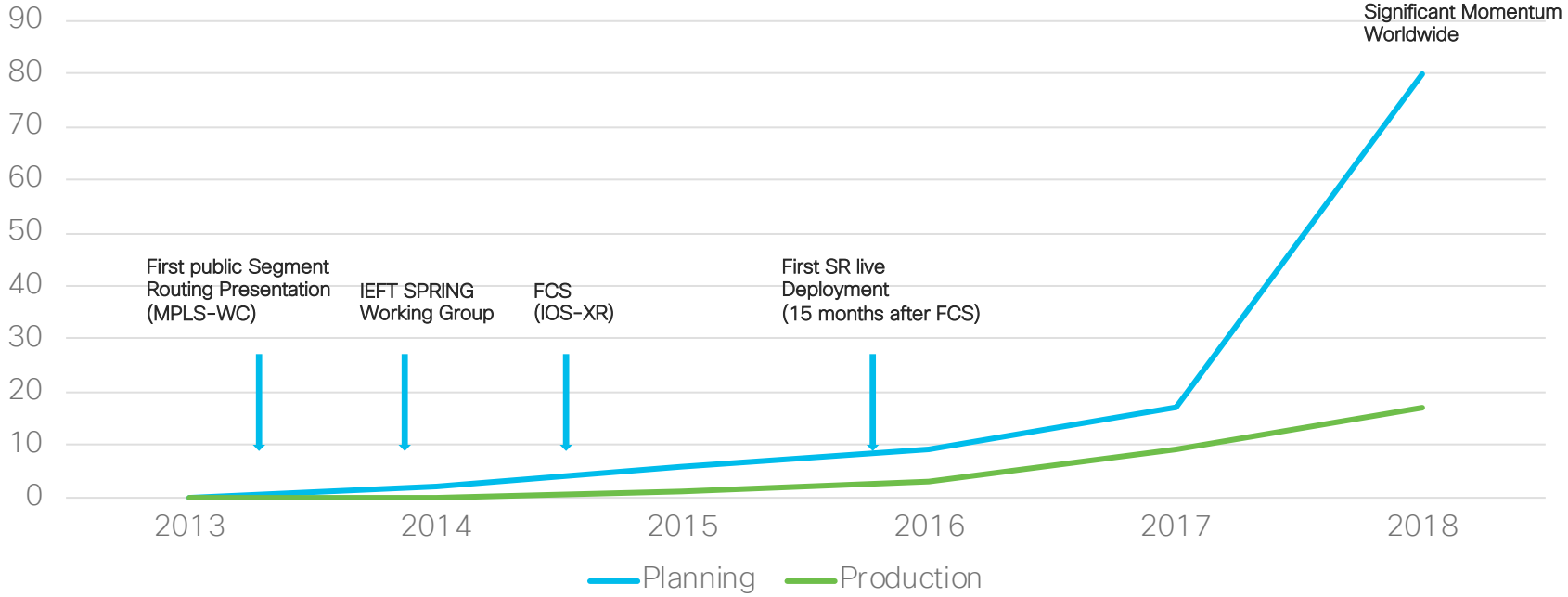
Network Service Programming

at Hyper scale

Industry Adoption

5 Years

Segment Routing Customer Adoption



Segment Routing adoption

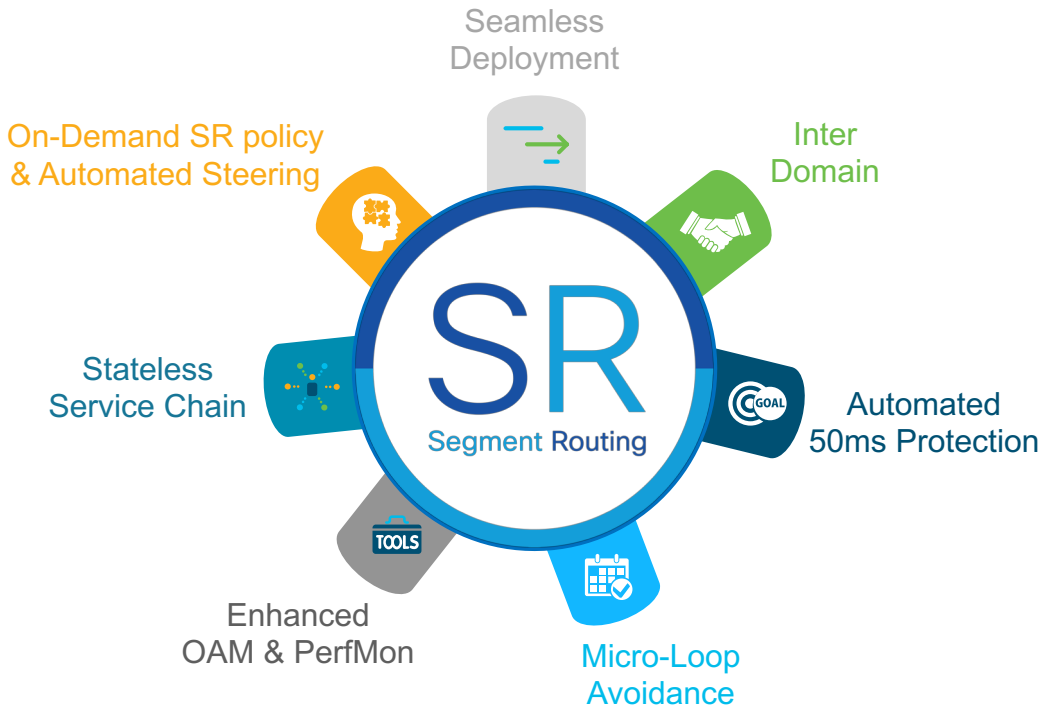
Public SR Announcements

BELL SOFTBANK VODAFONE ALIBABA WALMART

CHINA UNICOM SHENTEL TELEFONICA COLT

Conclusion

Segment Routing Attributes



Significant Momentum Worldwide

Stay up to date

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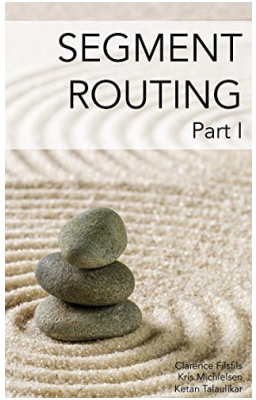

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