

# Segment Routing

A new paradigm for routing

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# Tackling network complexity

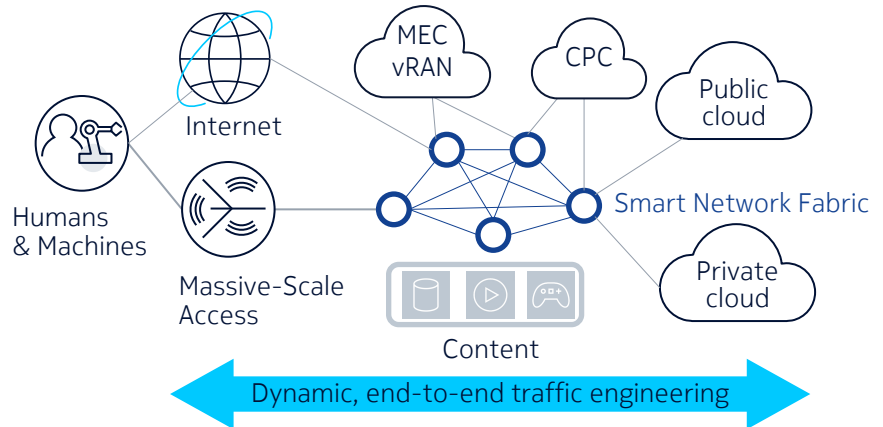
Segment routing is key to future network design

Evolution to cloud-centric design

Future IP networks will need finer routing control to enable new applications

RSVP-TE and LDP are de-facto in most service provider networks but fall short:

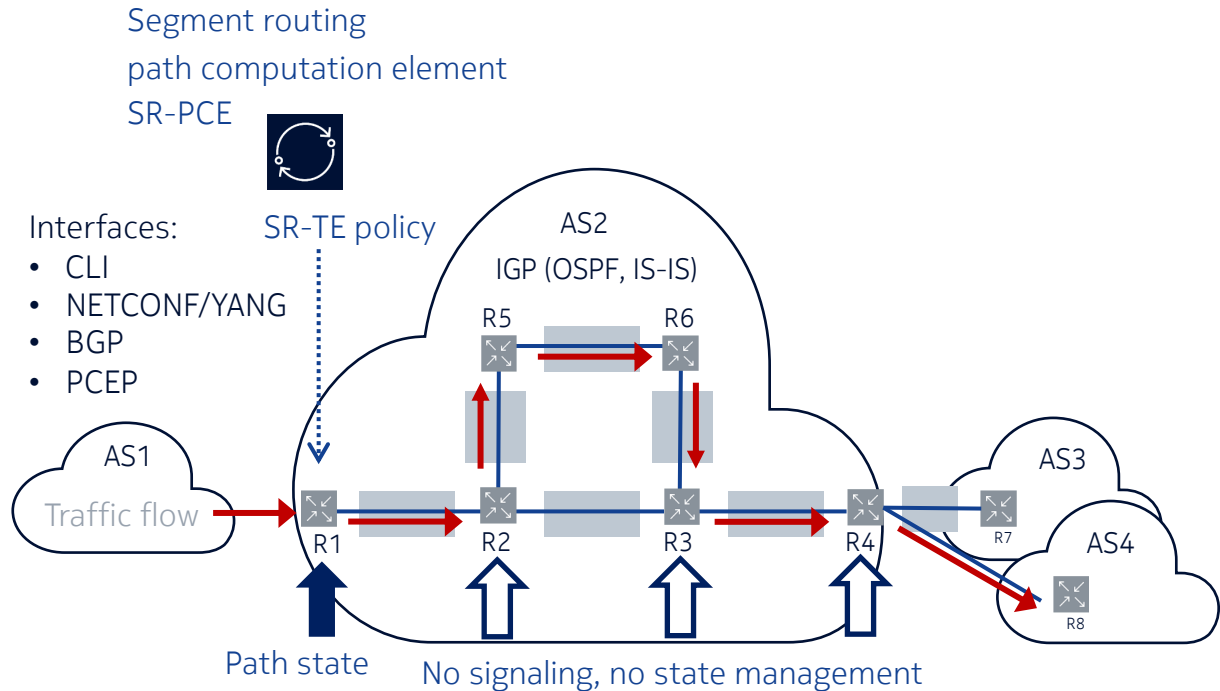
- Protocol-related scaling issues
- Traffic engineering is complex to implement and has limitations
- Source-based steering is complex
- Load balancing and fast reroute support have limitations



# What is Segment routing?

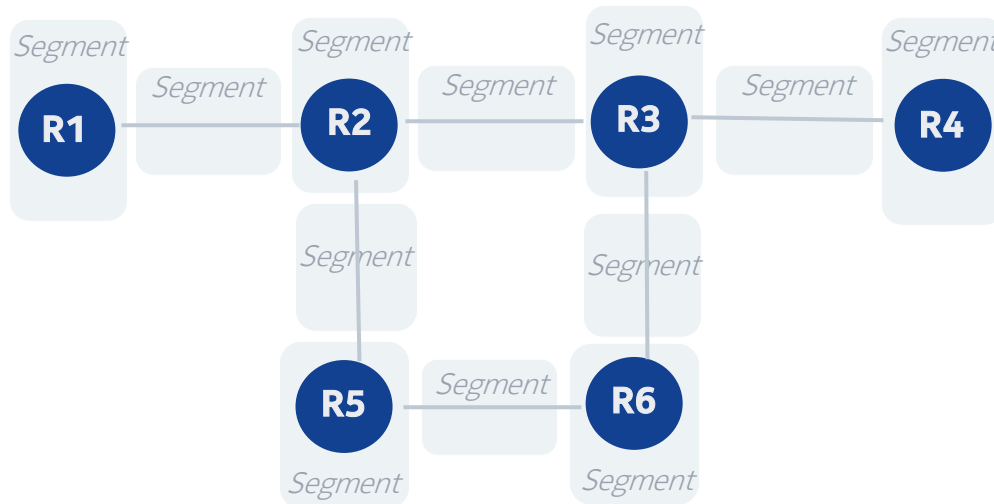
A source-based routing protocol to steer IP traffic along a specific path

- Routing done with a list of IDs (SIDs) for segments to traverse, appended to the packet
- Only the ingress router maintains policy and state information about the path
- Predefines paths to meet desired constraints
- Based on extensions to IGP protocols



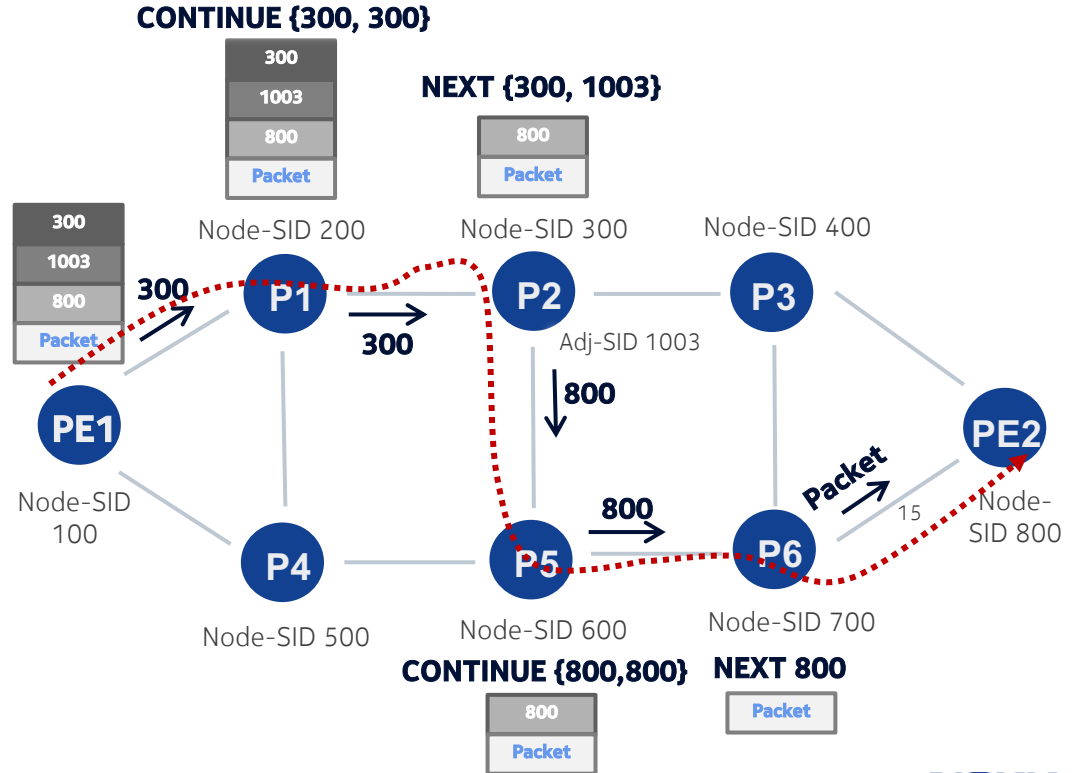
# What is Segment Routing?

- Segment Routing provides a tunneling mechanism that enables source routing.
- Paths are encoded as sequences of topological sub-paths called segments (identified by Segment Identifiers, SIDs), which are advertised by link-state routing protocols (IS-IS and OSPF).



# Segment Routing in operation

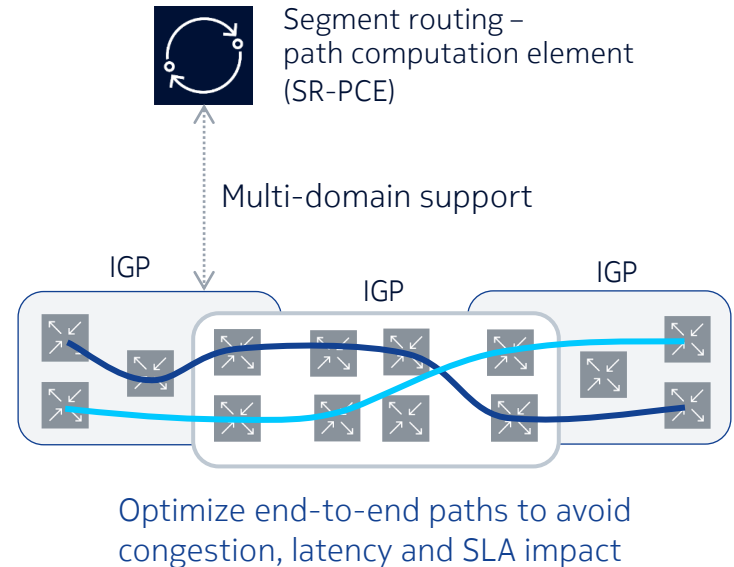
- In this example, PE1 wants to traverse the link P2-P5 on the way to PE2, as it is under-utilised.
- PE1 therefore imposes the segment list {300, 1003, 800} representing the Node-SID for P2, the Adj-SID for link P2-P5, and finally the Node-SID for PE2.



# Complementing segment routing with an SDN controller

## Benefits

- ✓ Real-time network **visualization**
- ✓ Improve **SLA adherence** by engineering paths end-to-end with routing decisions based on
  - Actual **utilization**
  - **Bandwidth** (bandwidth management)
  - **Latency** requirements
- ✓ **Automate** path [re-]routing
  - to distribute traffic for optimal network **capacity usage**
  - to trigger path **re-optimization**
  - to prevent issues from **maintenance** actions
- ✓ **Resiliency** enhancements
- ✓ Offline **simulation**



# So why Segment Routing?

Value Proposition – Simplicity by “Enhanced Forwarding Behavior”

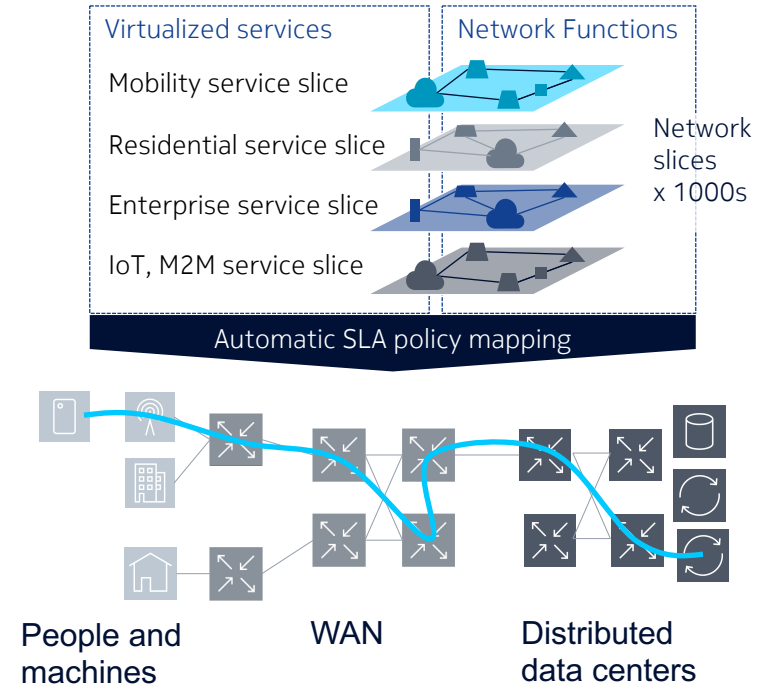
- Packet forwarding decision is based upon “Segments” and not upon “IP payload prefix”
- Segments are encoded as 32 bits or 128 bits
  - 32-bit segments supported over IPv6, MPLS, (or even IPv4) dataplane
  - 128-bit segments supported only over IPv6 dataplane
  - Sequence of segments represents a set of actions/instructions imposed to the packet
  - Both encodings achieve the same set of use-cases defined in RFC7855 [SPRING Problem Statement and Requirements] (e.g. SR rLFA/TI-LFA, SR Traffic Engineering, etc.)
- No per-flow state contained within the network
- Segments are distributed by Routing or SDN control
  - No more LDP or RSVP
  - Fair balance between “distributed intelligence” and “centralized optimization/programming”



# Service innovation and customer retention

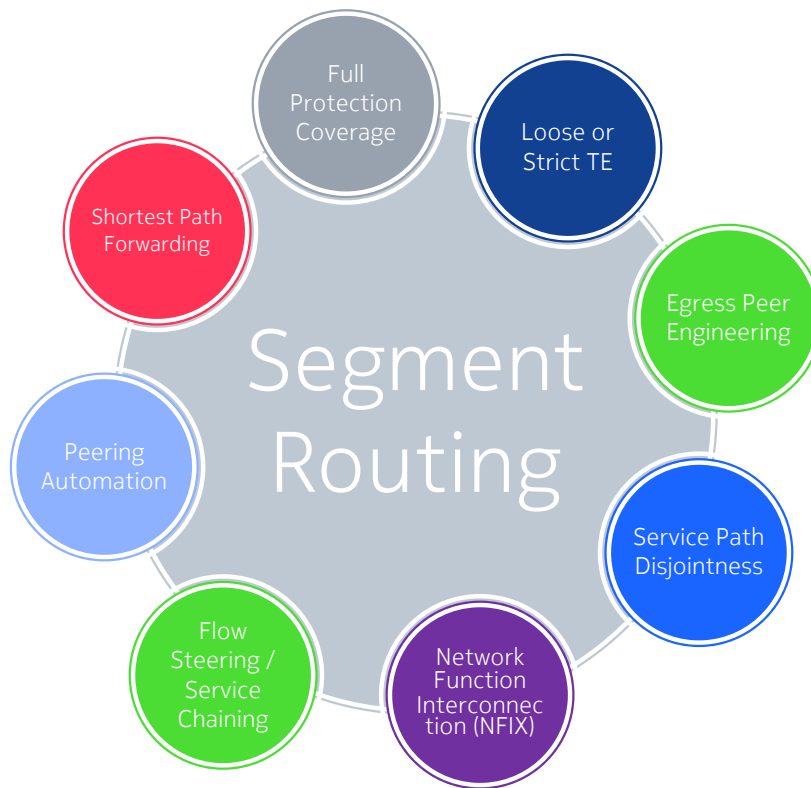
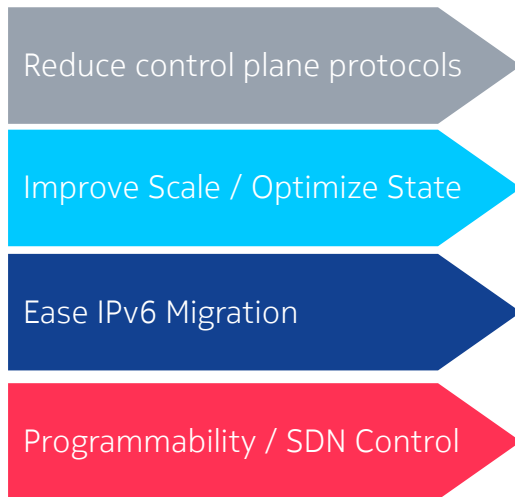
## Seamless interconnectivity across WAN, DC and MECs

- Eases network slicing implementation for future services
- Additional routing parameters for managed SLAs:
  - Physical diversity, link state, available bandwidth, accumulated latency
- High scalability for IoT, eMBB
- High availability
  - Control plane, path diversity
  - Fast reroute <50 ms
- Dynamically adapts to changing traffic patterns
  - Better customer experience
  - Potential for services based on elastic capacity





# Why segment routing ?



**NOKIA**