SRv6 based Network Slicing

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Security Level:

MPLS+SDN+NFVWORLD PARIS 2019

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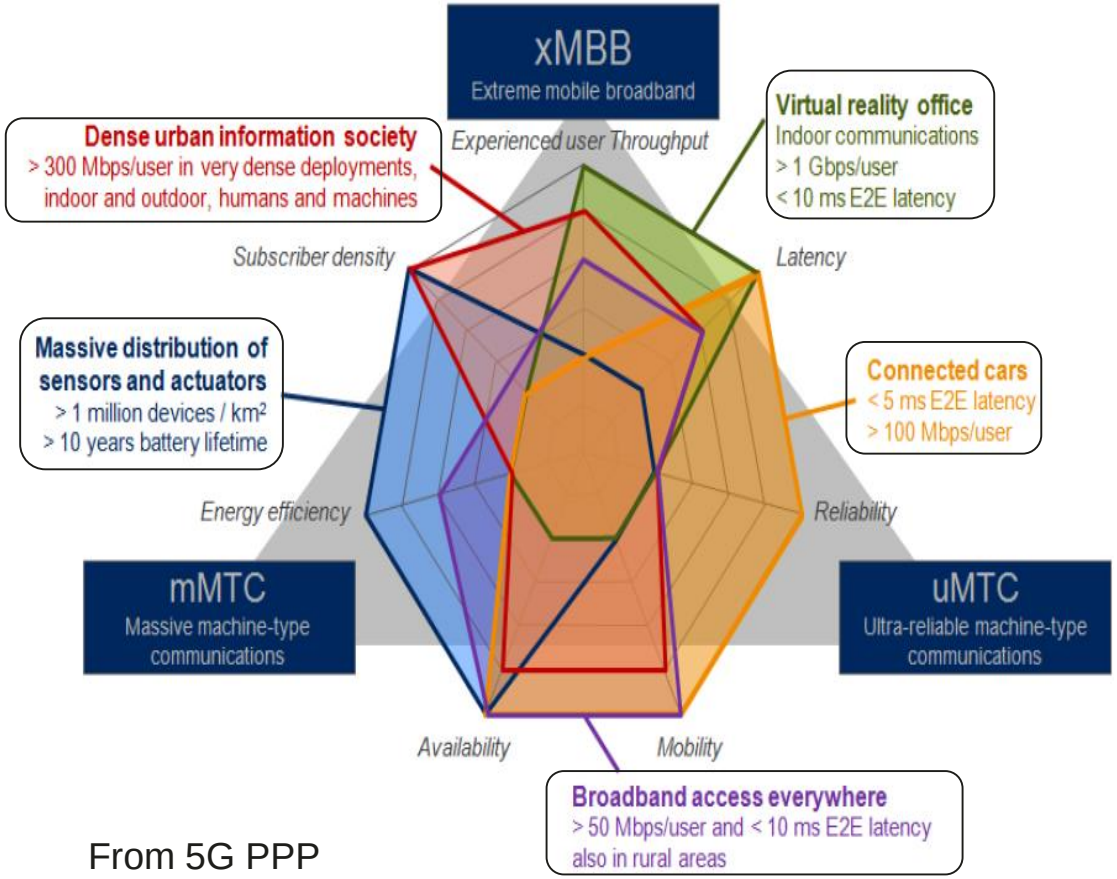
- Network Slicing Architecture
- SRv6 based Network Slicing

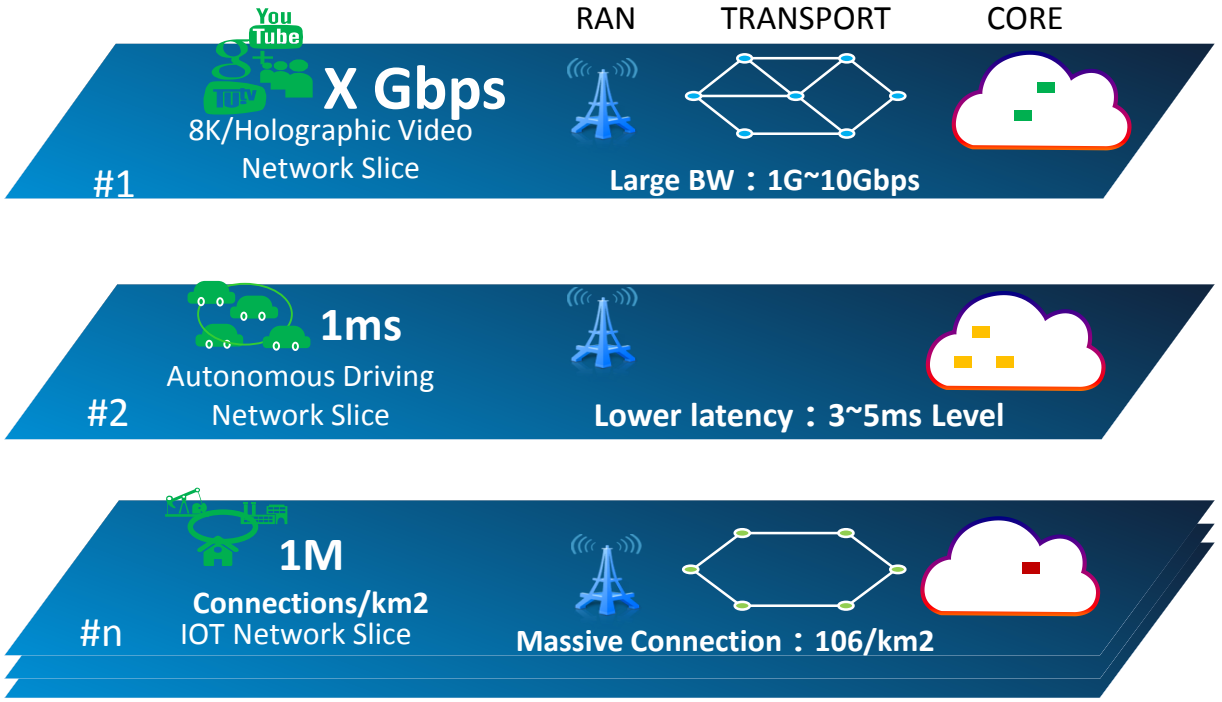
5G Emerging Services Leads to Network Slicing

Diversified Services, Stringent Requirements



From 5G PPP

Converged Network Infrastructure, Multiple Network Slices



Network Slicing is the KEY to meet diversified service requirement in one network

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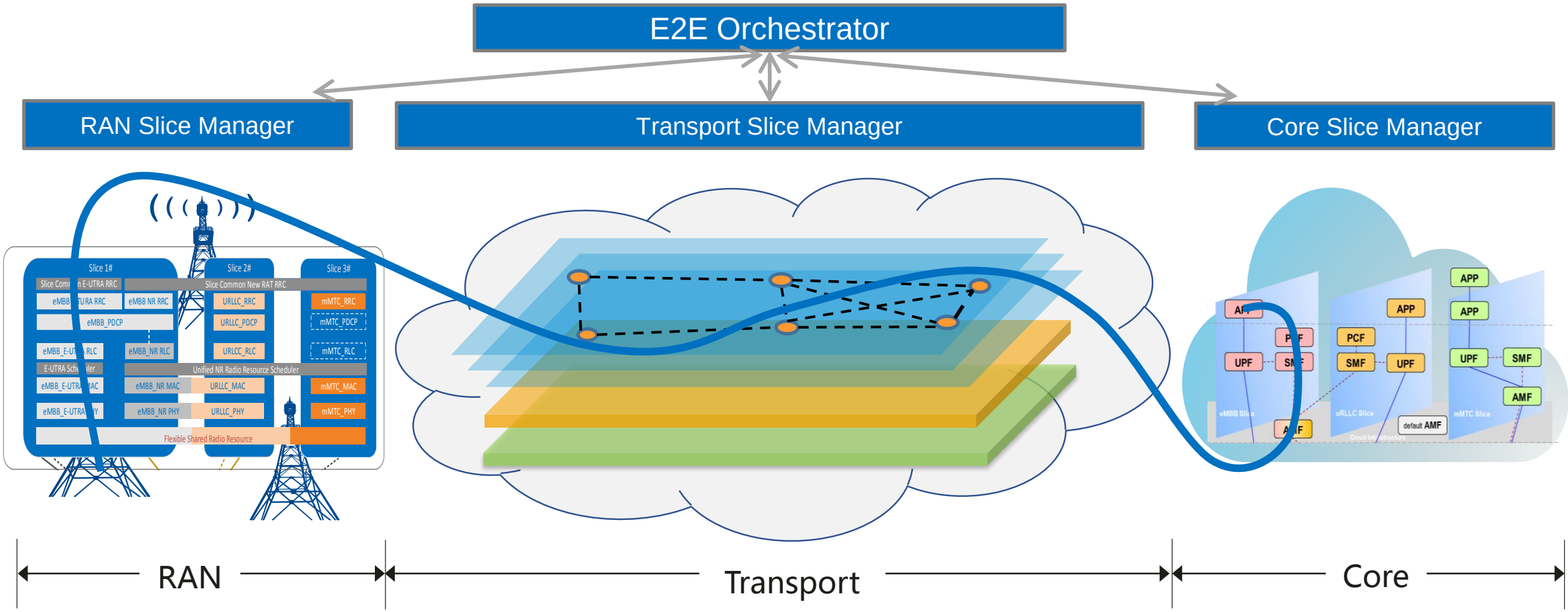
Transport Network in End-to-End Network Slicing



Transport network provides end-to-end network slice connectivity and SLA assurance

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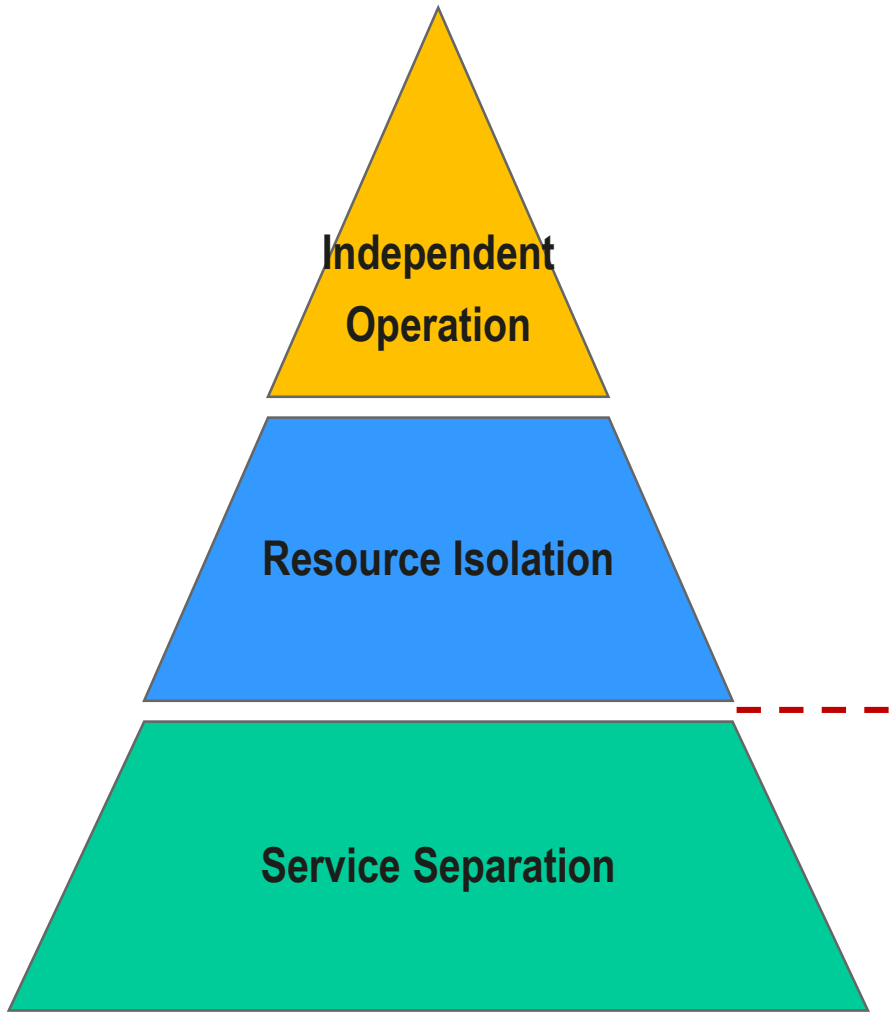
Transport Network Slicing Requirements



Level 3 – Independent Operation

- Independent management plane for on-demand provisioning of network slices
- For wholesale or self-operated vertical services

Level 2 – Resource Isolation

- Dedicated resource ensures **no interference** between network slices
- For **5G critical services** with demanding performance assurance

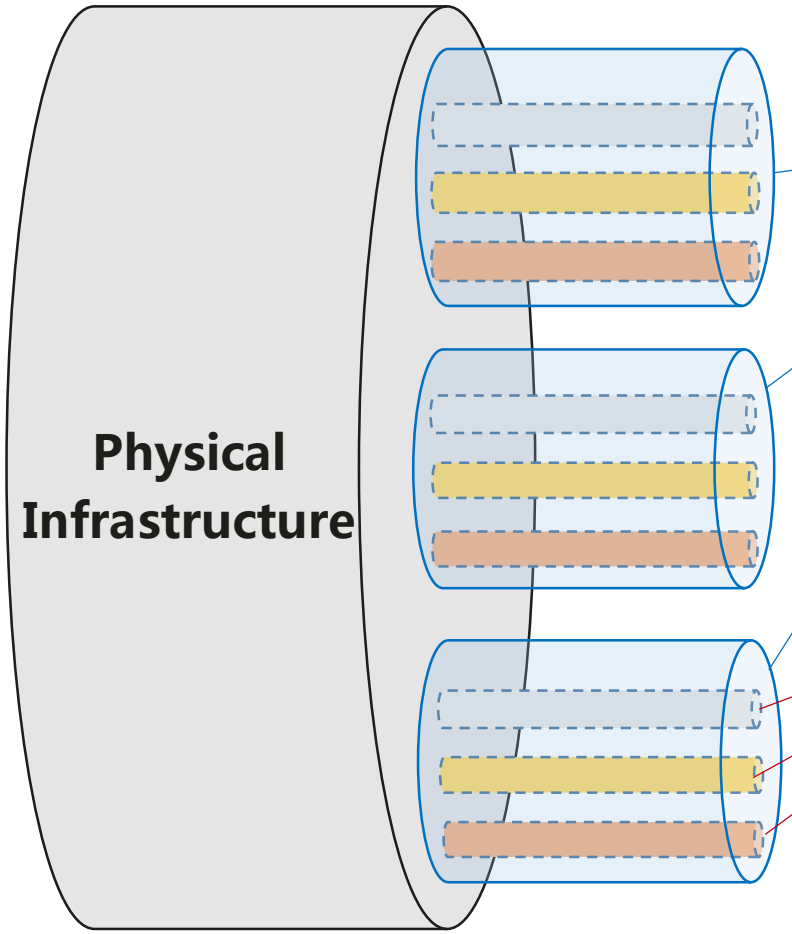
Level 1 – Service Separation

- Isolation in service access & connectivity
- **Possible interference** between services
- For traditional enterprise services

Addressed by Enhanced VPNs

Addressed by Existing VPNs

Degree of Isolation: Depends on Service Requirement

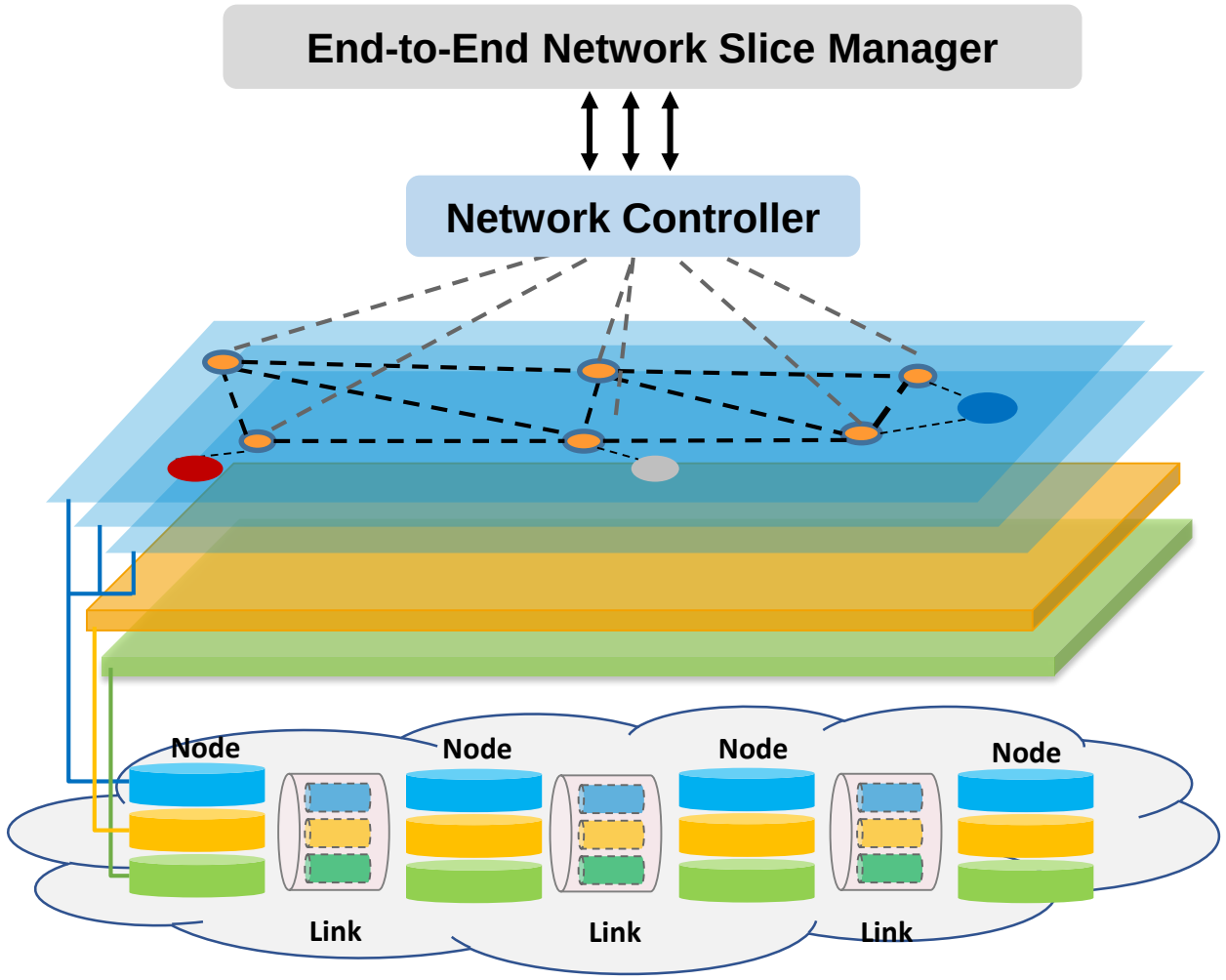


- Hard isolation
  - Dedicated resource
  - Guaranteed performance
  - Limited multiplexing

- Soft isolation
  - Shared resource
  - Differentiated treatment
  - Statistical multiplexing

Network Slicing requires both hard and soft isolation to meet different level of SLA requirement

Transport Network Slicing Architecture



Network Slice Management

- Dynamic/automatic network slice life-cycle management
  - Creation, monitoring, adjustment, deletion
- Network slice planning algorithms

Network Slice Instantiation

- Customize network slice topology and associated attributes
- Integration between overlay connectivity and underlay resource

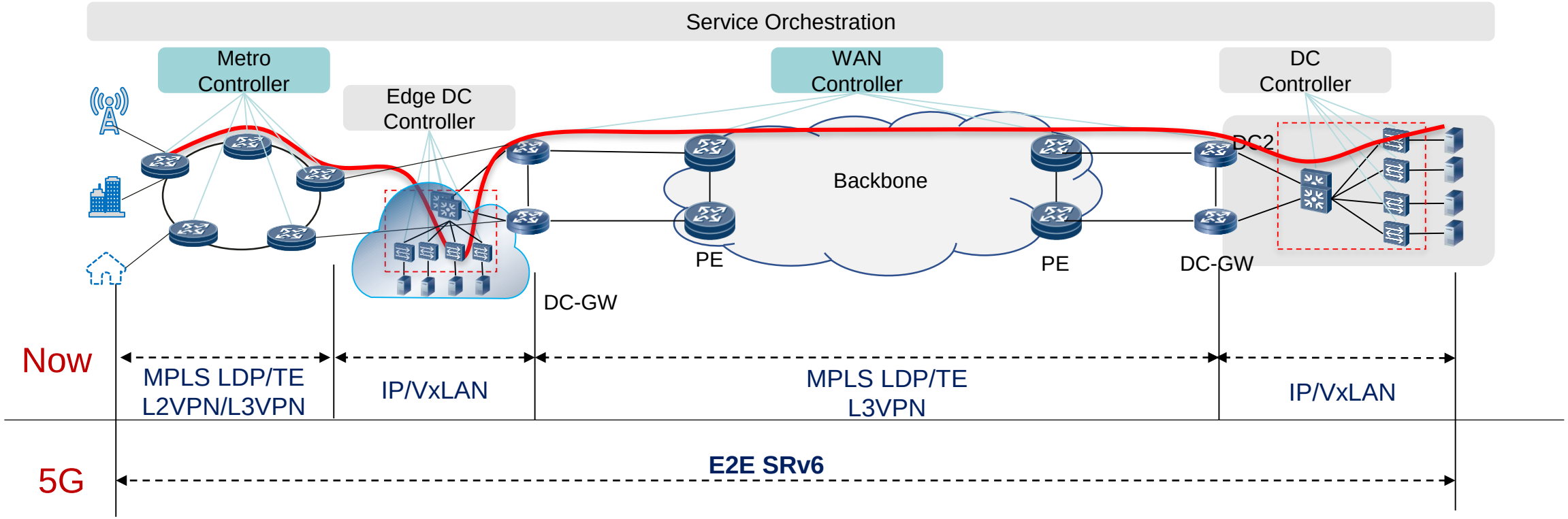
SRv6 based

Network Resource Partitioning

- Flexible Ethernet (FlexE)
- Logical sub-interface
- Dedicated queues
- Time Sensitive Networking (TSN)

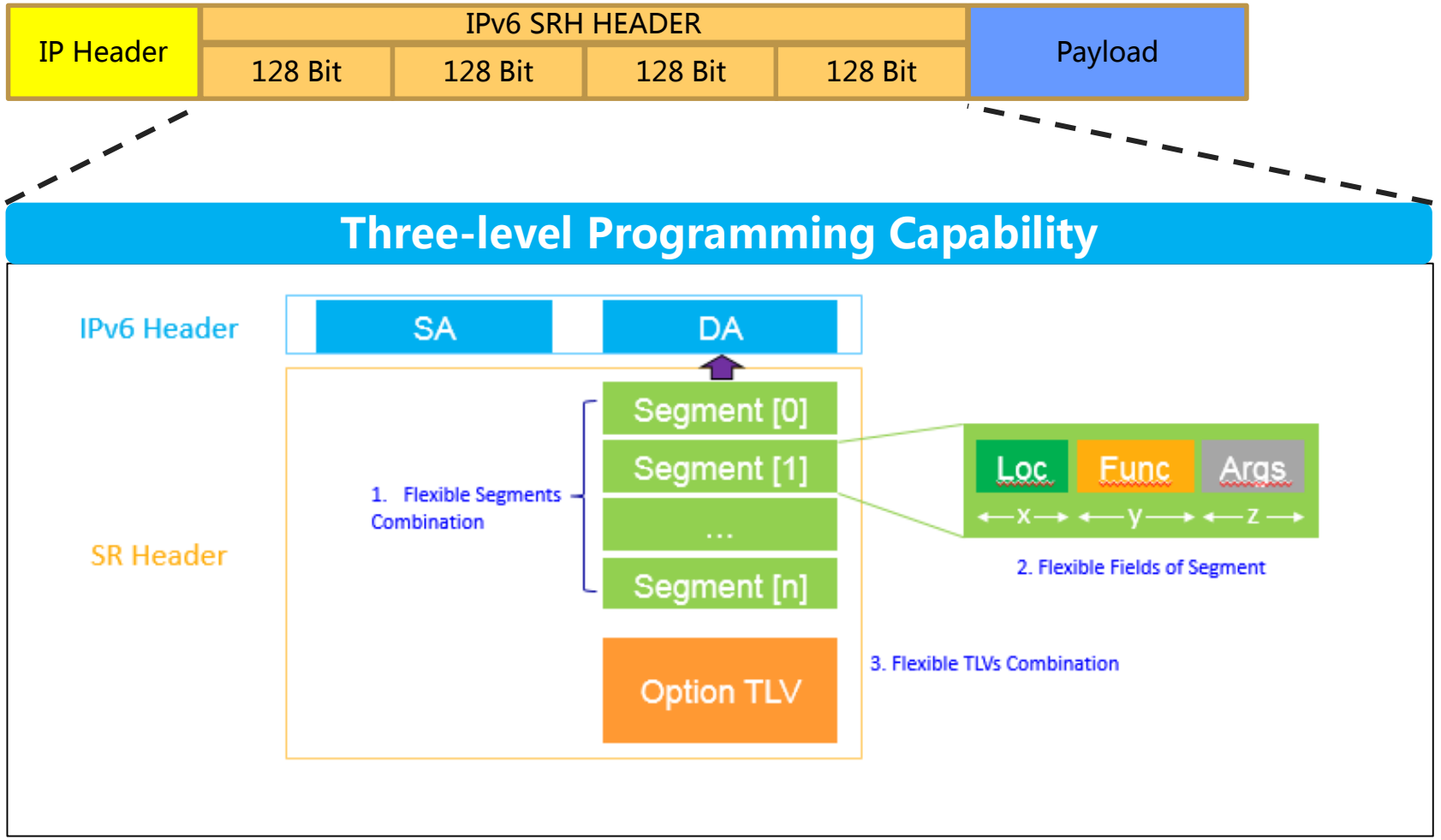
https://tools.ietf.org/html/draft-ietf-teas-enhanced-vpn

SRv6: End-to-End Unified Transport Network



- **Simplicity:** No extra signaling, less state maintained in network
- **Integration:** Underlay and overlay, network and application
- **End-to-End:** Unified mechanism across multiple network domains
- **DC Acceptance:** Based on IPv6 reachability, easier to be accepted in data center

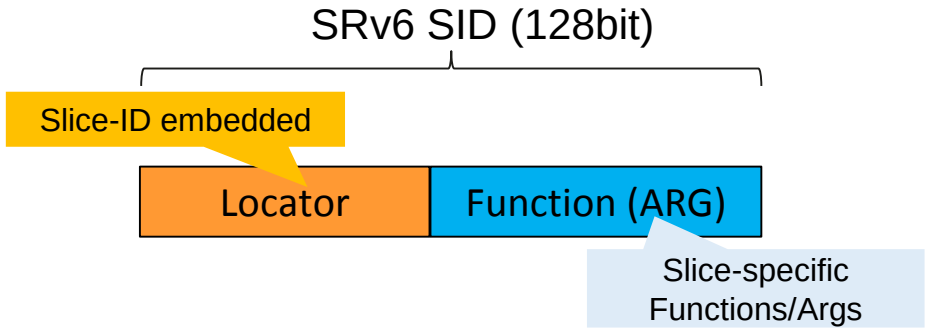
SRv6: Network Programming

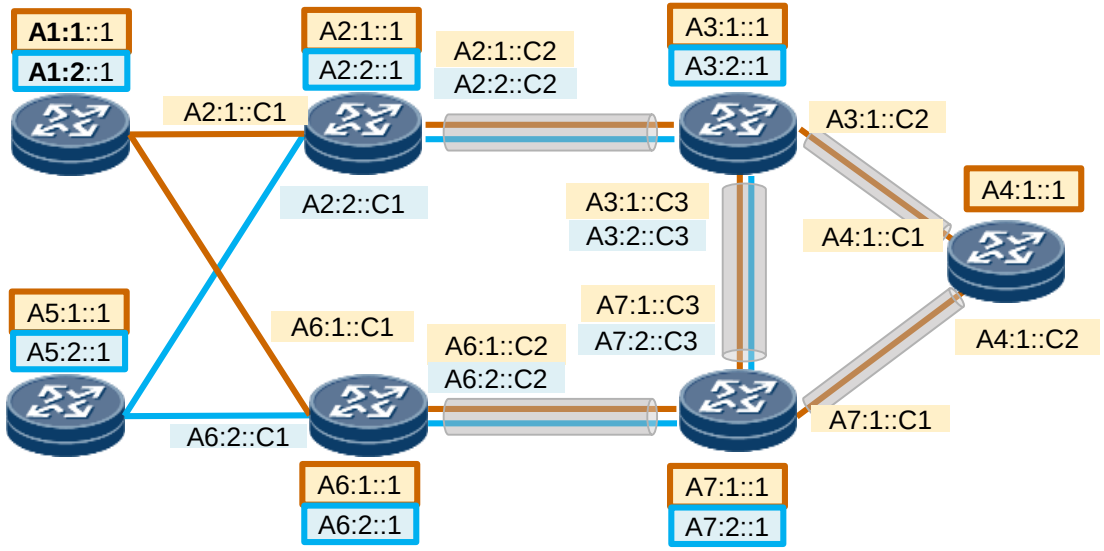


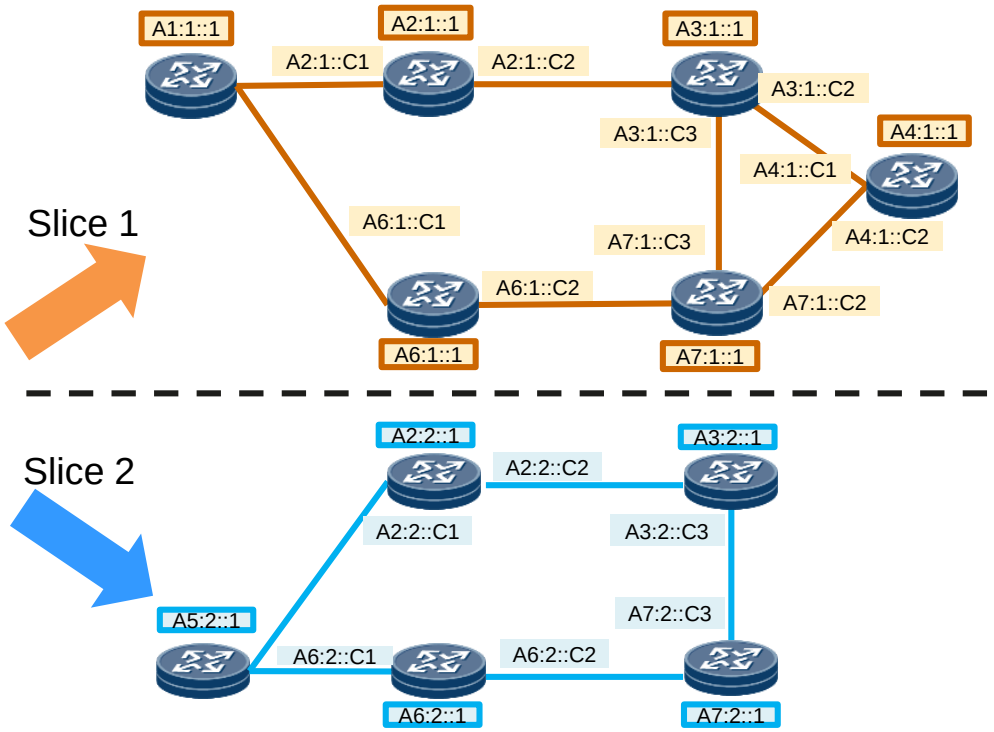
SRv6 programmability is essential for 5G network slicing and service innovation

SRv6 based Network Slicing: Data Plane

- SRv6 enhancement for network resource awareness
  - Different SRv6 SIDs represent network resource allocated on each segment for different network slices
- Network slice identification
  - Dedicated SRv6 Locator for each network slice
  - SRv6 SIDs inherit the slice identification from Locator







tools.ietf.org/html/draft-dong-spring-sr-for-enhanced-vpn

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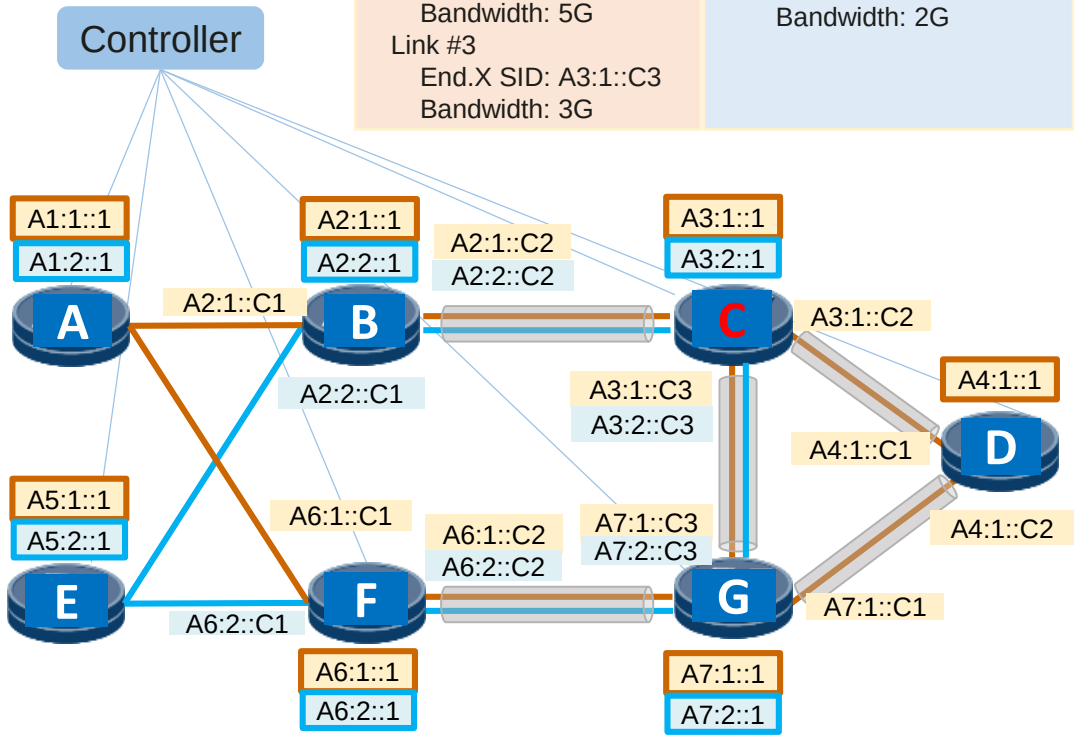
SRv6 based Network Slicing: Control Plane

- Hybrid of centralized and distributed control
  - SDN with SR/SRv6
- Based on Multi-Topology concept
  - Provide basic functionality for network slicing
    - Create multiple virtual topologies in a physical network
    - Allow topology-specific attribute customization
- Extensions for SRv6 network slicing
  - Reuse Topology-ID as network slice identifier
  - Advertise slice-specific SRv6 Locators and SIDs
  - Advertise resource attributes associated with SRv6 SIDs of different network slices

Node C advertises:

Network Slice Brown
Locator A3:1::
End SID: A3:1::1
Link #1:
End.X SID: A3:1::C1
Bandwidth: 2G
Link #2:
End.X SID: A3:1::C2
Bandwidth: 5G
Link #3
End.X SID: A3:1::C3
Bandwidth: 3G

Network Slice Blue
Locator: A3:2::
End SID: A3:2::1
Link #1:
End.X SID: A3:2::C1
Bandwidth: 1G
Link #2:
End.X SID: A3:2::C3
Bandwidth: 2G



tools.ietf.org/html/draft-dong-lsr-sr-enhanced-vpn

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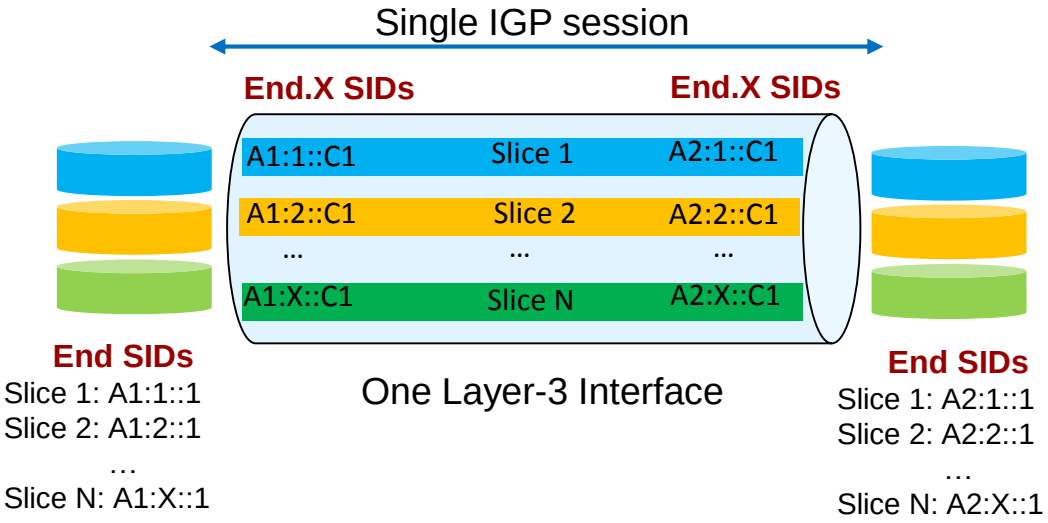
Network Slicing Scalability Considerations

- Comply to SR/SRv6 principle
  - No per-flow state introduced in the network
  - Necessary per-hop states for guaranteed performance
- Shared control plane, isolated data plane
  - Multiple network slices over the same control session
  - Use slice-specific SIDs to steer traffic into different set of resources
- Further optimizations
  - Reduce control plane overhead
  - Improve resource utilization



Network Slicing related Standards

RAN & Mobile Core

SA2: Network Slicing Architecture

- **TS 23.501:** System Architecture for the 5G System
- **TS 23.502:** Procedures for the 5G System (5GS)

SA5: Network Slicing Management

- **TS 28.530:** Management and orchestration, Concepts, use cases and requirements
- **TS 28.531:** Management and orchestration; Provisioning

Collaboration

Access & Transport Architecture

- **SD-406:** End-to-End Network Slicing
- **Mobile Transport & Routing**
  - SD.5GTransport / WT.5GTransport
- **MTNSi:** Mobile-Transport Network Slice instance Management Interface

Technical Specifications

Data, Control & Mgmt. plane

- **Enhanced VPN Framework (VPN+)**
  - draft-ietf-teas-enhanced-vpn (WG document)
- **Service/Data Models**
  - L3SM (RFC 8299) / L2SM (RFC 8466)
  - VN Model (WG document)
  - TE Service Mapping Model (WG document)
- **SR for Enhanced VPN**
  - draft-dong-spring-sr-for-enhanced-vpn
- **Control Protocol Extensions**
  - IGP: draft-dong-lsr-sr-enhanced-vpn
  - Other protocol extensions: in progress

Ethernet Network

Time Sensitive Network (TSN)

- TSN Profile for service provider networks

Flexible Ethernet

- FlexE 1.0
- FlexE 2.0

SG-15

- **GSTR-TN5G:** Transport network support of IMT-2020/5G
- **G.ctn5g:** Characteristics of transport networks to support IMT-2020/5G
- **G.mtn:** Interfaces for a metro transport network

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Summary

- Transport network slicing is a key component in 5G end-to-end network slicing
- Architectural enhancements are needed to fully meet different levels of network slicing requirements
- SRv6 E2E and programmability make it suitable for network slicing

Thank you.

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