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5G Transport Design Considerations Combining Onsite and Cloud-Based Deployments

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BRKSPM-2030

Agenda

- Introduction
- 5G Transport Design Requirements
- On-Prem Design Considerations
- Cloud Based Design Considerations
- Combining On-Prem and Cloud-Based (End-to-End)
- Key Takeaways

Introduction

This session will show how to deliver an end-to-end 5G transport network, including the Layer3/Layer2 connectivity between the xHaul O-RAN and 5G packet core functions. The end-to-end transport solution consists of Segment Routing across multiple different IOS-XR devices.

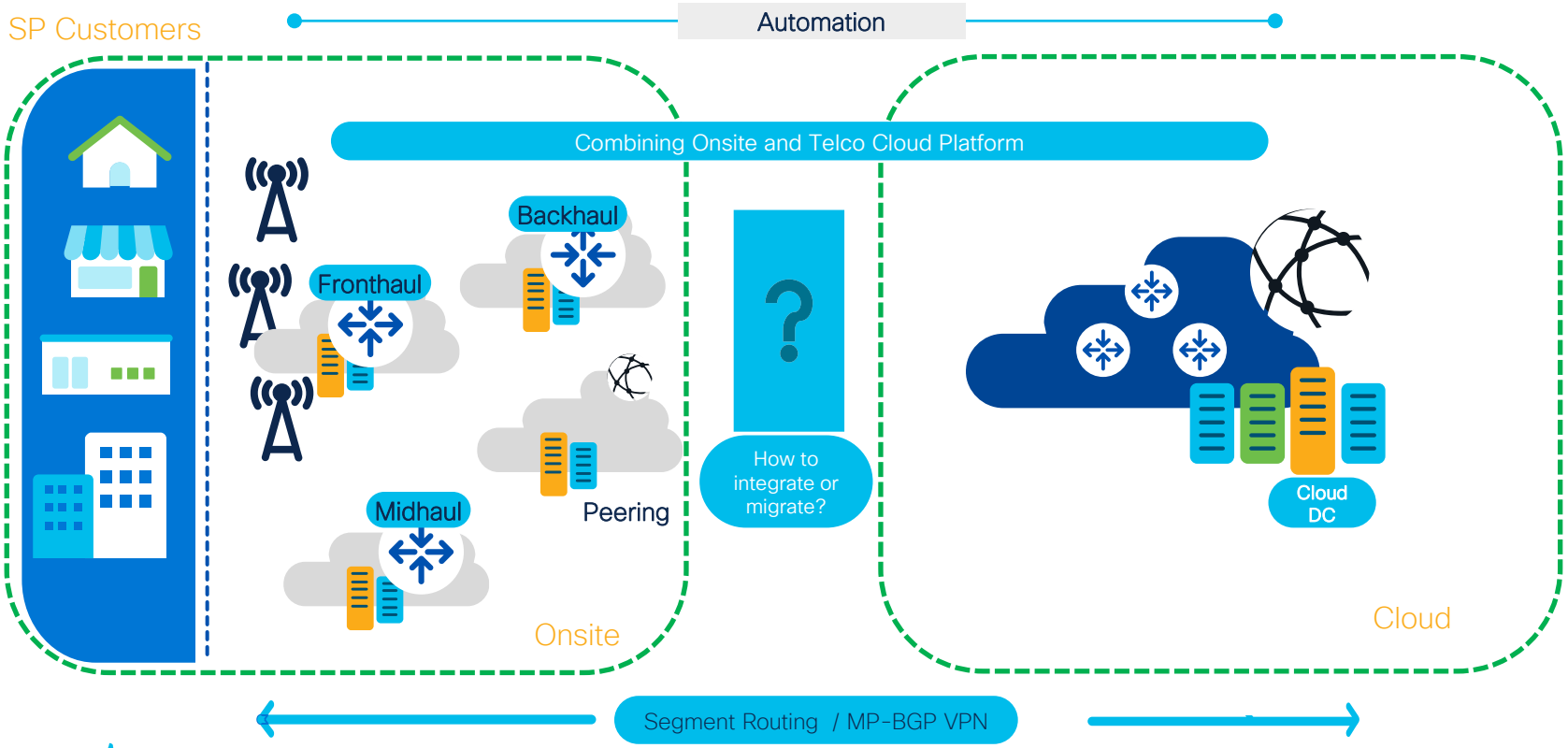
Session Goals

- *Understanding of Current 5G Transport Deployments*
- *On-Site and Cloud Transport Deployment*
- *Integration of On-Site and Cloud Transport Networks*

Session Non-Goals

- *Those topics are not covered in detail during this session:*
- *NCS5500 and XRv9k Platform*
- *Programmability and Automation*
- *5G Core Components*
- *End-to-End QoS*
- *Timing for 5G Transport Network*
- *Related sessions:*
  - IBOSPG-2005 - Deploying 400G High Scale Aggregation with NCS5500, NCS5700 Series Routers
  - *BRKSPG-2031 - Deploying XR Programmability in Production Networks*
  - *BRKSPM-2977 - 5G RAN Transport Architecture*

5G Hybrid Transport Network (OnSite + Cloud Based)



5G Network Deployment Key Questions

What are the 5G Transport Network Requirements?

How can I migrate/integrate my 5G Transport Network with Cloud Vendors?

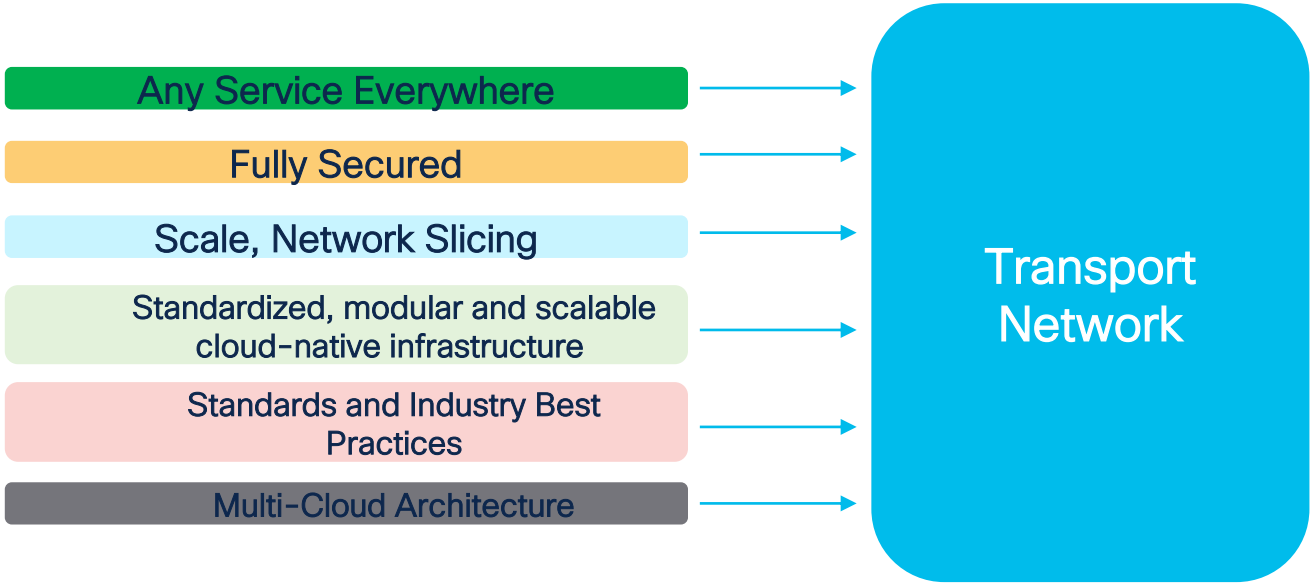
What are the current technologies that I need to consider?

5G Transport Design Requirements

5G Transport Design Requirements

Business Requirements

- Mobile Service Providers are transitioning to migrate/deploy 5G mobile network using fully virtualized (RAN to CORE) cloud native architecture.



5G Transport Design Requirements

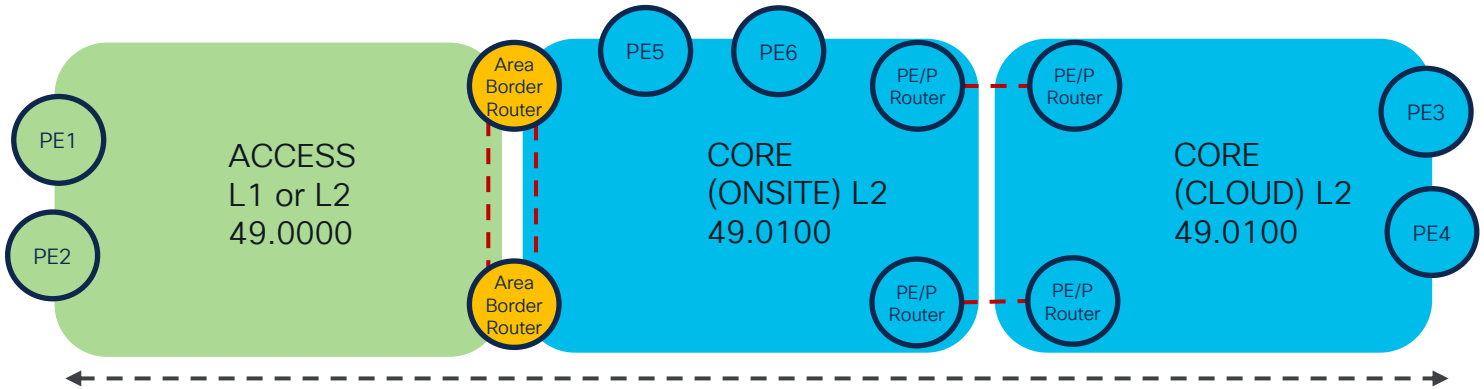
Technical Requirements

- Transport Network should be ready to support:
  - Deployed Transport Devices in both public and private (On-Site) clouds with goal of “Fully Automated”
  - Ultra-low latency for selected traffic (Meet E2E O-RAN Standard Specs)
    - Fronthaul, Mid-haul and Backhaul (Latency, Delay, etc)
  - Multi-Access Edge Compute for infrastructure and enterprise workloads
  - Massive increase in bandwidth for Physical and Virtual Devices
  - Converged SDN Transport
    - Segment-Routing End-to-End with Fast Convergence
    - Multi-Layer Architecture (Access, Aggregation, Core)

5G Transport Design SR End to End

Technical Requirements

- Segment Routing to Provide Seamless Network
- L3VPN or EVPN depends on customer use cases
- Segment Routing inside Cloud to provide End-to-End LSP's



Underlay: End-to-End Segment Routing, Inter-Domain LSP *(Depends on Platform Support)
Overlay: L3VPN (v4&v6) End-to-End MP-BGP + L2VPN EVPN for L2 Services

On-Prem Deployment Design Considerations

Low Latency (On-Site)

Technical Requirements

- 5G Networks Transport Network meet the following requirements based on O-RAN specs:

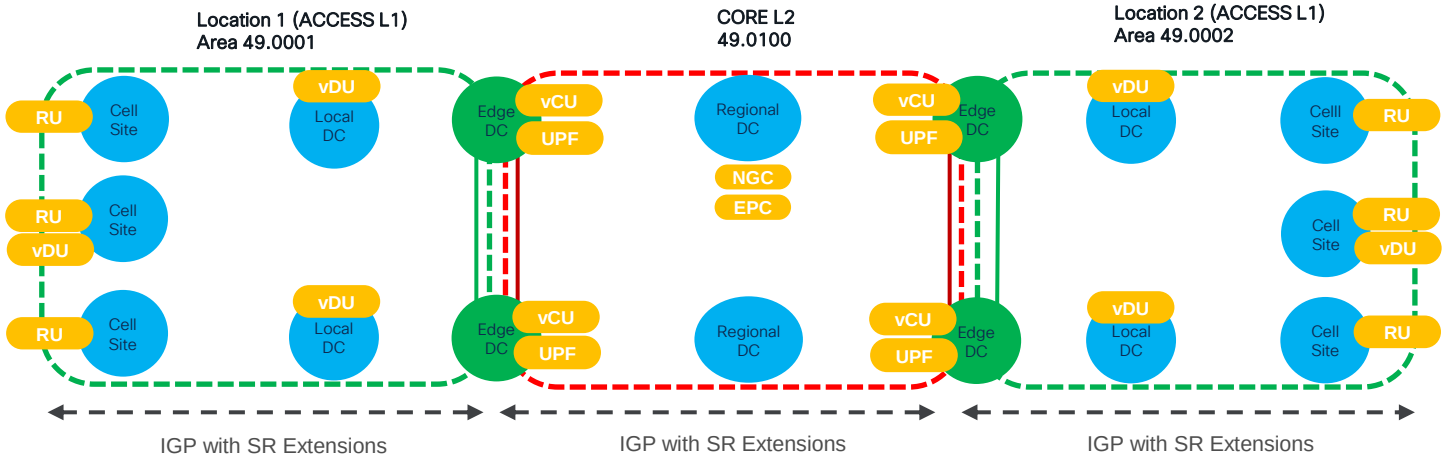
Network	Latency One-way * (Max)	Distance (km)	Jitter	Timing and Synch
Fronthaul	<160us	25km	<40us	NA
Midhaul	1-25ms	100km	<1ms	+/- 65ns to +/- 130ns
Backhaul	10-300ms	250km	<2ms	+/- 390ns to +/- 1.5us

*Note: Those values are depending on vendors specs

Multi-Layer Architecture (On-Site)

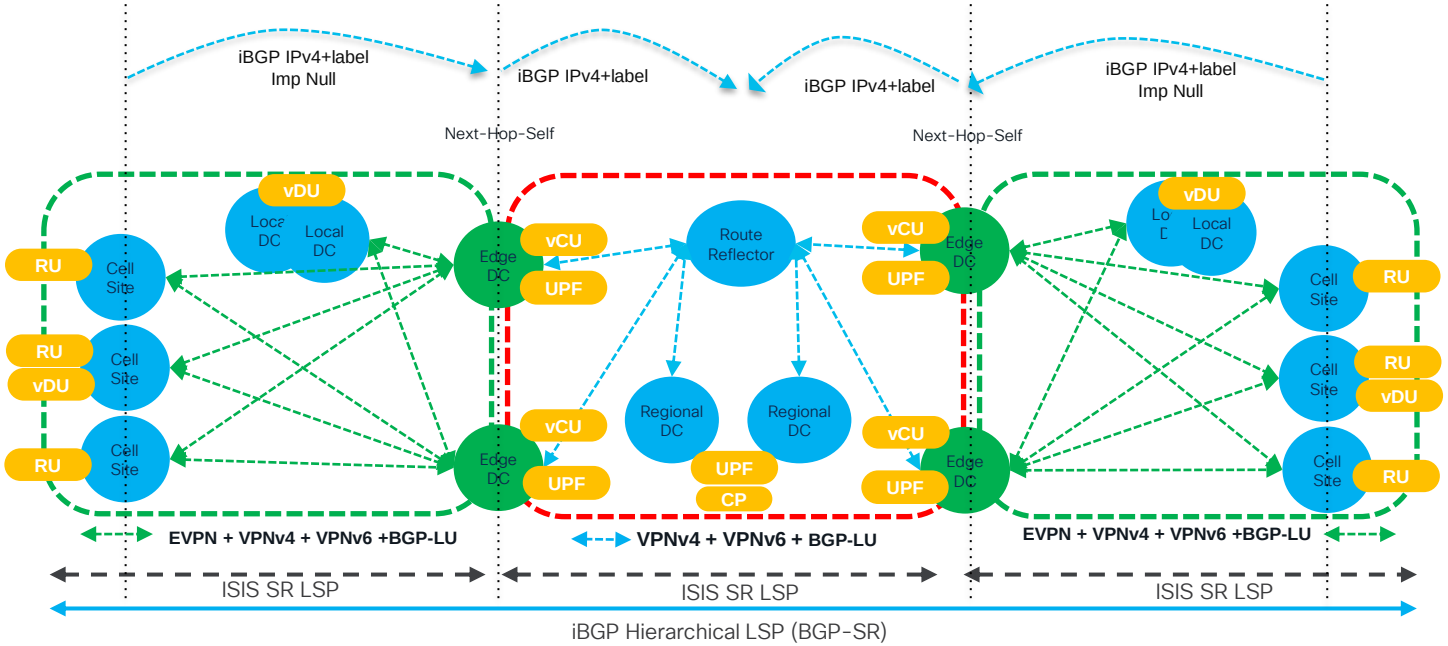
Technical Requirements

- Hierarchical Architecture having multiple layers (routing domains) can have 2 or 3 layers.



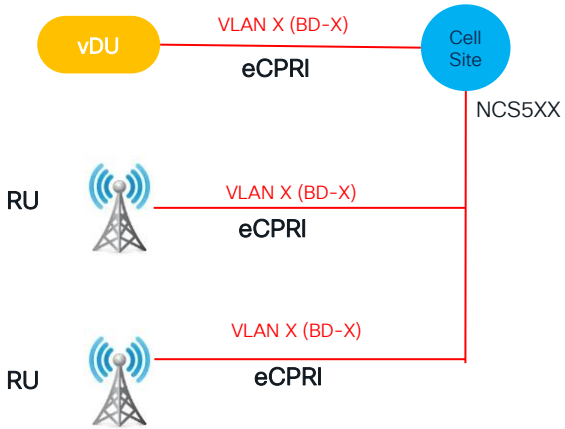
BGP-Segment Routing for Multi-domain Architecture (On-Site)

- Hierarchical LSP use BGP + Segment Routing to interconnect L2 to L1 Domain

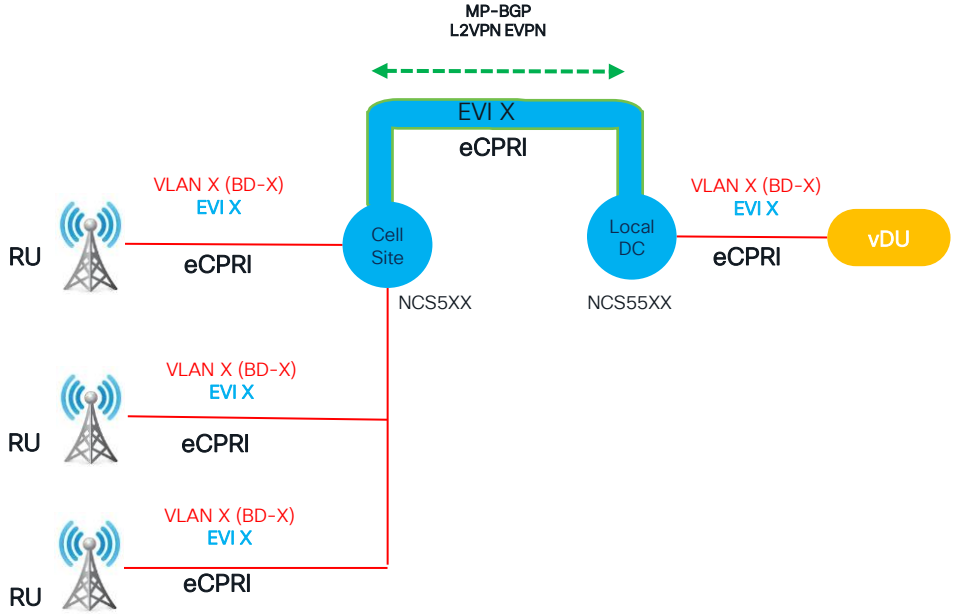


L2VPN Use Cases (On-Site) Fronthaul

Local L2VPN Services
- Endpoints Sharing same L2 Domain into a Single PE

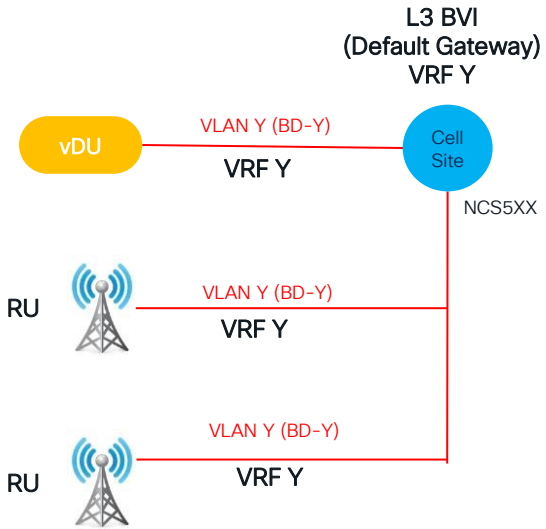


L2VPN EVPN Services (SR-MPLS)
- Multiple Endpoints Sharing same L2 Domain across multiple PEs

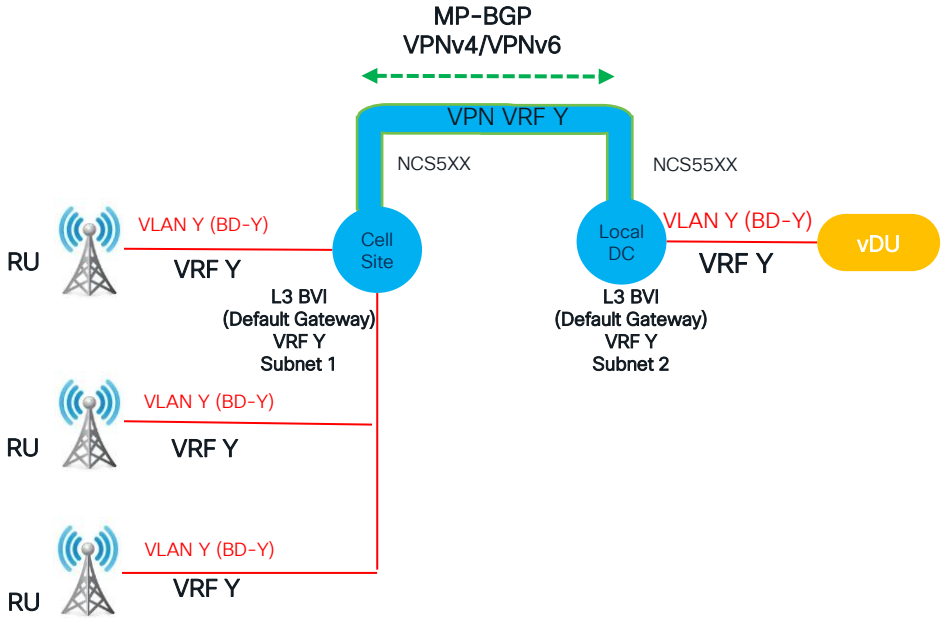


L3VPN Use Cases (On-Site)

Local L3VPN Services
- Endpoints Sharing same L2 Domain + L3 BVI Default Gateway into a Single PE



L3VPN VPNv4 and VPNv6 Services (SR-MPLS)
- Endpoints Sharing same VPN (v4/v6) in multiple PEs



Cloud Based Deployment Design Considerations

Low Latency (Cloud)

Technical Requirements

- 5G Networks Transport Network should meet the following requirements based on O-RAN specs:

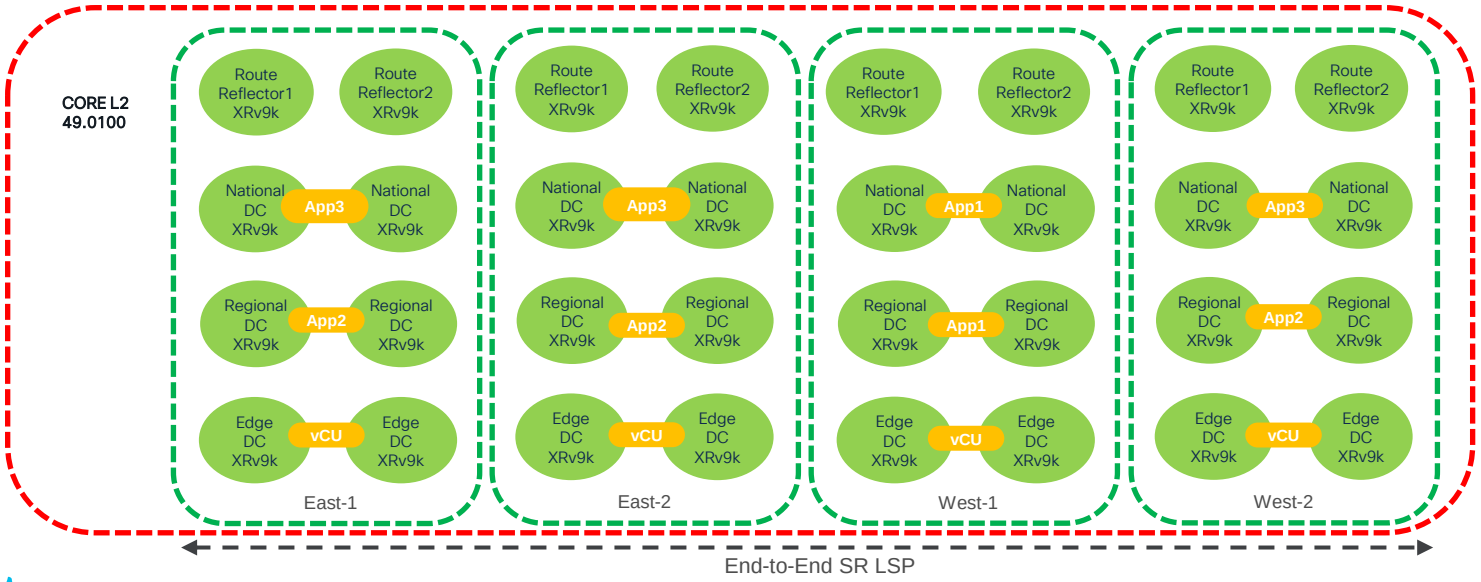
Network	Latency One-way * (Max)	Distance (km)	Jitter	Timing and Synch
Fronthaul	NA**	NA**	NA**	NA**
Midhaul	1-25ms	100km	<1ms	+/- 65ns to +/- 130ns
Backhaul	10-300ms	250km	<2ms	+/- 390ns to +/- 1.5us

*Note: Those values are depending on vendors specs
** Note: Fronthaul only applies for on-site.

Multi-Layer Architecture (Cloud)

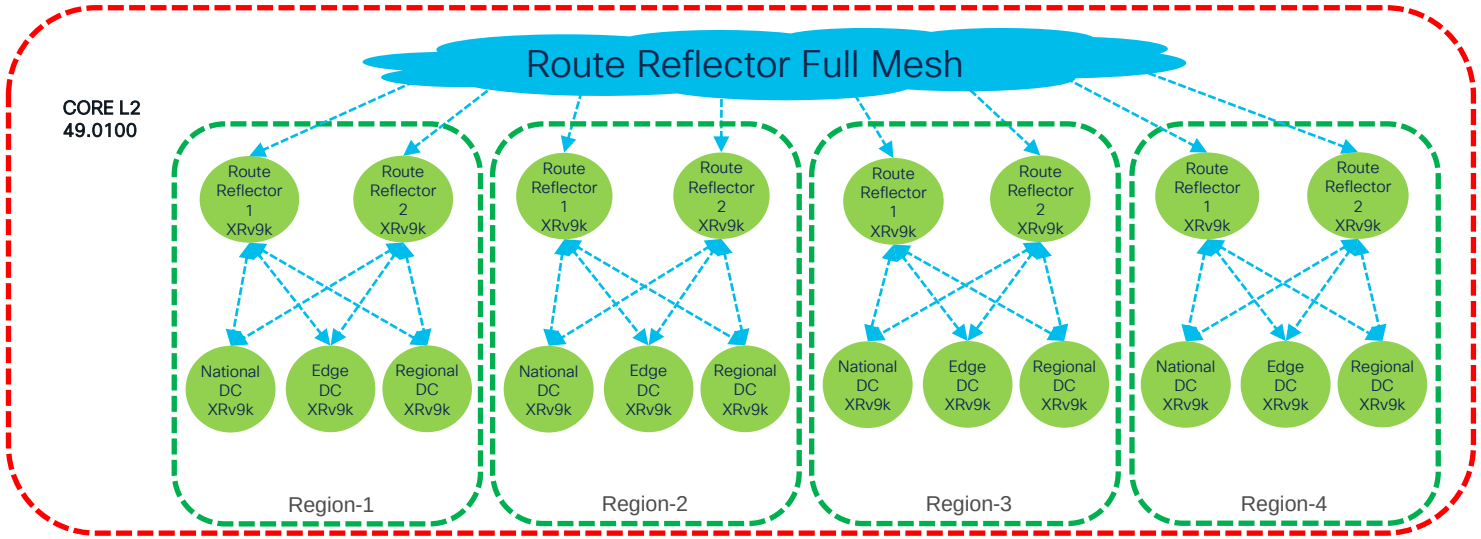
Technical Requirements

- Hierarchical Cloud Network Deployment depends on Cloud Vendor, Regions, and POP of each one SP.
- Based-on Latency requirements apps are hosted in each layer



BGP-SR for Multi-domain Architecture (On-Site)

- Hierarchical Cloud Network Deployment can use ISIS (Only) or BGP-SR to interconnect with On-Site Network.
- Segment Routing Allows to use Low Latency Path (using SR-TE)



*Note: Region numbers depending on Cloud vendors availability.

Combining On-Prem and Cloud-Based Deployments (End-to-End)

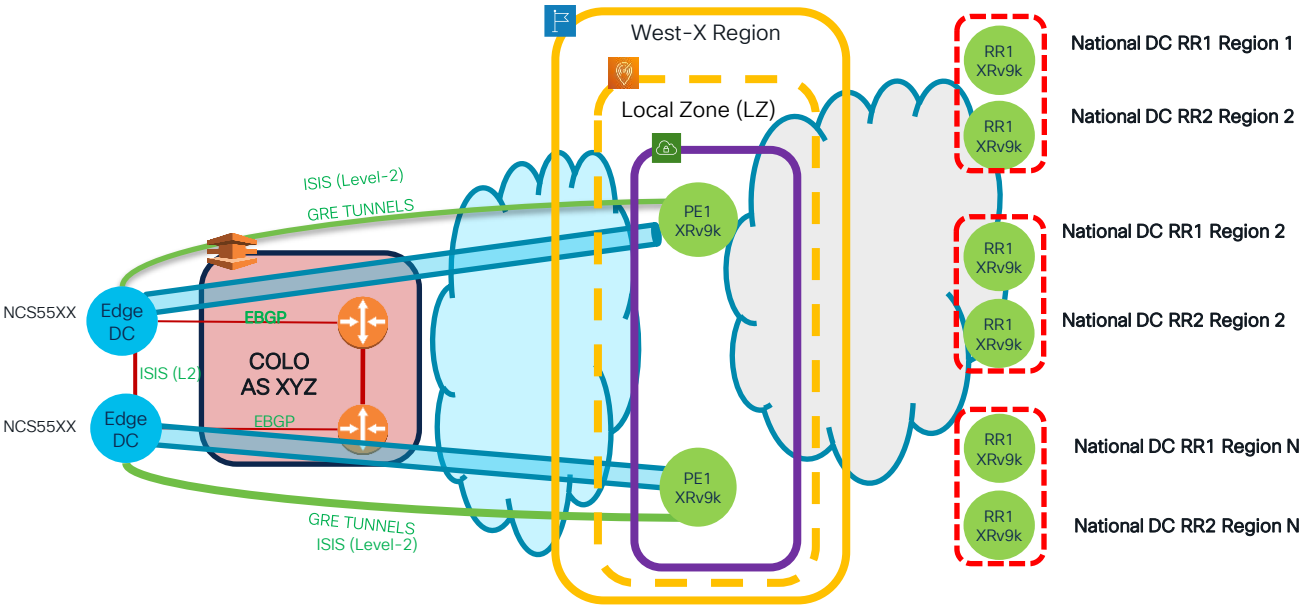
5G Transport Connectivity Requirements

Business Requirements

- End to End Segment Routing Seamless Network
- Easy to Operate
- Easy to Integrate/Migrate
- Multi-Vendor Support
- Low Latency Best Path Selection based on 5G latency requirements
- Easy to Automate Deployment

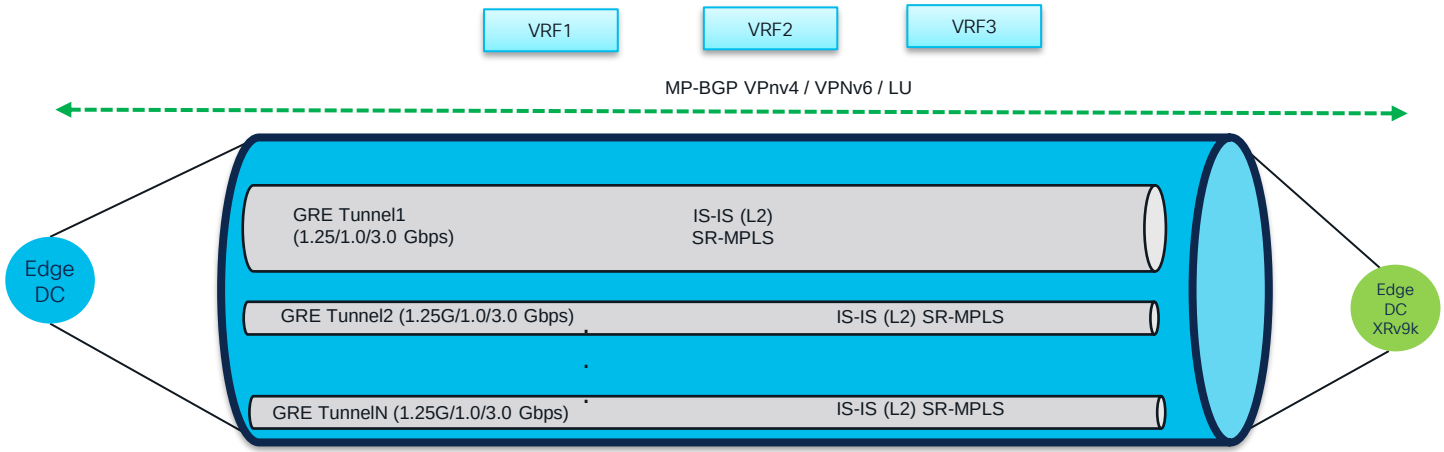
Underlay Transport Connectivity Requirements

- eBGP session to create exchange Tunnels Subnet (VPN in Cloud Vendor)
- XRv9k and Edge DC PE belongs to same IGP Core Domain
- Segment Routing extended using GRE Tunnels



Overlay Transport Connectivity Requirements

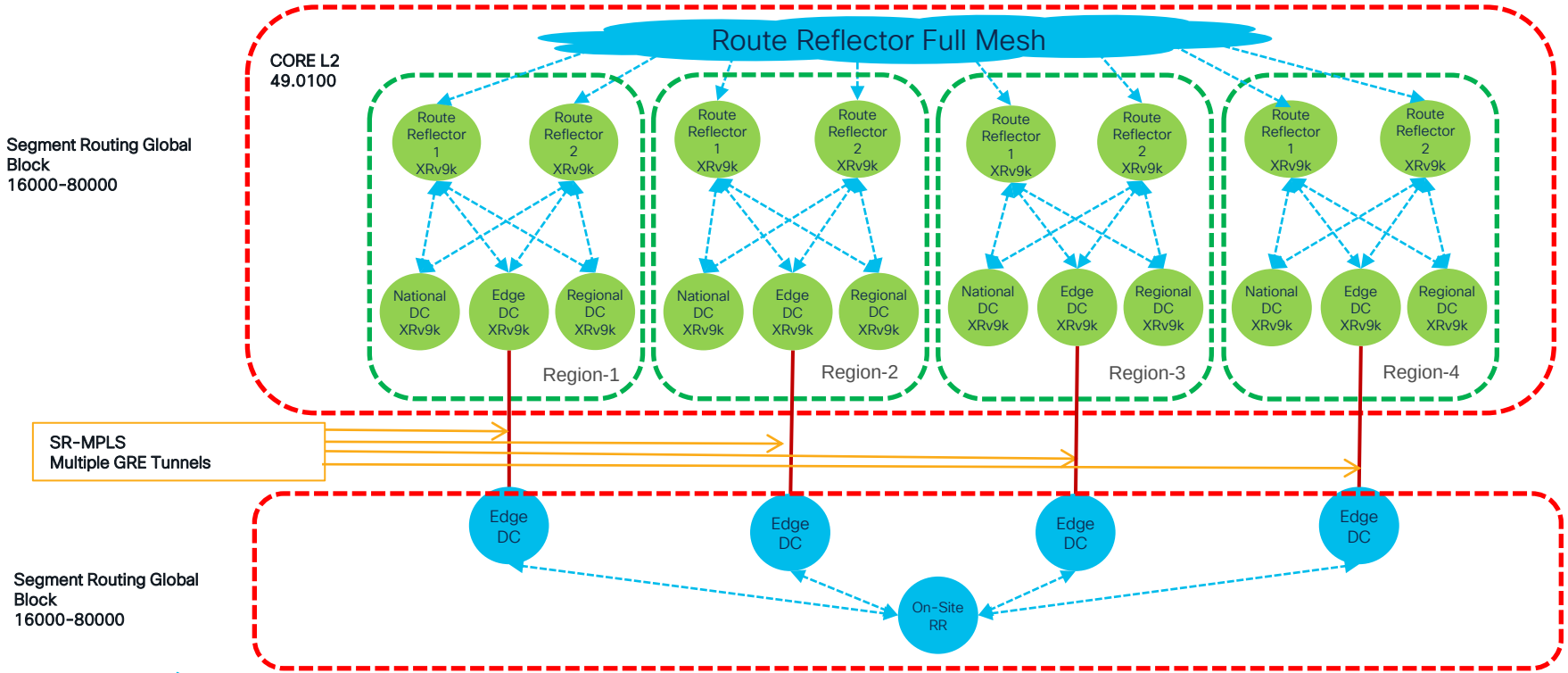
- Latency and Bandwidth tested to choose best Cloud Vendor per Use Case.
- Depending on Bandwidth required multiple Tunnel should be required with ECMP
- Static Routes or Dynamic routing protocol depending on Cloud Vendor.



*Note: Tunnel Capacity depends on each Cloud Vendor.

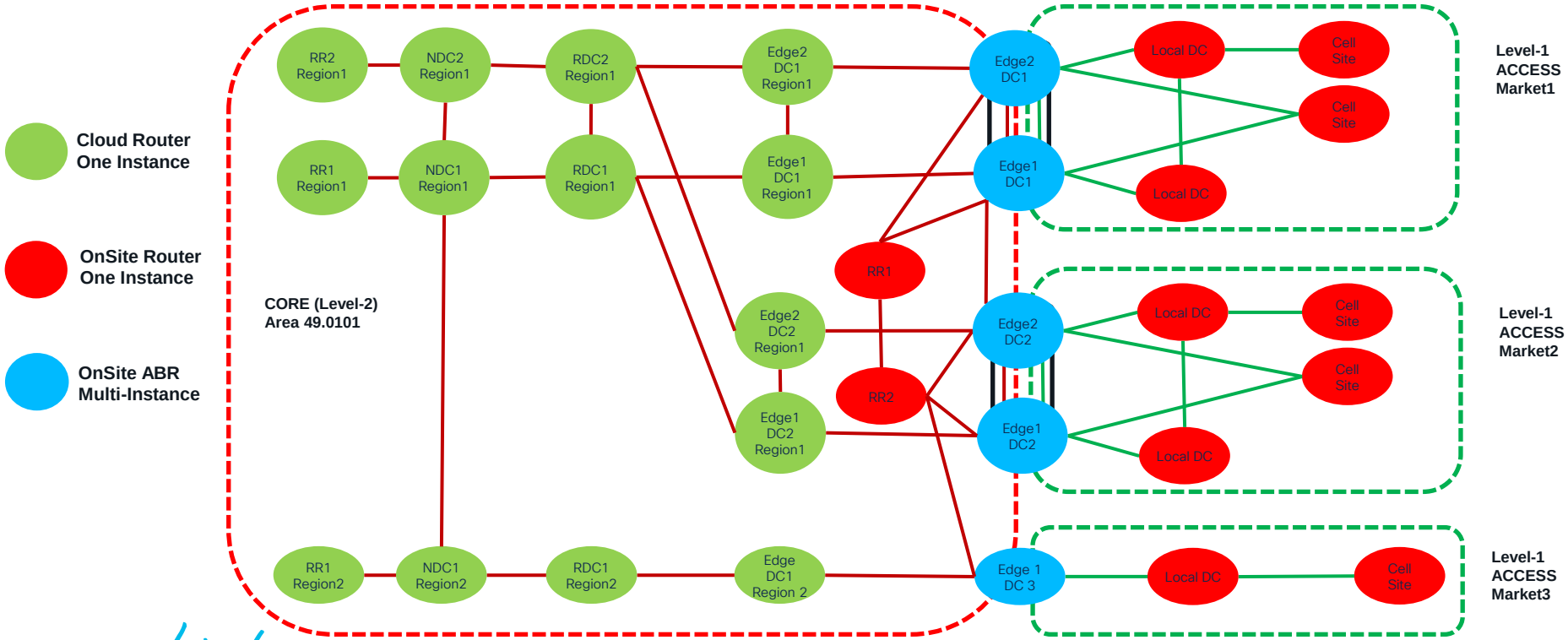
End-To-End Multi-Layer Architecture

Seamless Hierarchical Segment Routing Transport Network



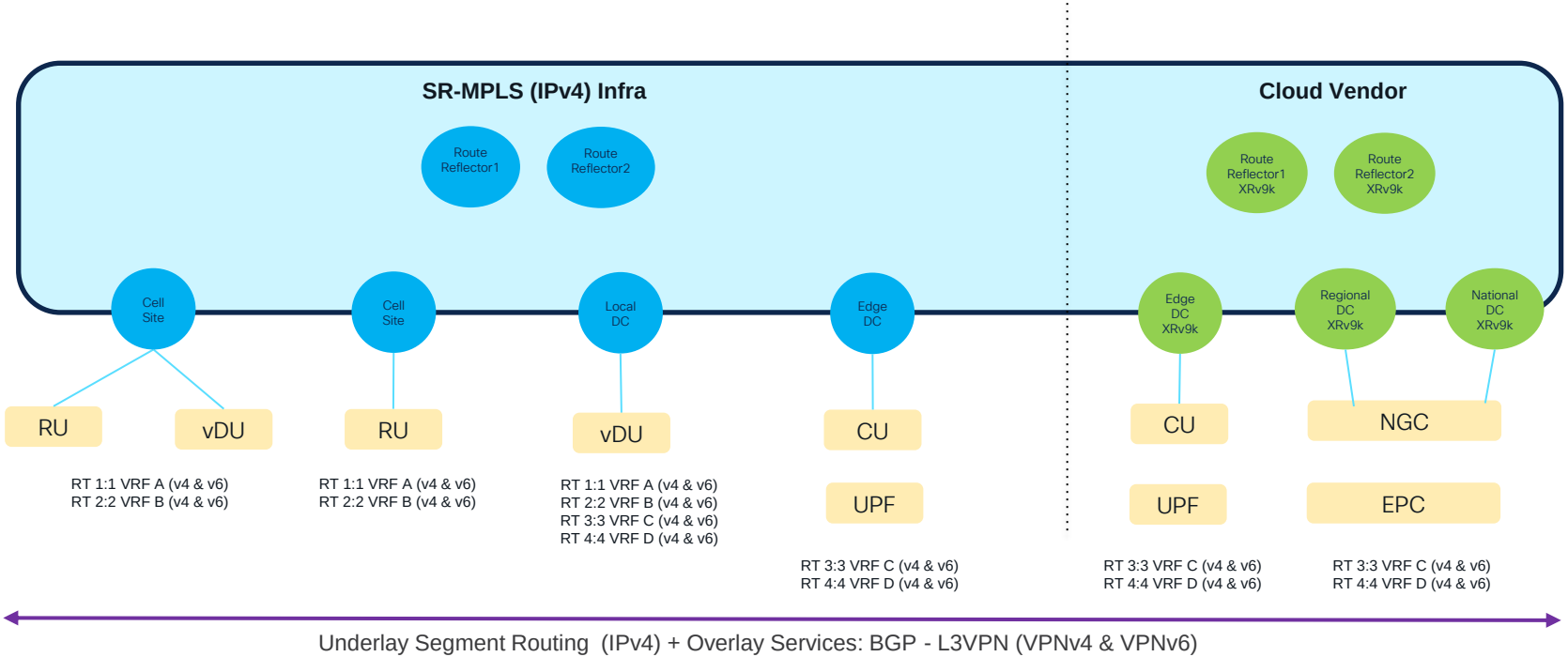
End-To-End Multi-Layer Architecture

Seamless Hierarchical Segment Routing Transport Network



L3VPN Use Cases (On-Site + Cloud)

- Combining On-Site and Cloud Transport Network allow End-to-End v4&v6 Services
- Segment Routing Allows to use Low Latency Path between On-site and Cloud (using SR-TE)



Key Takeaways

- Segment Routing allows to meet 5G low latency requirements between On-Site and Cloud End-to-End Traffic flows.
- Design can change slightly based on service offer per Mobile Service Provider
- Complexity to integrate both worlds can be simplified using Segment Routing End-to-End
- Segment Routing mixed business and technical requirements to provide seamless networks.

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