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Unleashing the Power of a Software-Defined 5G Network

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BRKSPM-2786

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Barcelona | January 27-31, 2020

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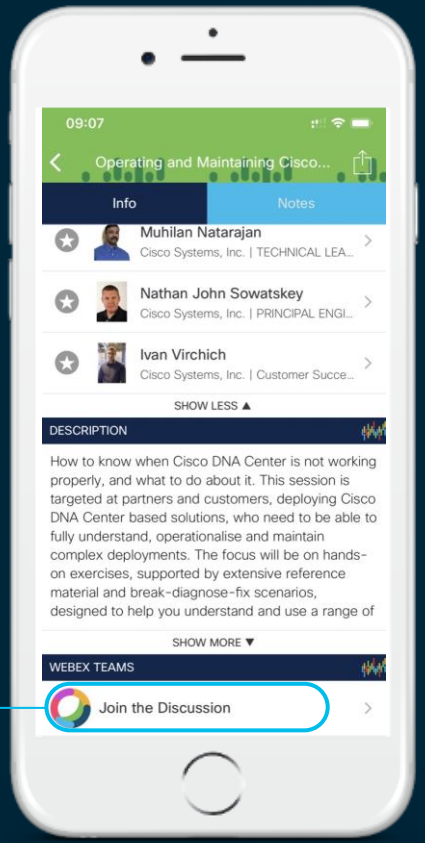
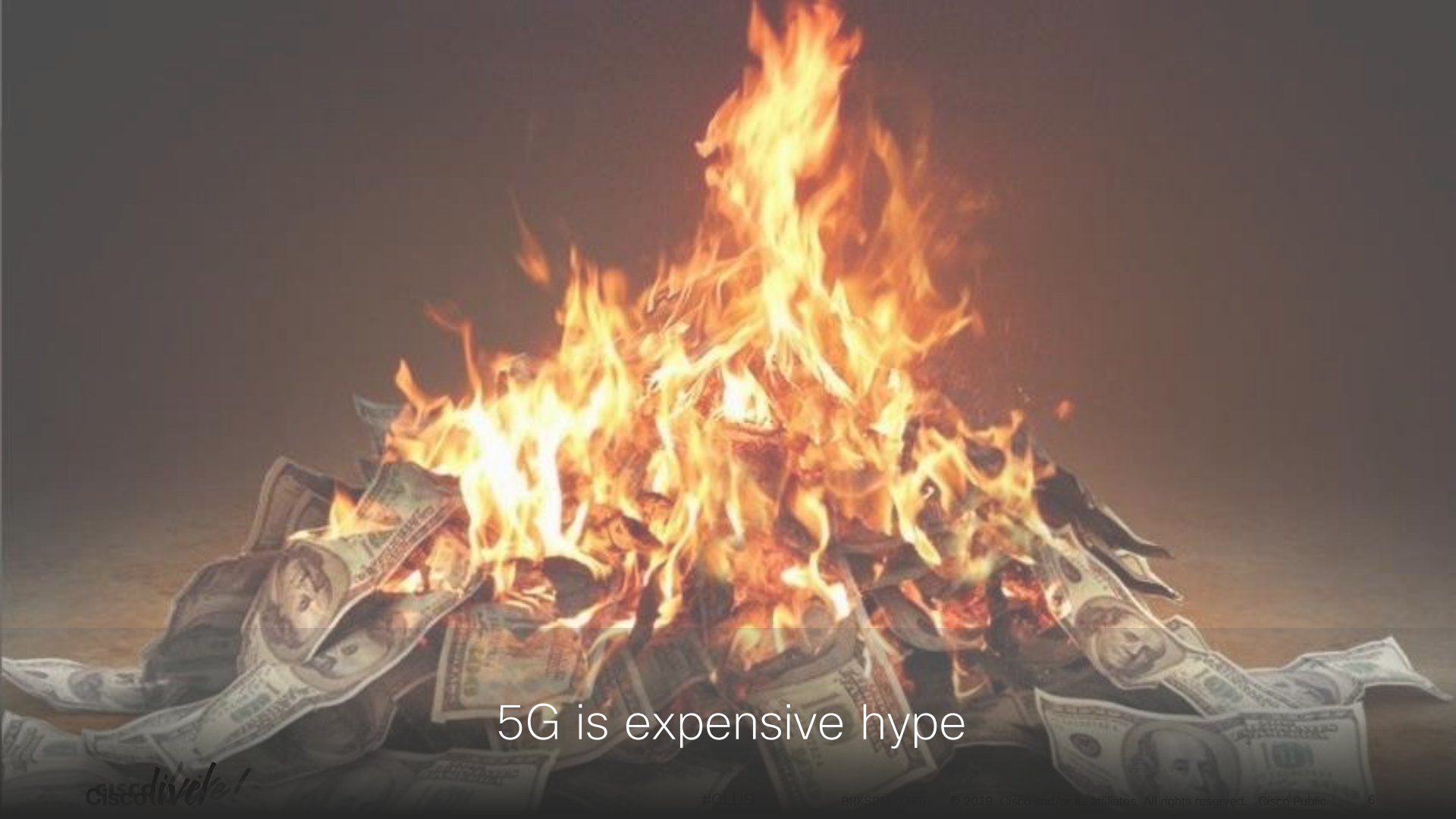


Agenda

- Introduction and Market Drivers
- RAN Evolution
- Progression to Cloud Native
- Network Slicing
- Automation and Orchestration
- Enterprise and Edge

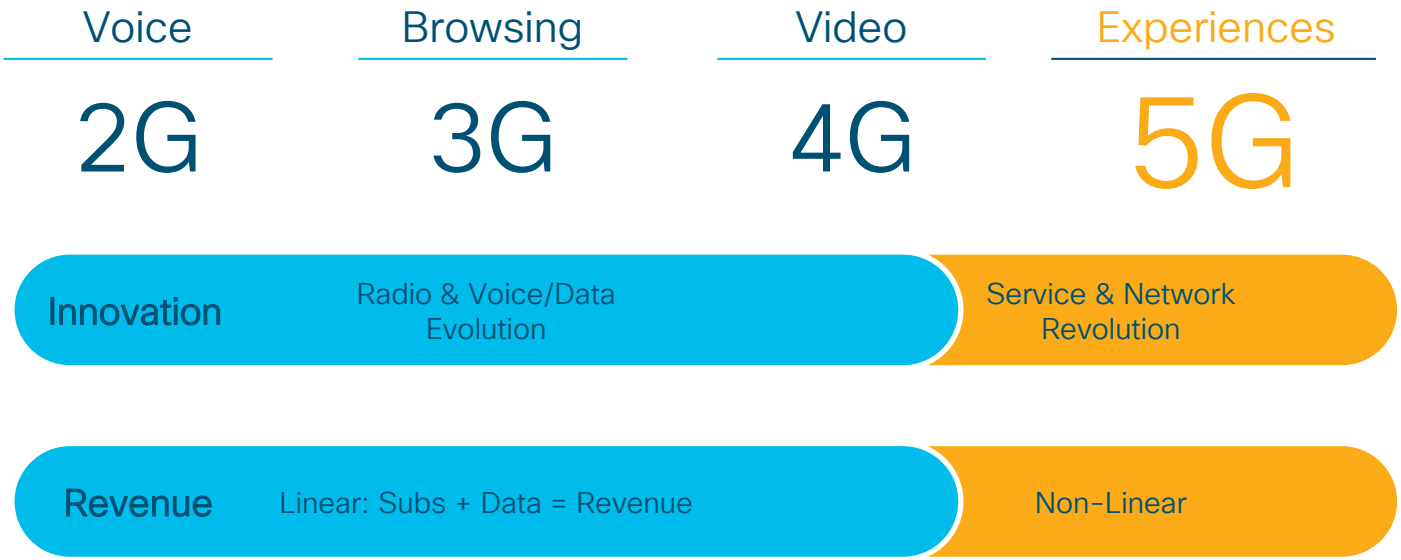
5G will save the world



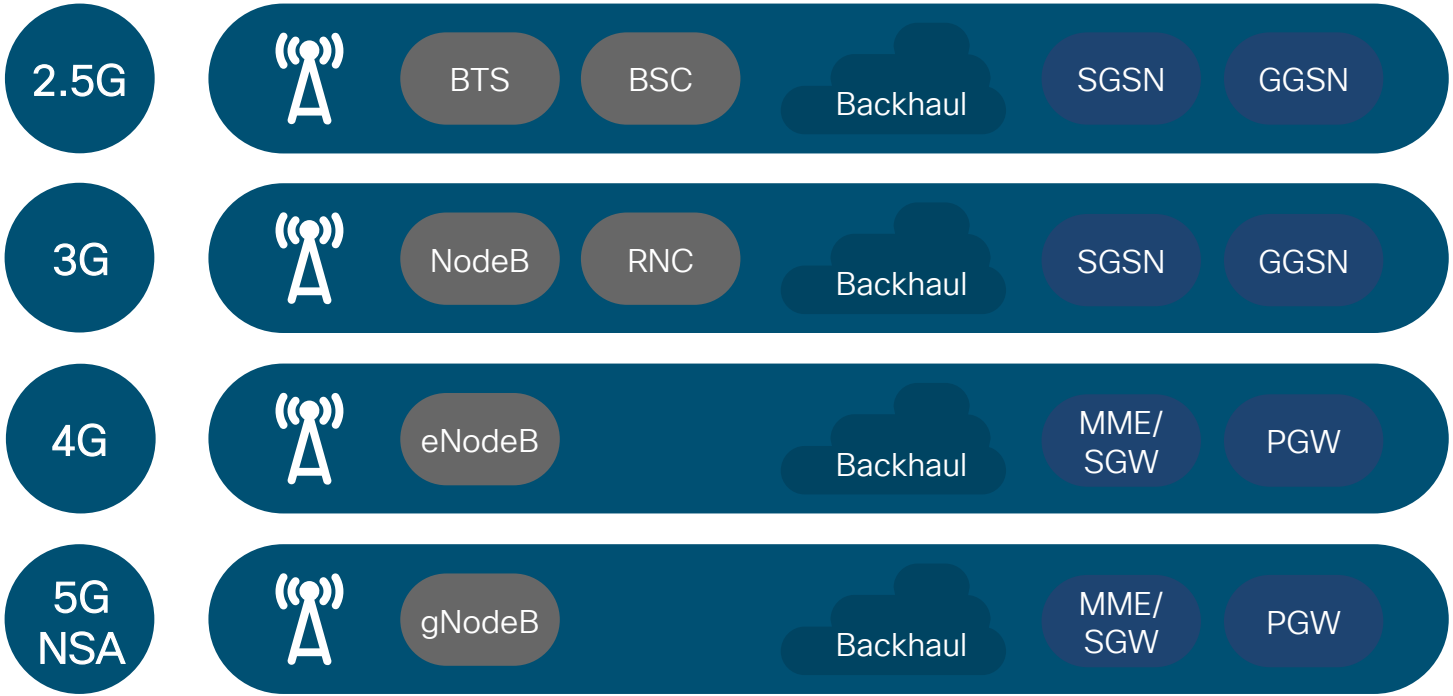
Reality is not binary

The real question is about profitable transformation

...and how we do it right



Historically, the more things “changed”, the more they stayed the same…



Meanwhile, the world around the mobile network has changed significantly

Operators Must Evolve to Compete Effectively

	Traditional Approach	New (5G) Approach
Business Model	Connectivity	Experience
Services	Slow, Inflexible	Agile, Self-Service
Architecture	Legacy, Rigid	SDN, Cloud Native
Radio Access	Monolithic, Closed	Open, Virtualized
OSS / Automation	Silos	Automated, Unified
Operations	Traditional NOC	CloudOps

Software Defined Mobile Network

From:		***To:***
Monolithic, Proprietary Systems		Flexible, Agile Software-Based Solutions
Closed interfaces, limited options		Open, modular solutions
Network defined (and constrained) by RAN		Network defined by the services, and desired operational model

5 Architecture Pillars of 5G

Higher Flexibility
High BW, low latency
Multiband Connectivity
Massive MIMO

Radio Access
Mobile Core
Converged Core
Open, Disaggregated

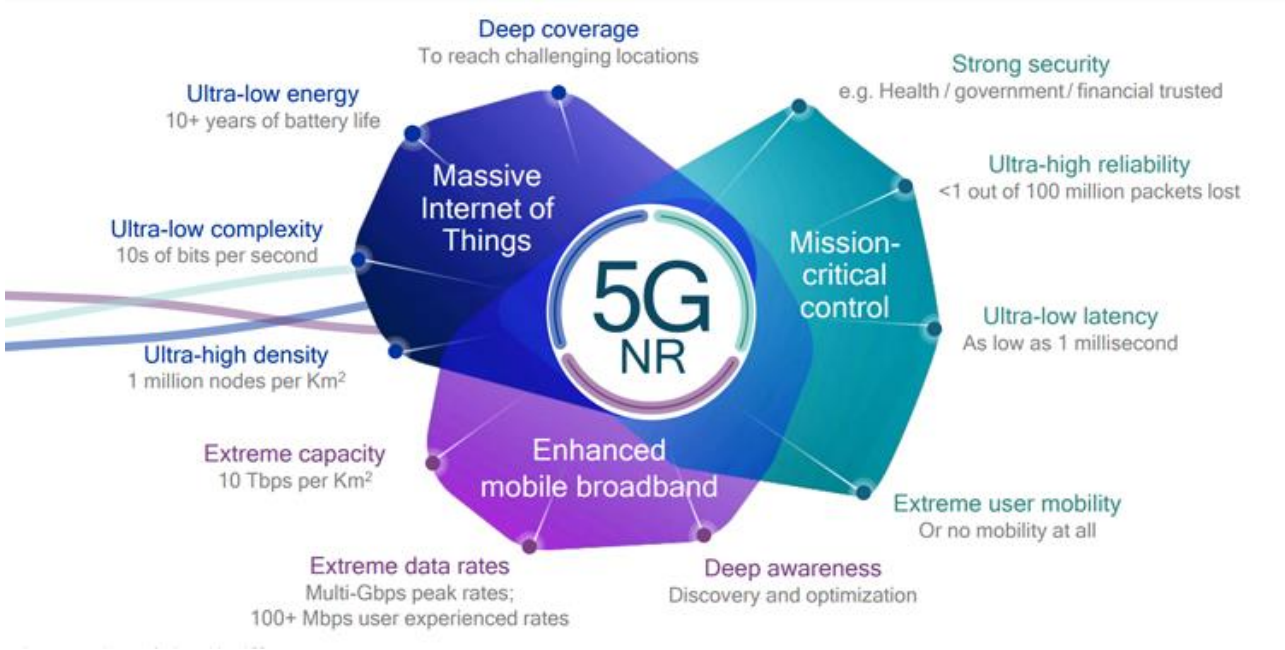
Virtualization
Cloud Native
Edge Computing
Programmable

Any Access
Common Sub Mgmt.
Converged Transport
Common Policy

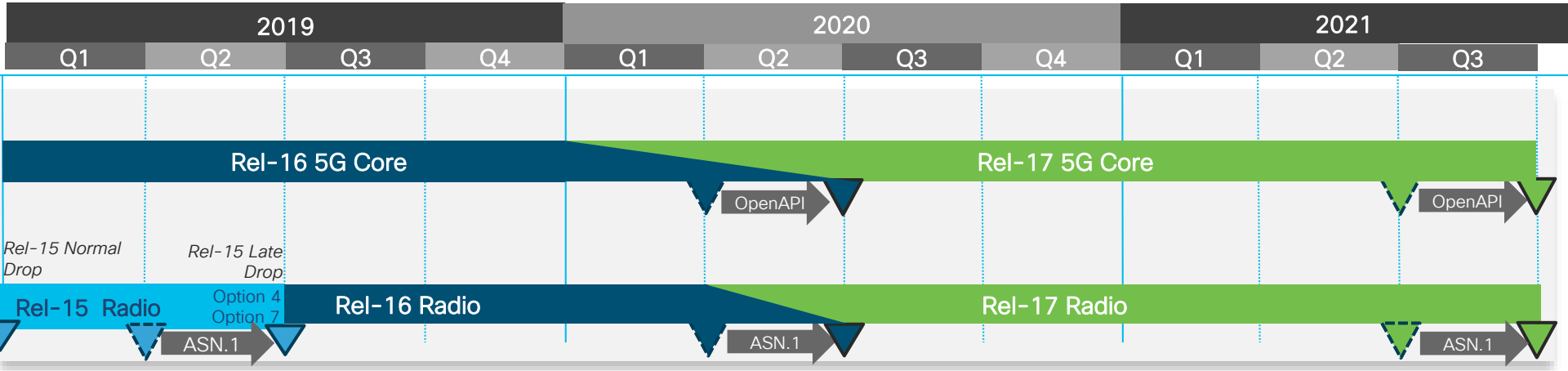
Closed Loop
Multi Domain
Network Slicing
Service Assurance

5G NR | 5G Systems Architecture

Applicable to today's 4G LTE Networks as well



3GPP Standards Timelines and Features



Rel-15

- **New Radio (NR)**
  - NR NSA (w EPC)
  - NR SA
  - Wide BW (~400 MHz)
  - Wide Freq Range (upto 28GHz)
- **New 5G Core**
  - Service Based Architecture (SBA)
  - Slicing
  - MEC

Rel-16

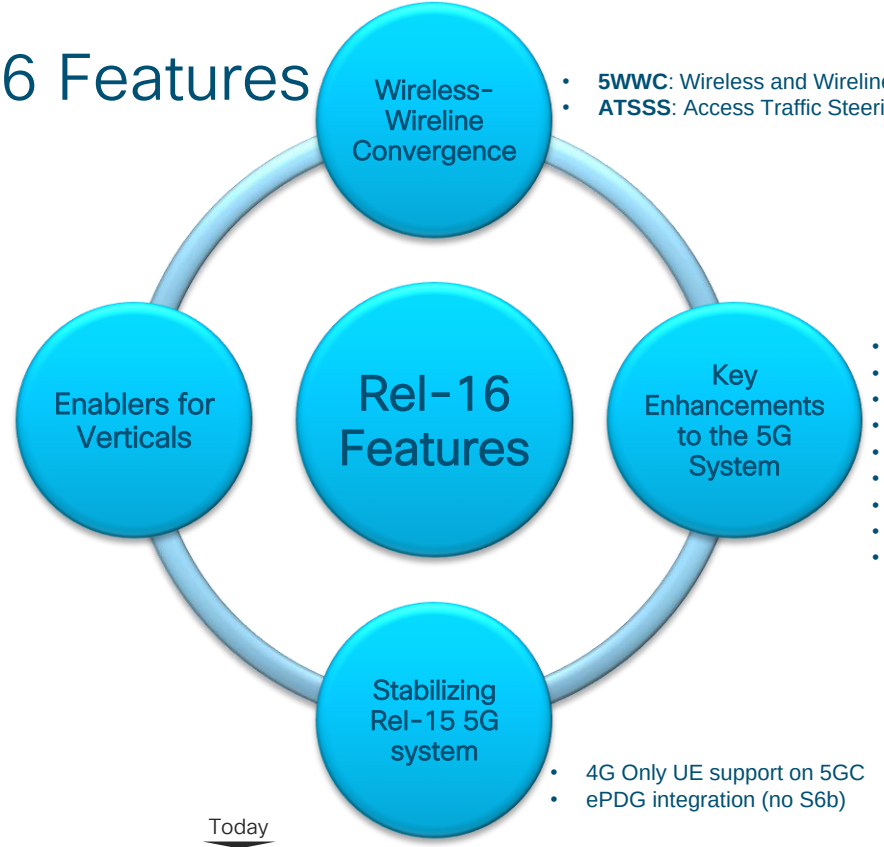
- **Radio**
  - NR in unlicensed band
  - Industrial IOT (TSN)
  - Accurate NR Positioning
- **5G Core**
  - Enhanced SBA (eSBA)
  - Private networks
  - Wireless/Wireline (Cable/BNG) Convergence + Access Steering
  - Time Sensitive Network (TSN)
  - Cellular IoT (NB-IOT, CatM)
  - Slice Management
  - Network Analytics

Rel-17

- **Radio**
  - Public Safety (P2P) / NR Multicast
  - NR IIOT/URLLC
  - Sub-meter NR Positioning for IIOT/V2X
  - Low complexity, low power NR UE
- **5G Core**
  - Public Safety (P2P)/ Multicast
  - Enhanced Network Analytics
  - Enhanced Private Network
  - Enhanced Edge Computing
  - Support of Drones

5G 3GPP Rel-16 Features

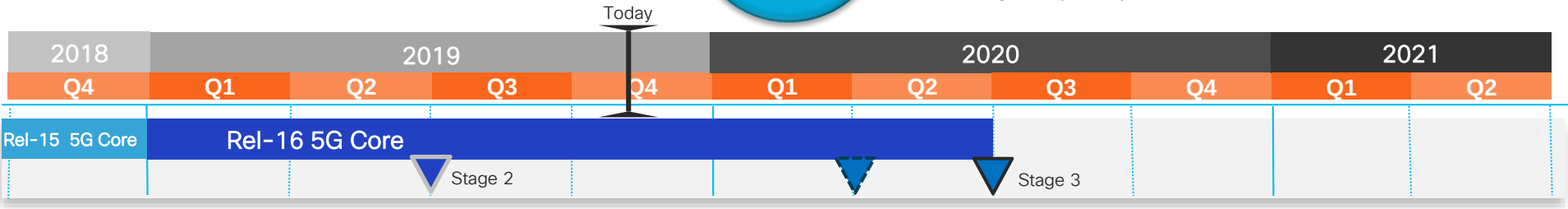
- **Enterprise**
  Non-Public Networks
- **Factory Floor**
  TSN
  URLLC
  5G LAN
- **Low Power IoT**
  5G CIoT
- **Intelligent Transport**
  Advanced V2X Services
- **Satellite**
  Satellite Architecture



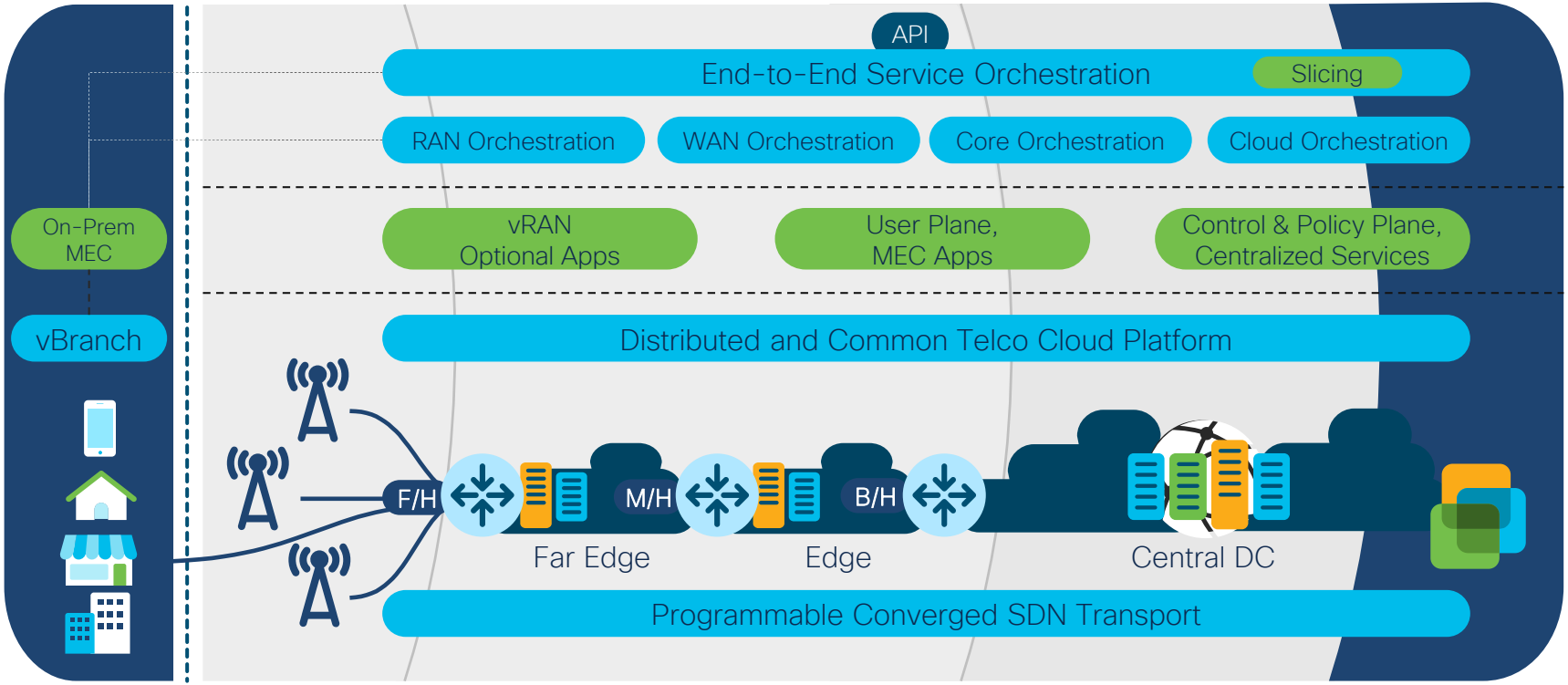
- **5WWC**: Wireless and Wireline Convergence
- **ATSSS**: Access Traffic Steering, Switch and Splitting Support

- **eSBA:** Service Based Architecture
- **eNA**: Network Automation
- **eNS**: Network Slicing (Slice Authentication)
- **eIMS_5G**: N7 to PCF and SBI to HSS
- **eLCS**: Location Services
- **RACS**: Optimized UE radio capability Signaling
- **ETSUN**: SMF Chaining
- **UDICOM**: UDM/HSS Interworking
- **5G_SRVCC**: 5G to 3G CS SRVCC

- 4G Only UE support on 5GC
- ePDG integration (no S6b)



A Better End-to-End Architecture
Building a truly software-defined (mobile) network (SDMN)



RAN Evolution

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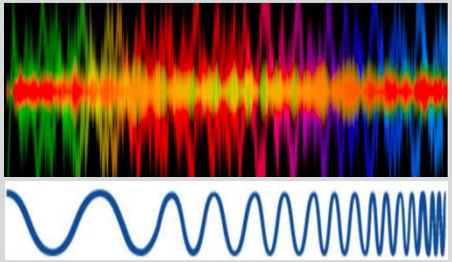
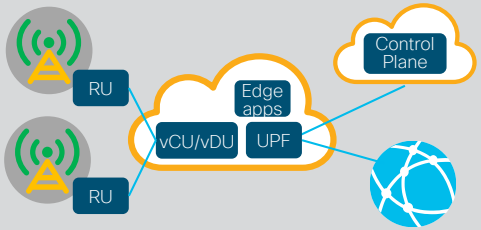
5G New Radio – Highlights

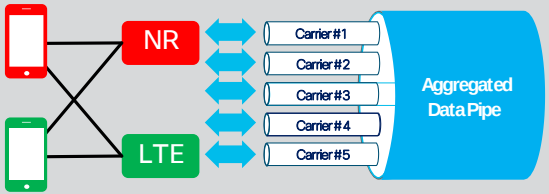
Expanded Spectrum: NR new bands



RAN Decomposition: Towards vRAN

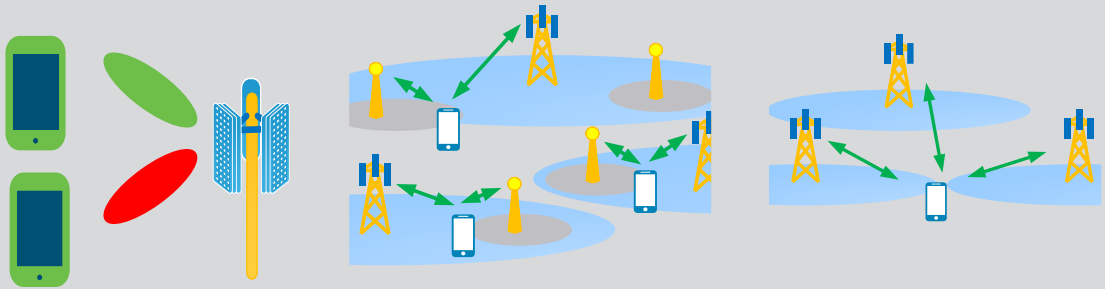


Multiband Connectivity

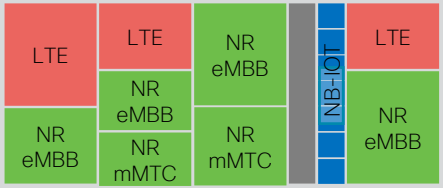


CA & DC options

Advanced Radio Techniques

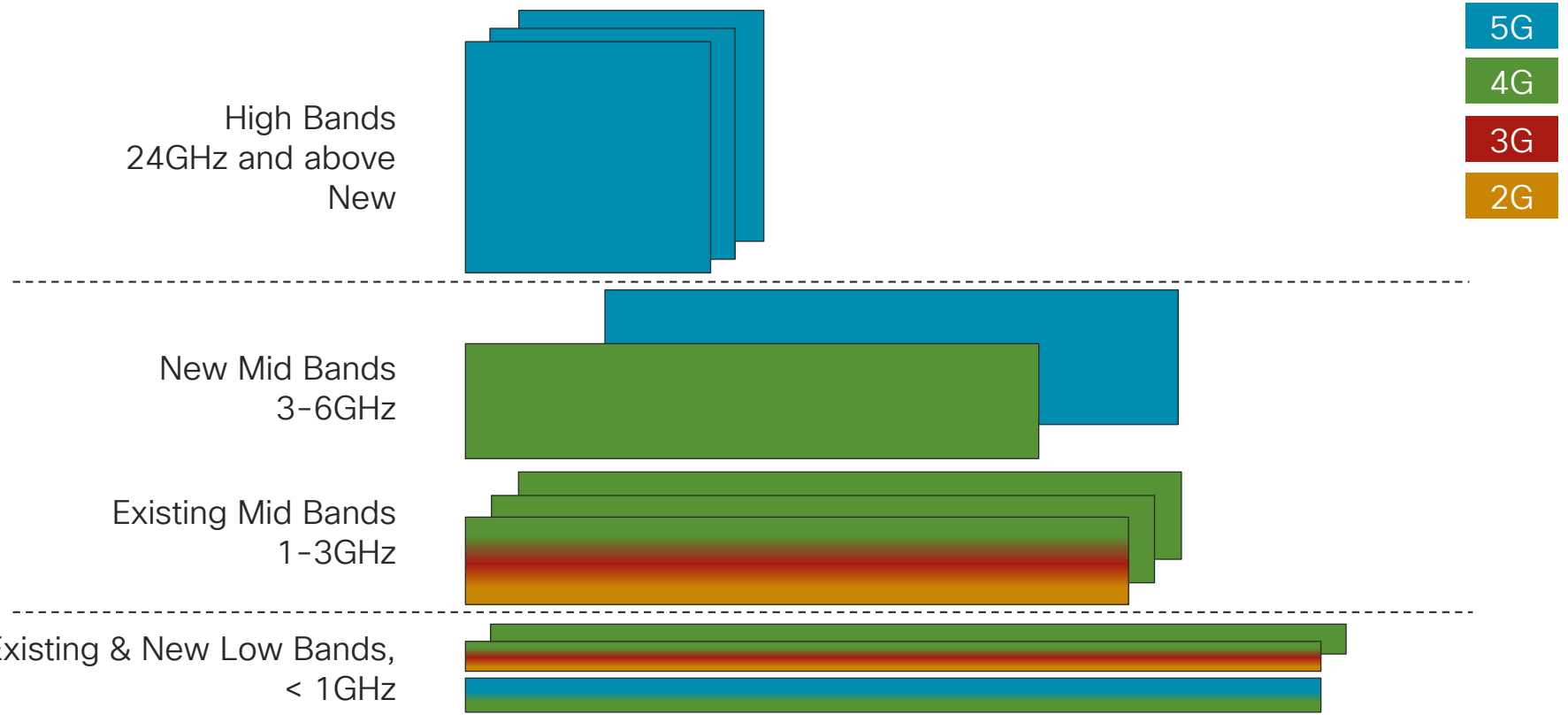


DSS & Flexible NR Protocol

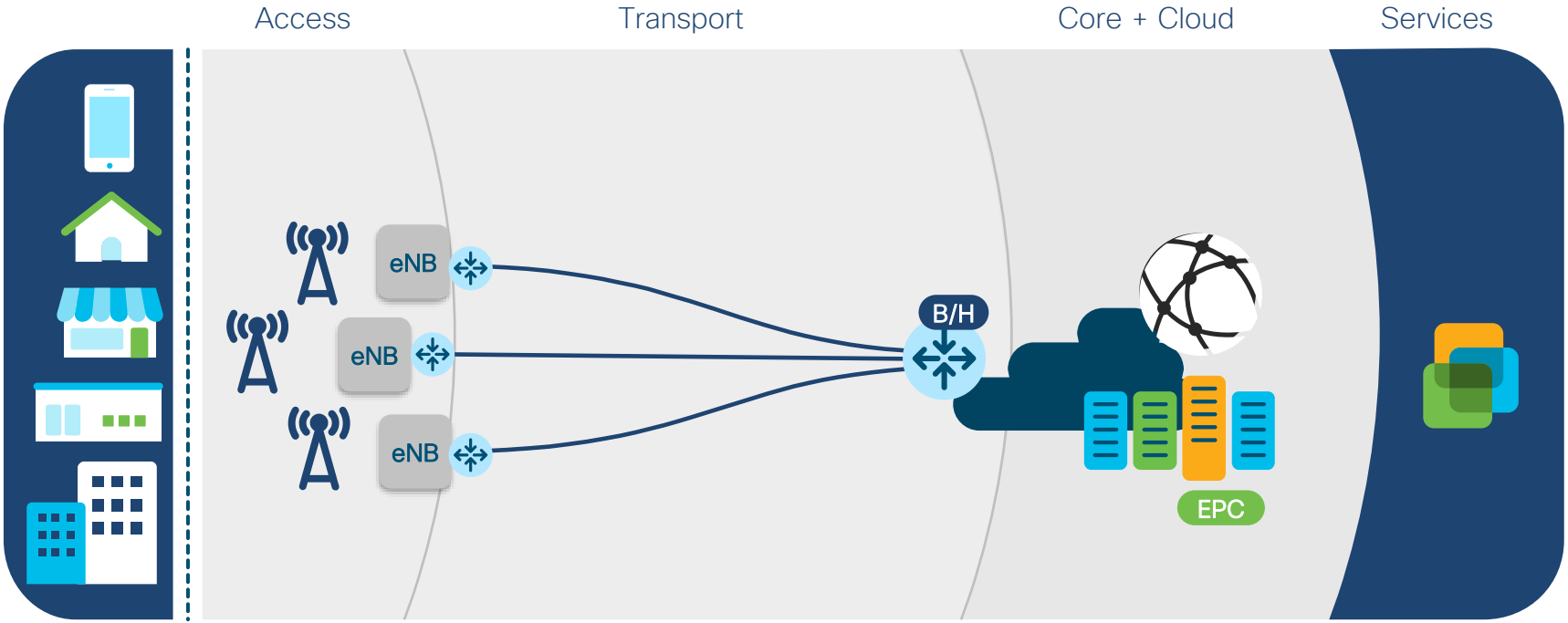


- Dynamic Spectrum Sharing (share spectrum 4G & 5G)
- 5G Bandwidth parts optimized for different service types / slices

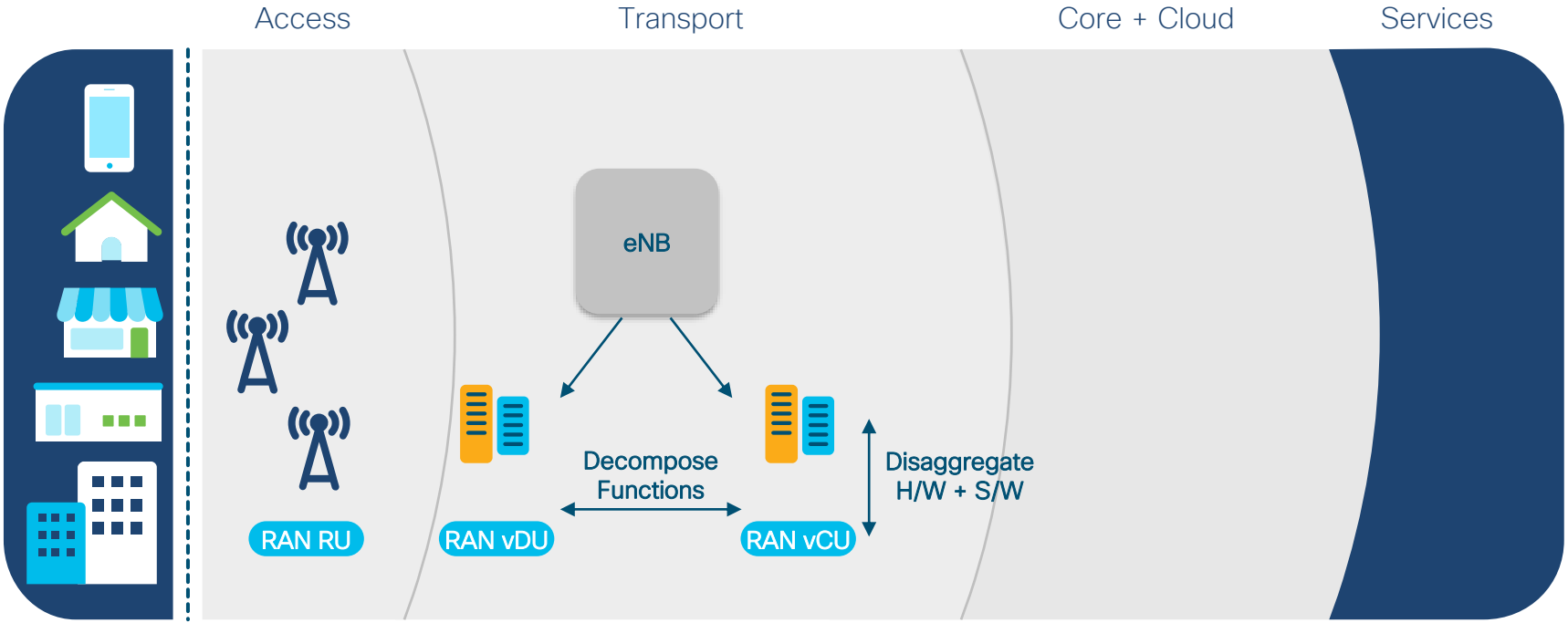
Mobile Network Spectrum



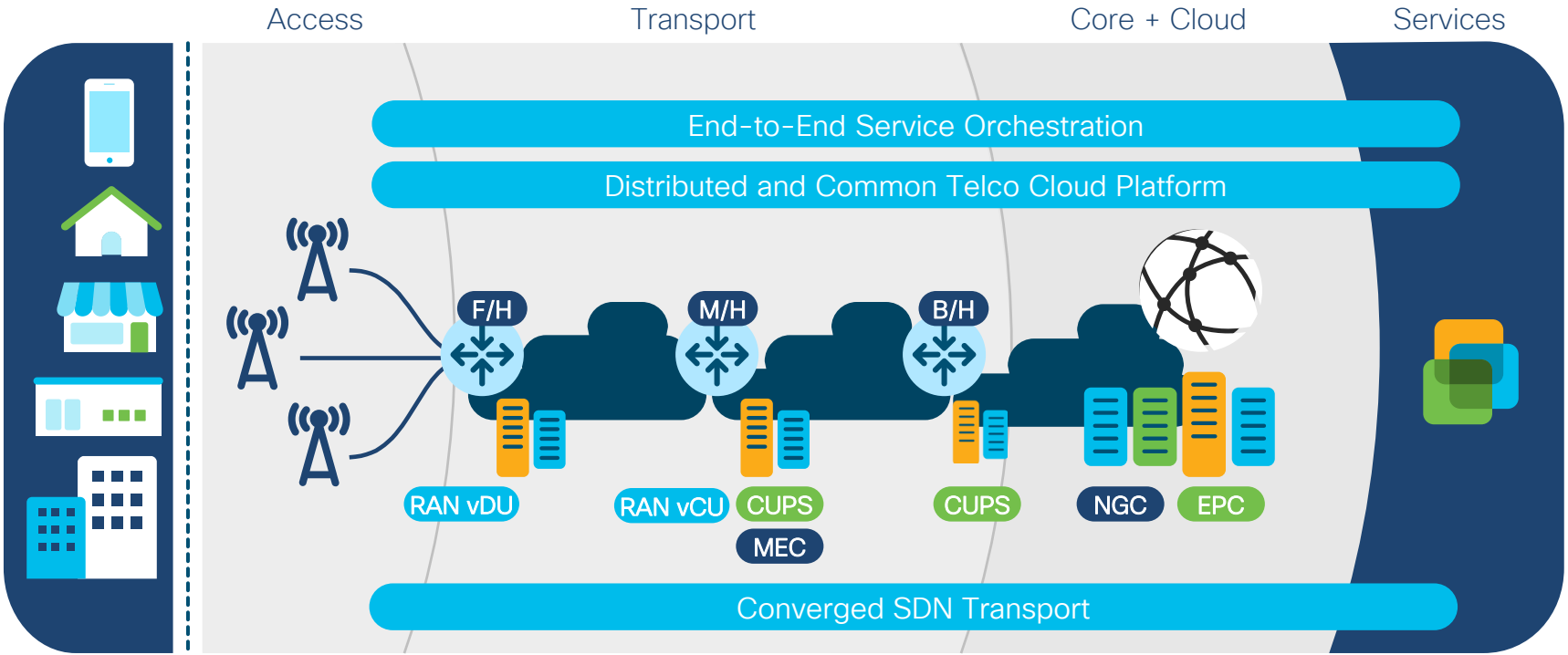
Traditional Distributed RAN – Monolithic eNB/gNB



RAN Transformation to Software

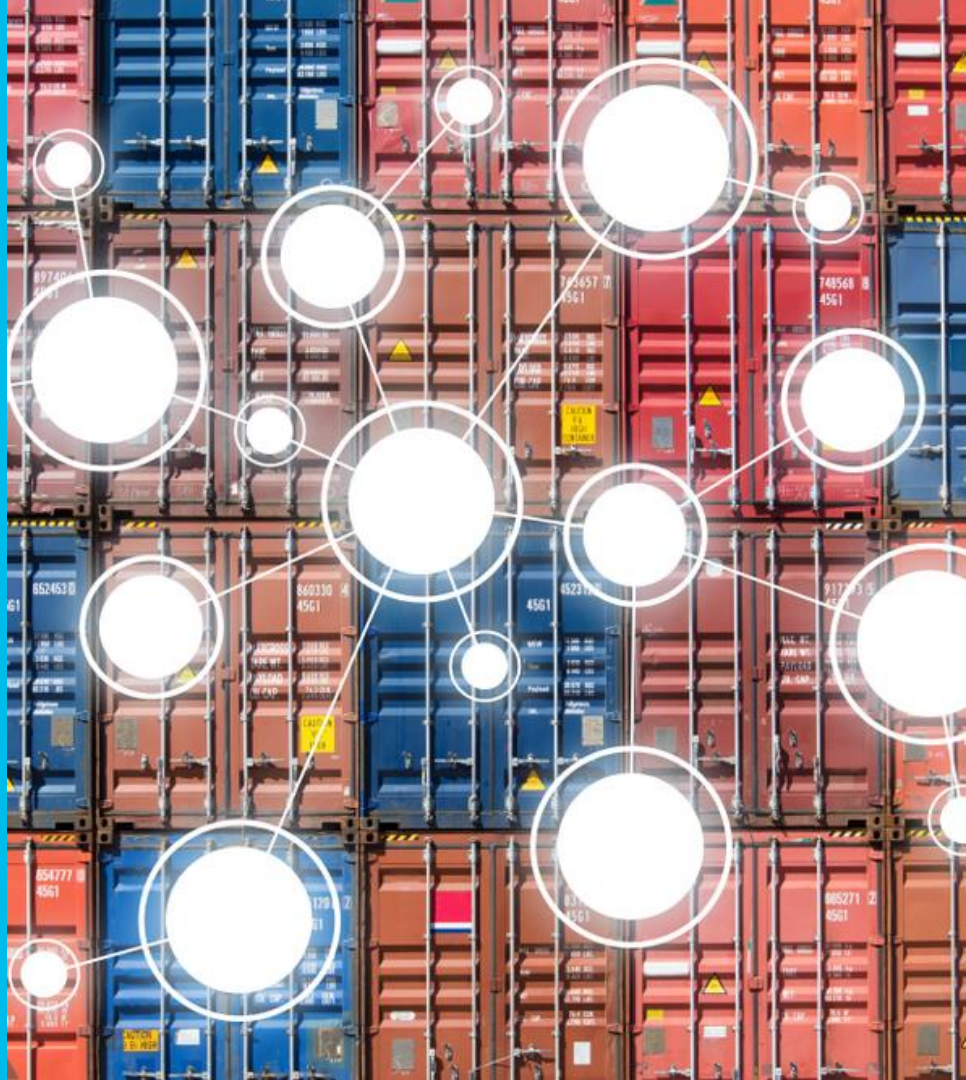


Transformed RAN in the SDMN



Cloud Native Evolution

Why Cloud Native?



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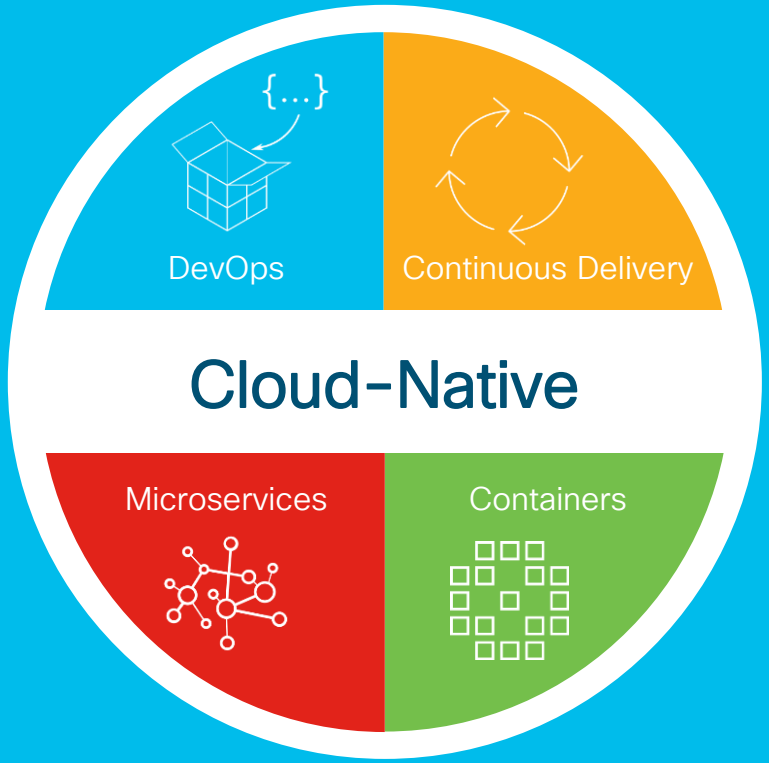
Why not rush to use this right now?

Challenges:

- Organizations build around HW
- Organizations built around fixed location service points
- Technology Maturity
- Product Maturity
- Culture

End-to-End Requirements:

- Common Service Definitions
- Common Infrastructure for deploying Functions Dynamically
- Procurement of horizontal platforms for deployment, monitoring, automating



Microservices

- Modular, loosely coupled software services
- Individually deployed and lifecycle managed

Containers

- Virtualization and management of Microservices
- Highly portable to different deployment targets

Continuous Delivery

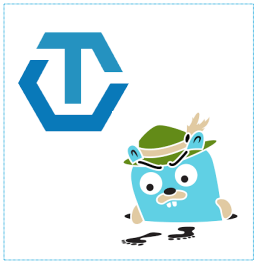
- Automated continuous integration, validation and availability of containers

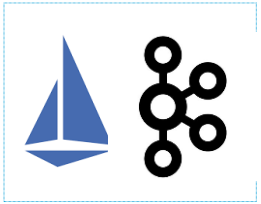
DevOps

- Automate and manage rapid deployments
- Isolate production changes and deploy once validated

Container as a Service Platform Components

- Orchestration: Kubernetes, Docker and Helm
- Service mesh: Istio
- Logging and Tracing
- Telemetry and Assurance: Prometheus + Grafana
- Security: Vault K8s key management
- Messaging: Kafka between consumers and producers




Mobility & Automation Architecture

Automation & Orchestration

- Assurance
- Orchestration
- Slicing

Network Functions

- vRAN NFs
- User Plane and Edge NFs
- Control and Policy, Centralized NFs

Cloud-Native Platform

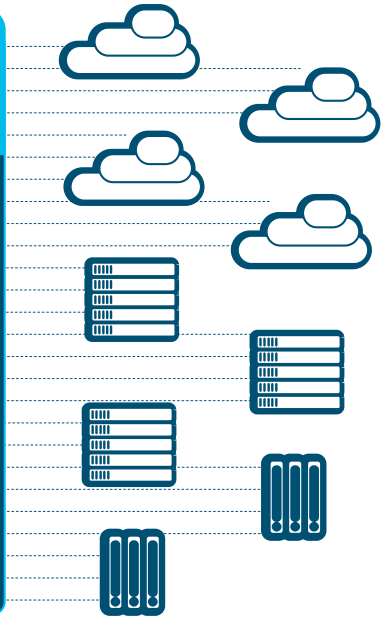
- KPI/Telemetry
- Service Mesh
- OA&M
- Security
- CaaS (Kubernetes, Docker, Helm)

Infrastructure

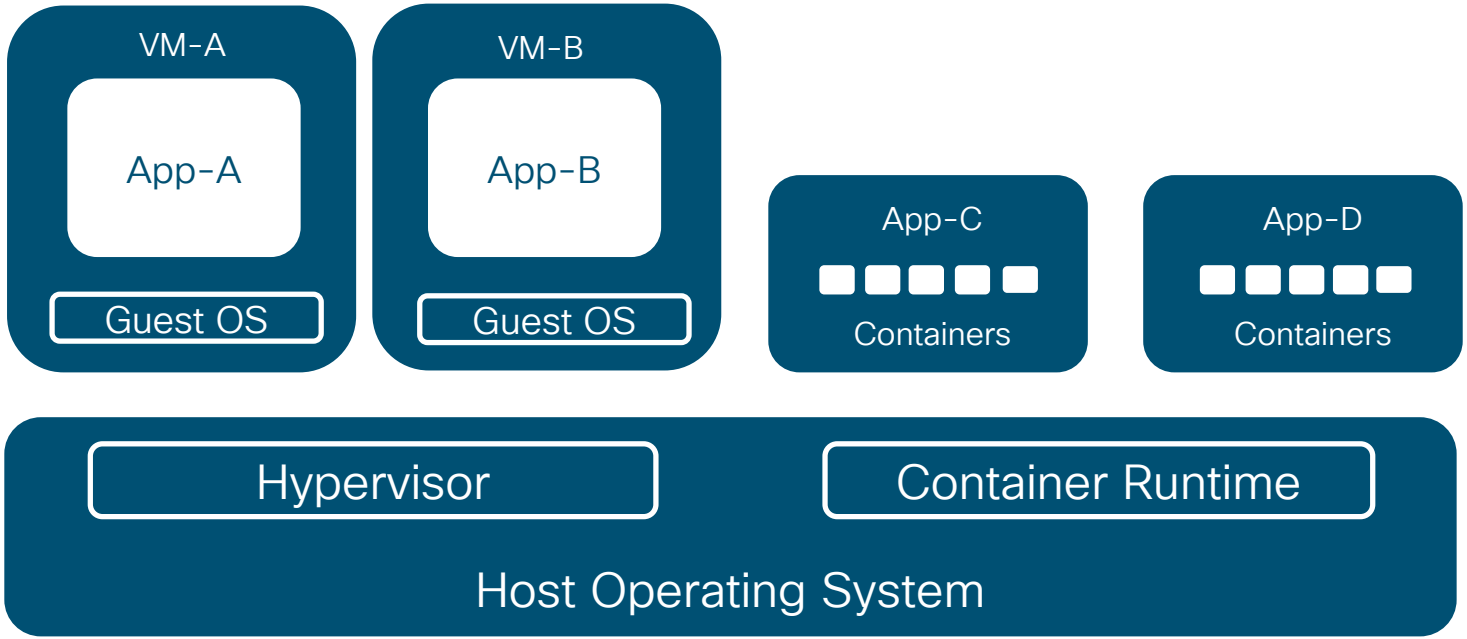
- VMs
- NFVI
- Bare Metal

Automate and Deploy Securely

- Network Edge
- Telco Cloud
- Bare Metal
- As a Service



Virtual Machines vs. Containers



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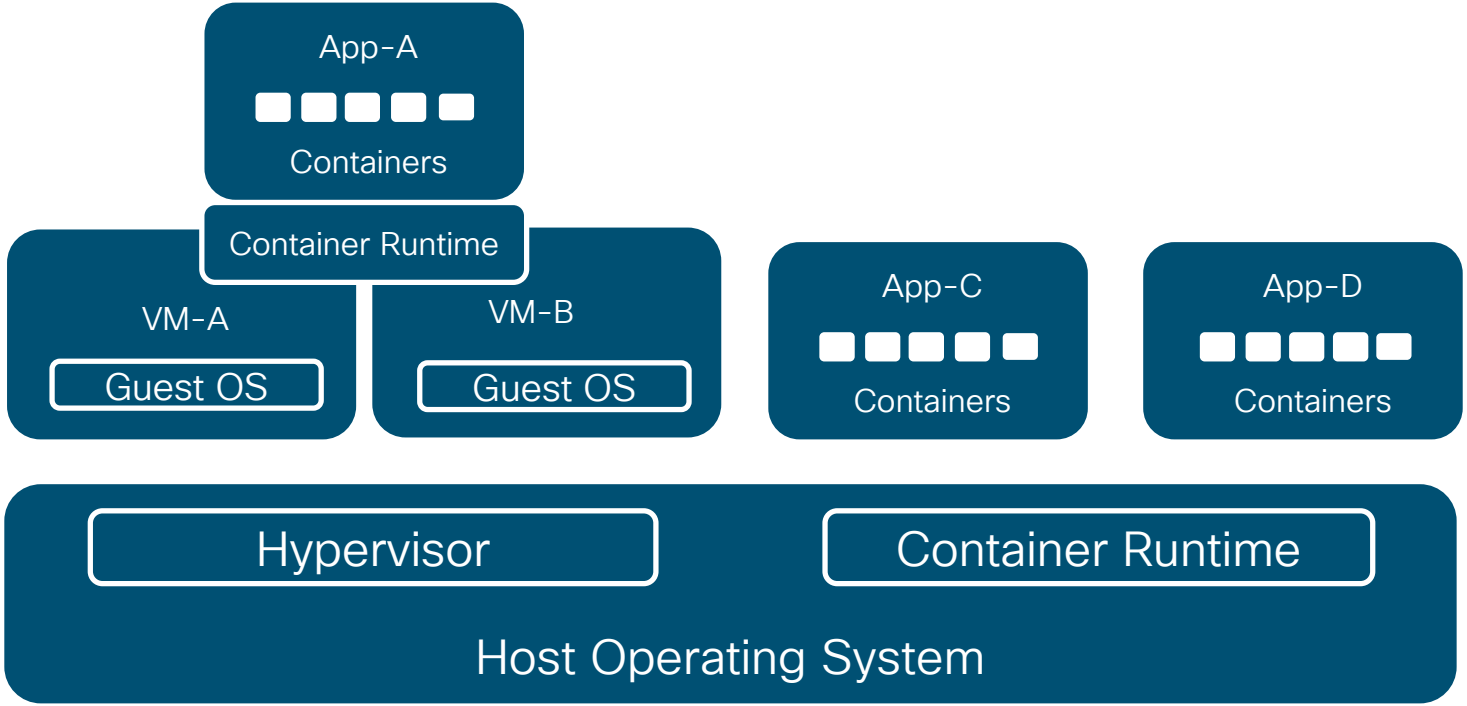
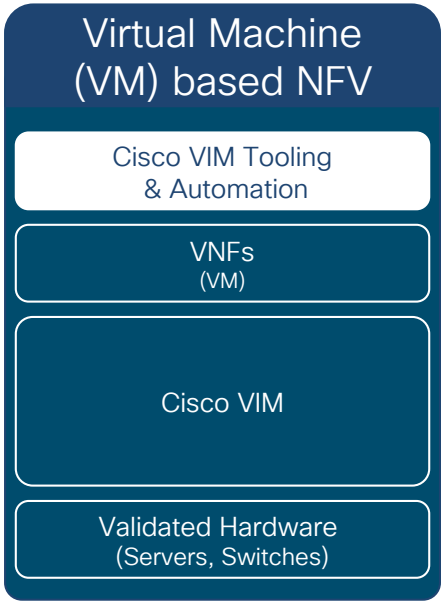
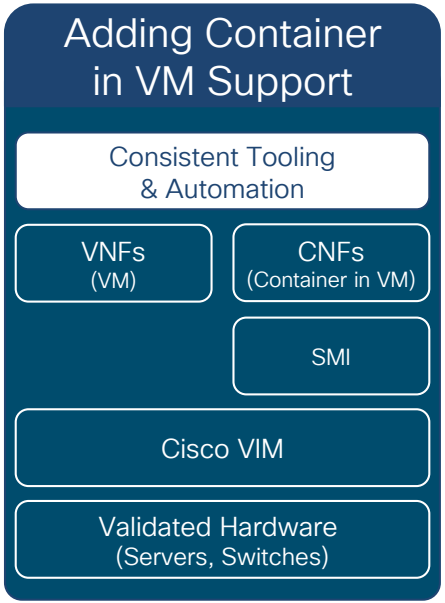
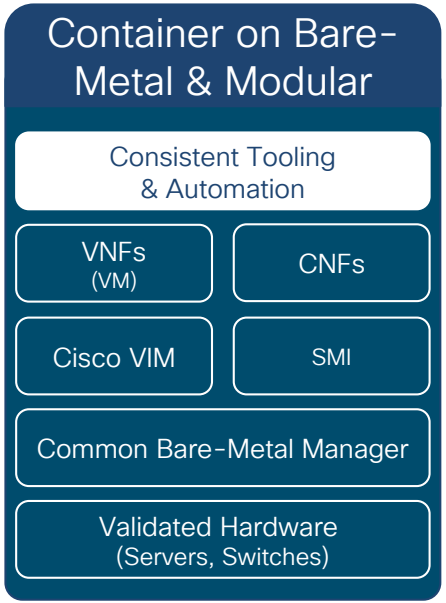


Cisco Infrastructure Deployment Options

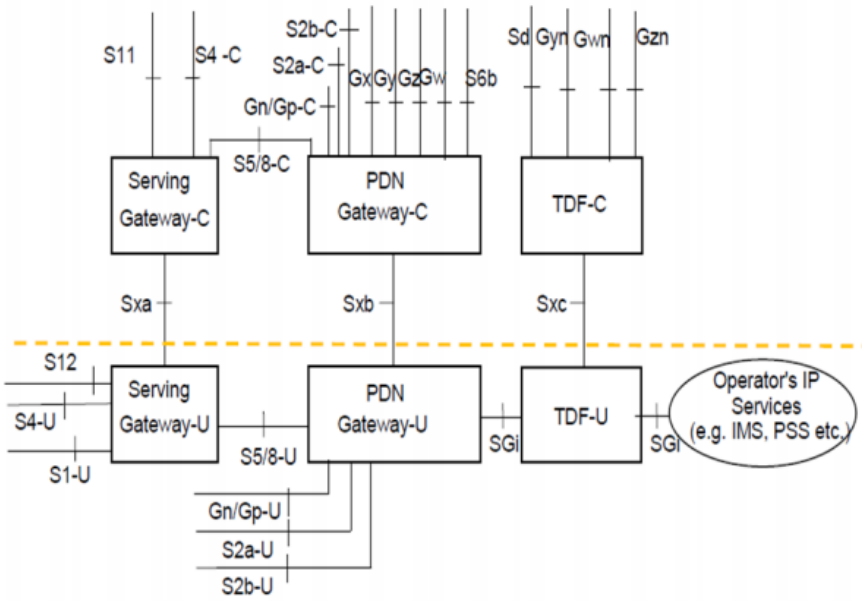




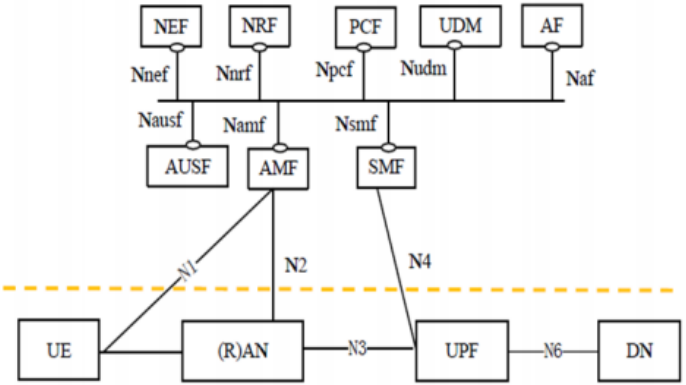


4G vs. 5G Core Architecture

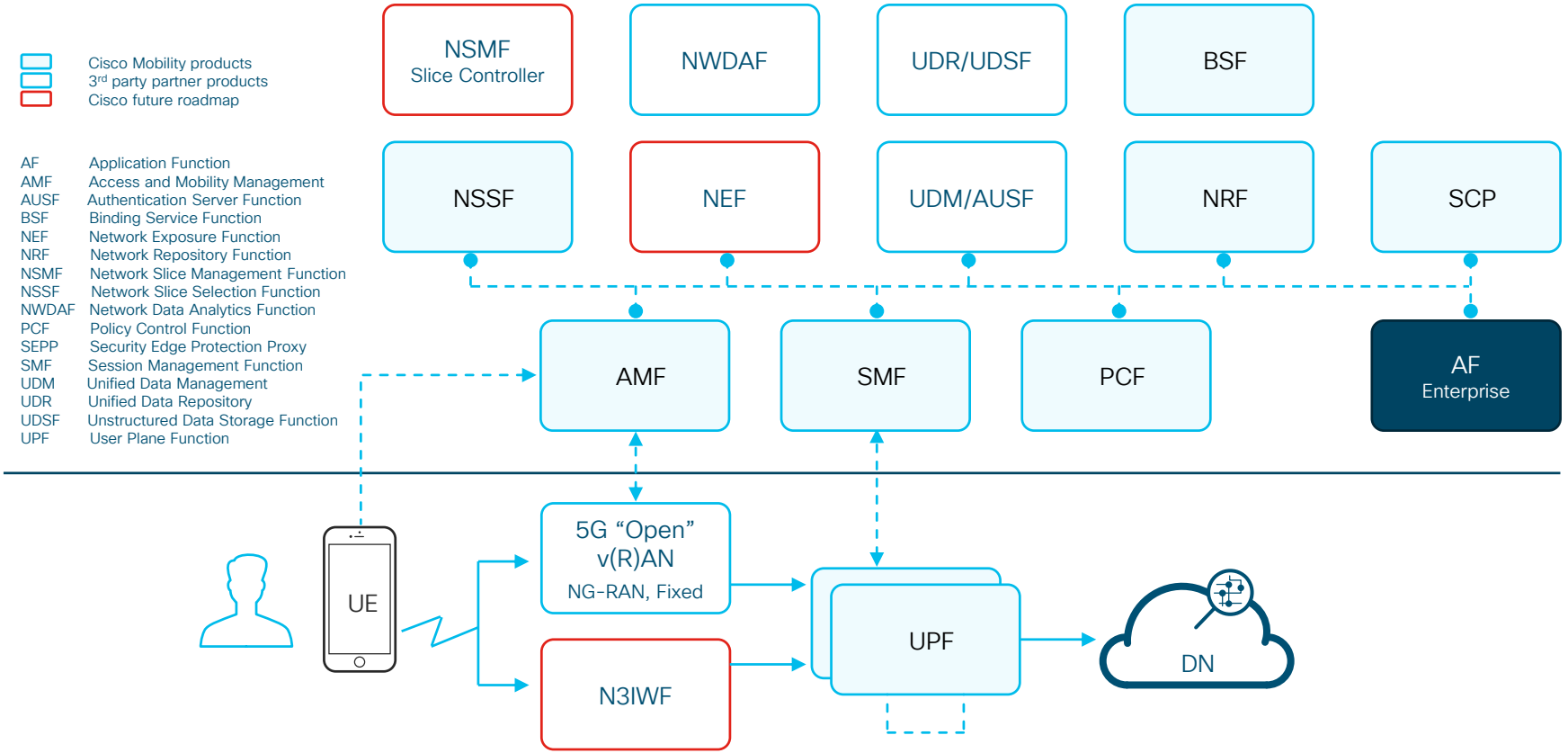
4G Core Using CUPS
(Control & User Plane Separation)



5G Core Using SBA
(Service Based Architecture)



5G Core Network Functions



Mobility & Automation Cisco Solution

Automation & Orchestration

- Matrix + Situation Mgr
- Service and Slice Orchestration
- AppDynamics Subscriber Intel

Network Functions

- vRAN NFs
- Ultra User Plane + Edge
- Ultra Control Plane + Policy

Cloud-Native Platform

- KPI/Telemetry
- Service Mesh
- OA&M
- Cisco Security
- CaaS (Kubernetes, Docker, Helm)
- SMI

Infrastructure

- Cisco VIM
- ESC (VNFM)
- NSO (NFVO)
- Bare Metal Manager

Automate and Deploy Securely

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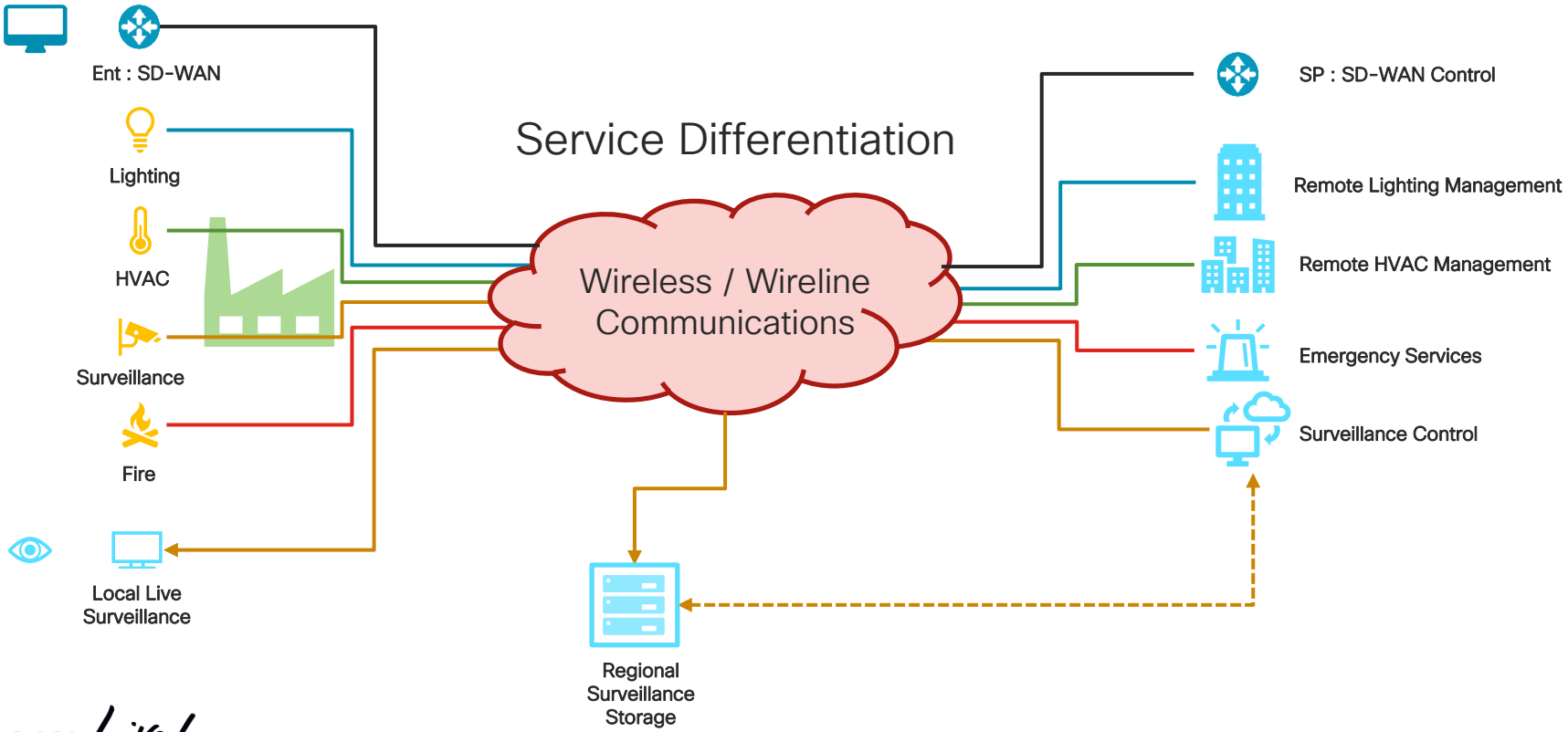
Network Slicing

Network Slicing Example – Industrial Monitoring



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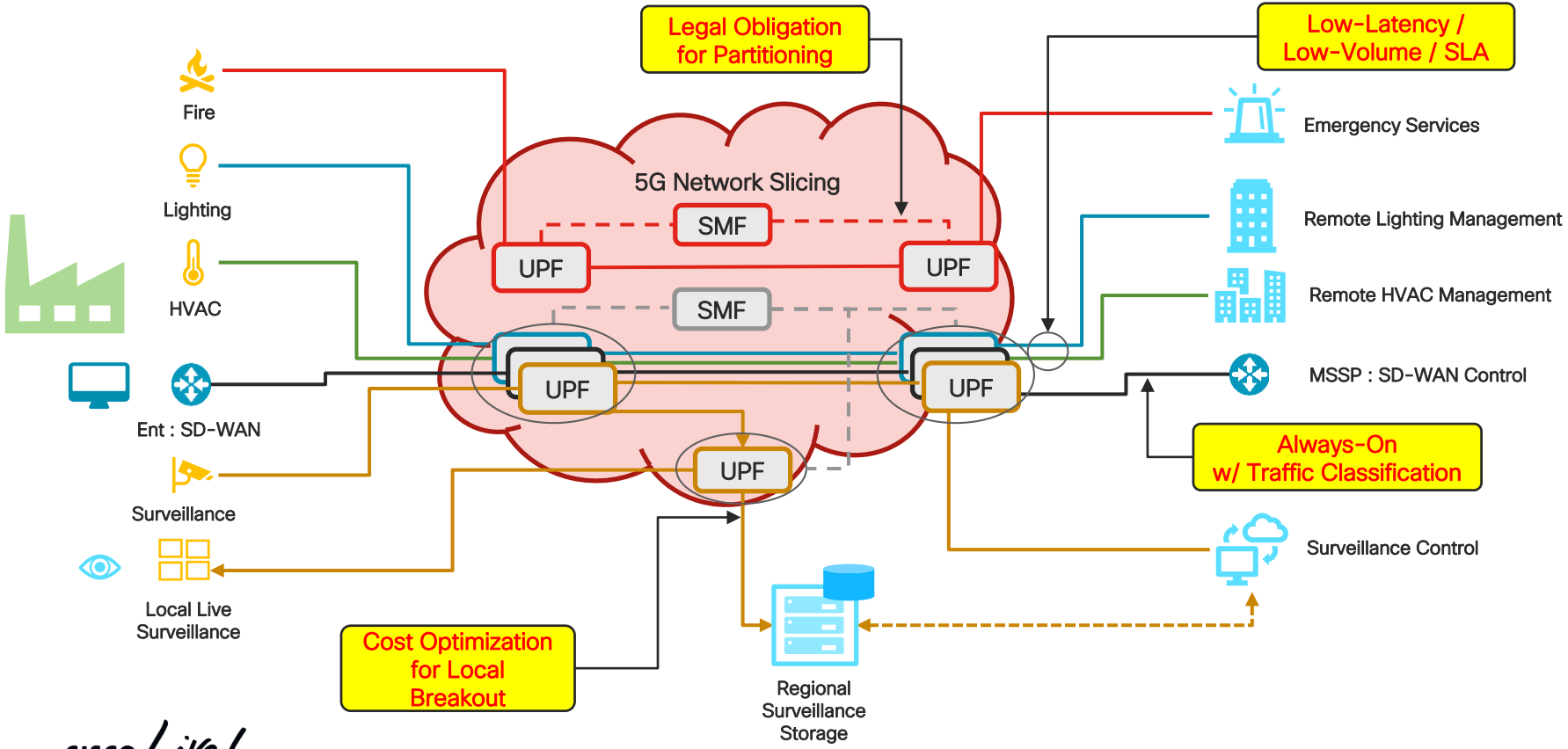


3GPP TS 23.501 Network Slicing Definition

Network Slice:

"A logical network that provides specific network capabilities and network characteristics." *Such as what behavior?*

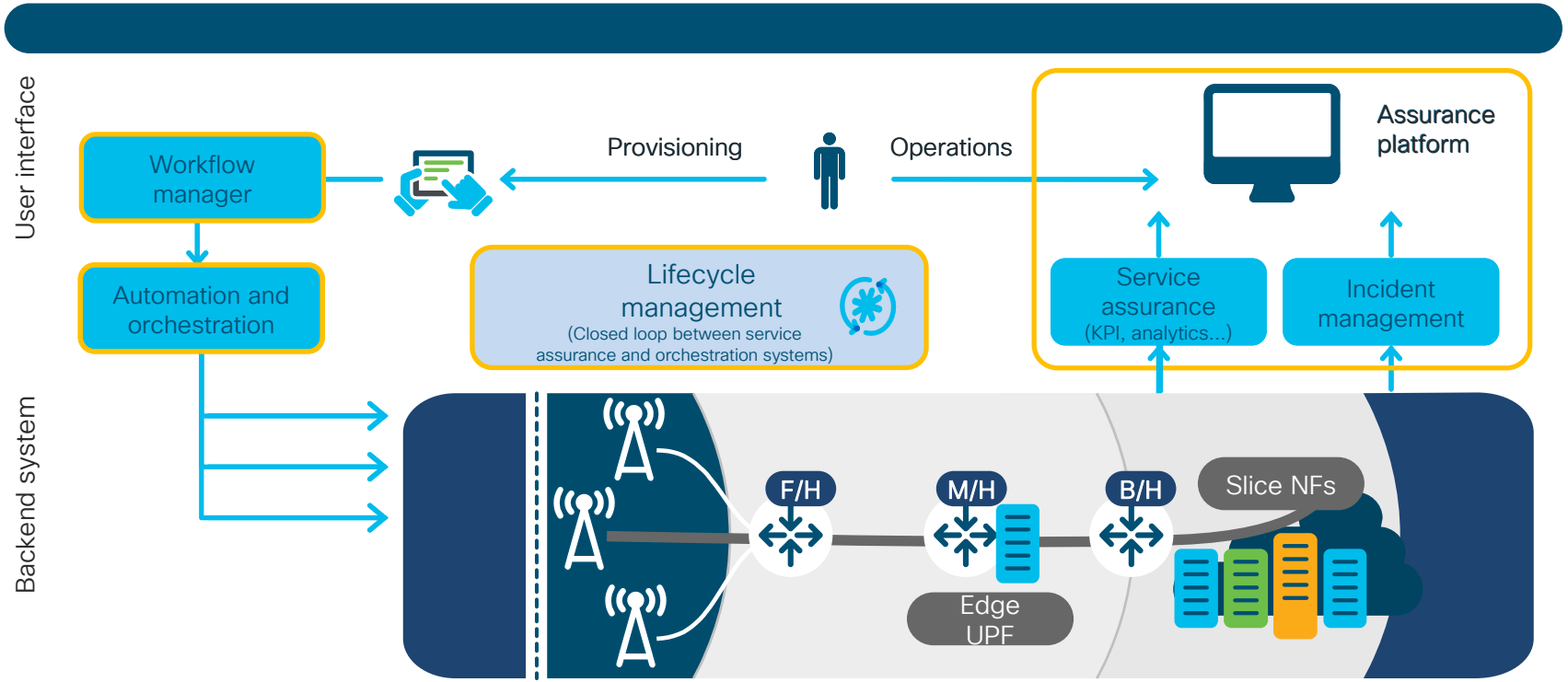
Network Slice instance:

A set of Network Function instances and the required resources (e.g. compute, storage and networking resources) which form a deployed Network Slice. *Allocated by whom?*

5G Slicing – Imperative to Enterprise/Vertical Services

Applicable to heterogenous radio access environments... Wi Fi LTE 5G NR

5G Network Slicing Automation



Slicing Primitives for SLA

UPF Placement

- Edge/Far Edge
- Regional, Central
- Customer Edge, Customer Prem

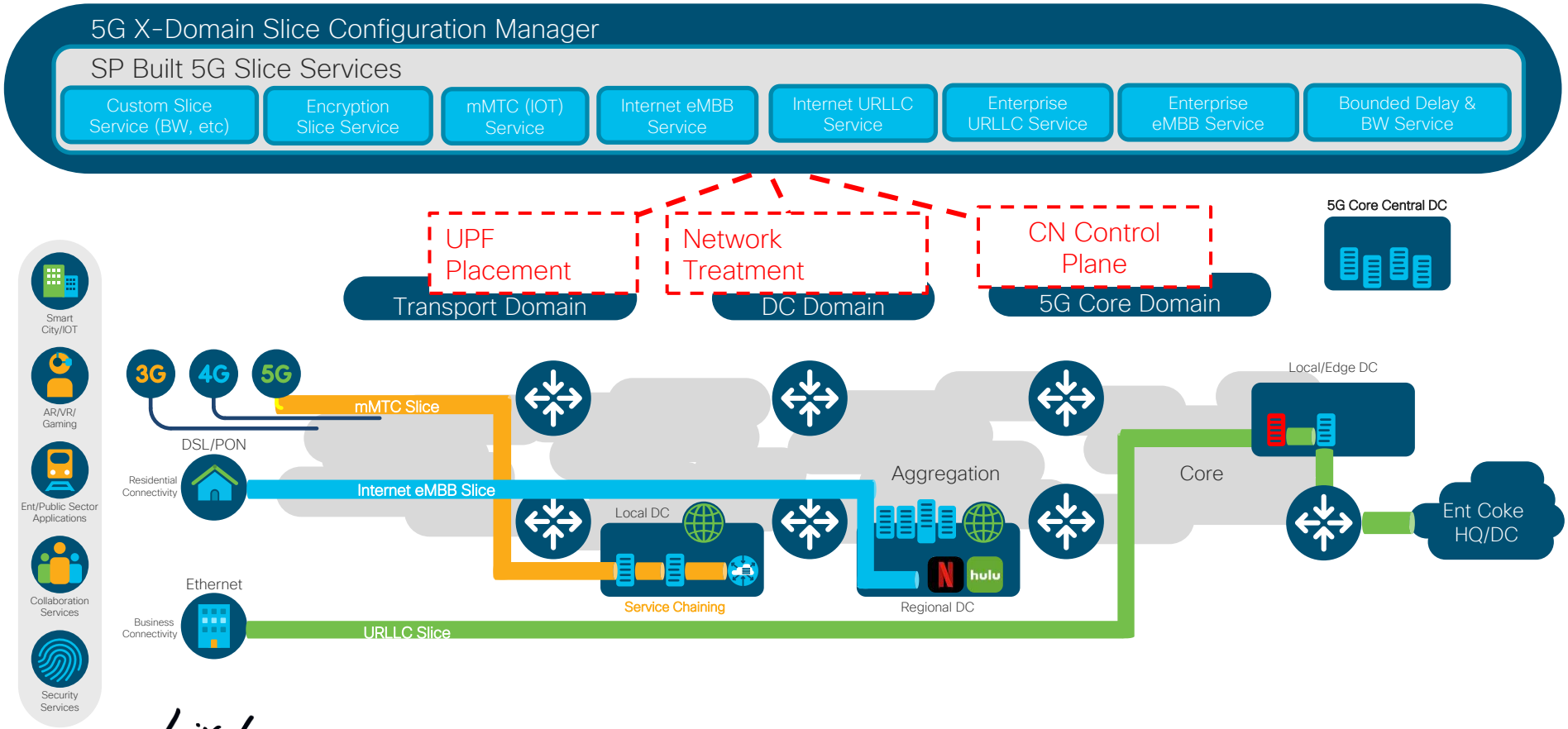
Cloud Native 5G Core Requirements

- Shared or Dedicated Mobility NFs, and which ones? (SMF, PCF, etc)
- Control Plane Piece Placement
- Per-NF attributes

Transport Network Path Behavior (SLA)

- Low Latency
- High BW (IGP) and BWoD/CAC
- Highly Reliable (Fast Re-Route, SRLG, etc)
- Path Dis-jointness
- Encrypted Paths
- Max-Bounded Latency

Cross Domain Slicing

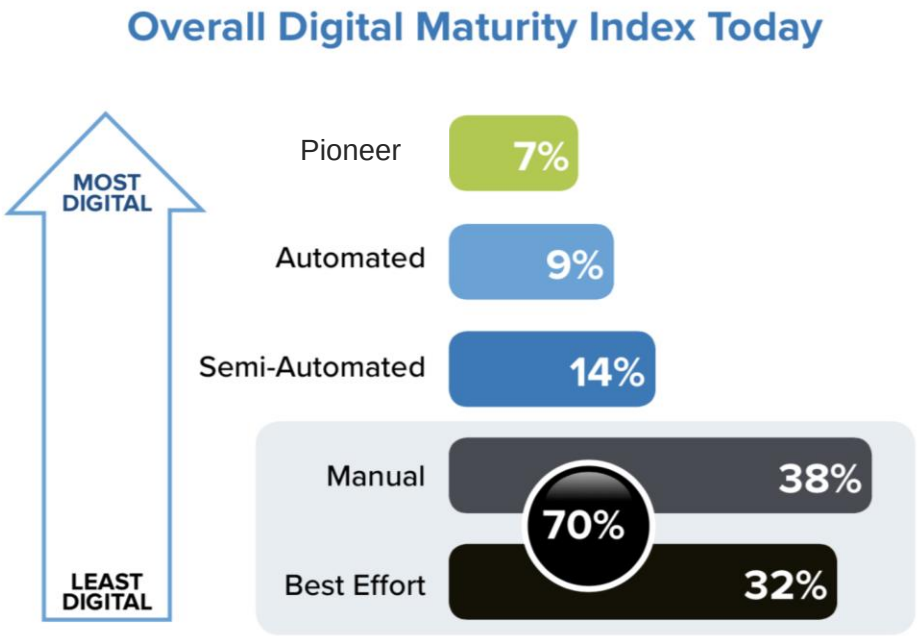


Automation and Orchestration

Where are SPs on the Journey to Automation?

Key Findings:

70% of SPs describe themselves as only in “Manual” or “Best Effort”



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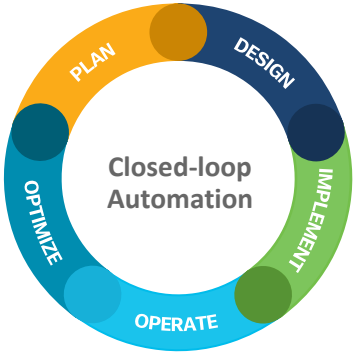
5G Automation, Orchestration and Assurance

AppDynamics subscriber QoE and container level transaction analytics.

Intent based closed loop container optimization with Subscriber Microservices Infra (SMI).



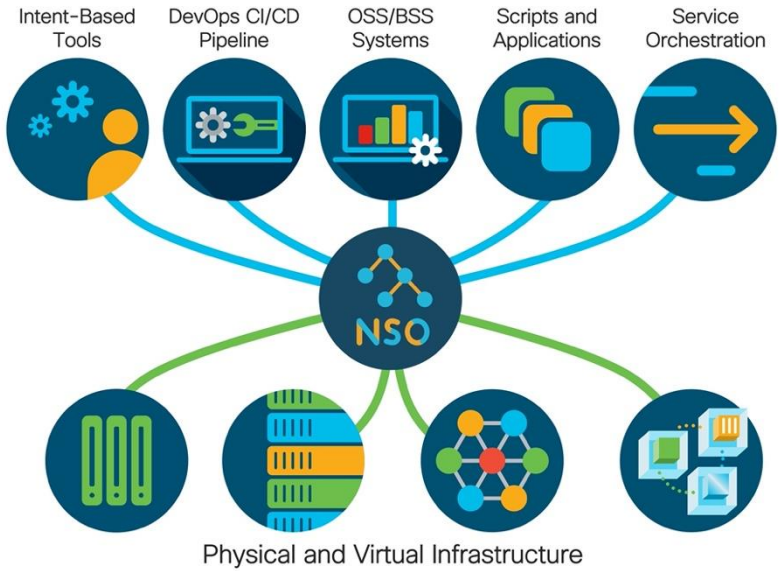
NFVO MANO orchestration with NSO and ESC. Cloud native container and LCM configuration management

Assurance and telemetry data captured with Matrix and Situation Manager. Trigger closed loop operations.

Sample Use Cases

- NFV Cloud Orchestration
- VNF/CNF Instantiation and LCM
- Intent based Configuration Management
- Scale in/out, Self-healing, node recovery
- Automated NF upgrades: Canary
- Fault/telemetry capture, AI, Closed Loop
- E2E Slicing Management and Assurance

NSO: powerful infrastructure automation



- Cross-domain, multi-vendor automation
- Consistent, simplified automation of physical + virtual infra
- Clean simple OSS integration
- Horizontal scalability

NFVO Core Function Pack

- ETSI compliant – supports SOL001, SOL003, SOL004, SOL006
- E2E service orchestration: chains of VNFs, spanning resources inside and across datacenters and VNFM instances, defined by a SOL006 compliant NSD
- Support for Cisco and 3rd party VNFs, VIMs and VNFMs
- Vendor Independent VNF Descriptors with tools for translating SOL001-SOL006

Elastic Services Controller

- Full-lifecycle management
- Open, modular, API-driven
- ETSI-complaint gVNFM
- Intelligent VNF placement
- Advanced health & service monitoring for recovery and elasticity
- Flexible analytics and rules with customizable workflows

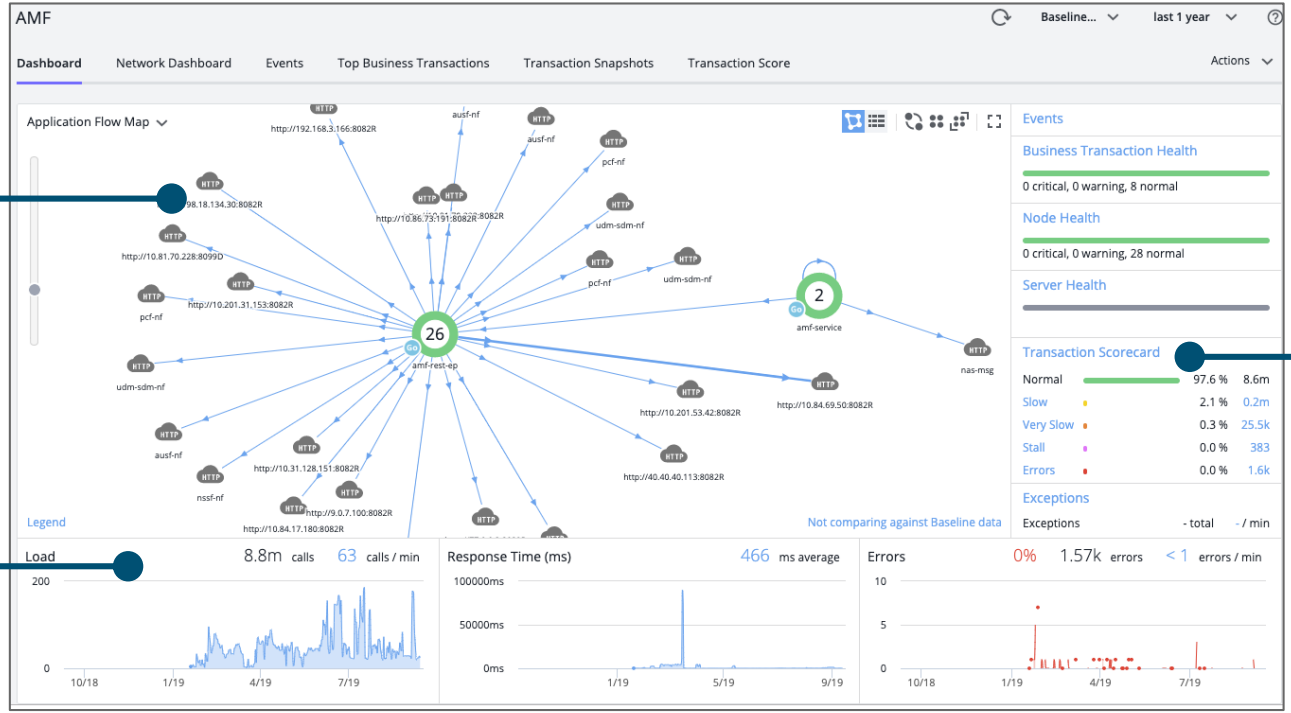
Application intelligence with AppDynamics

Visibility	Insight	Action
Automated Discovery & Dynamic Baselines for Production Applications **Every User, Every Transaction, Near Real Time**	Live Customer Journeys for every Business Transaction Automatically Collected, Fully Correlated Business Context of anomalies, trends & patterns	Proactive Alert on Realtime Business Metric Programmable Actions to adjust resource allocation User Impact Analysis due to new code deploy

5G control plane visibility and insights

Near real-time E2E visibility

Application health KPIs

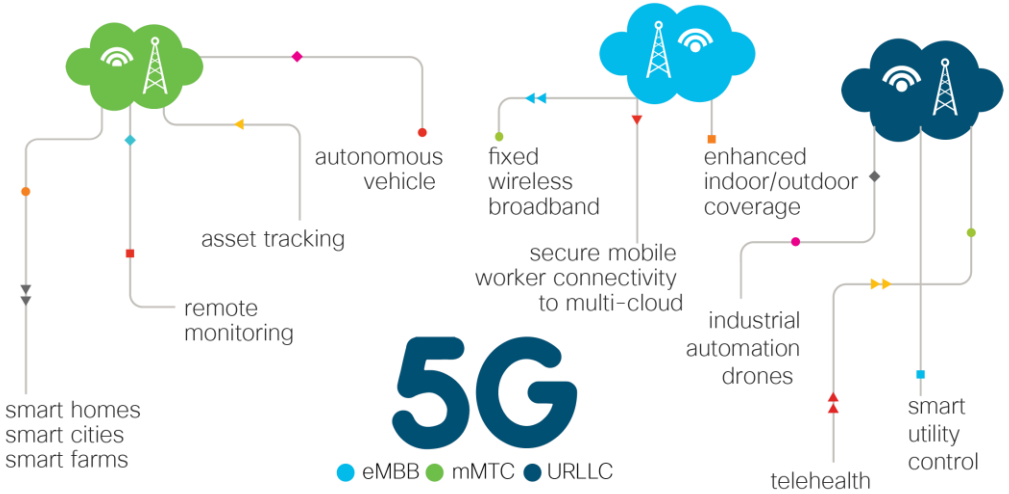


AI/ML-based dynamic scorecard

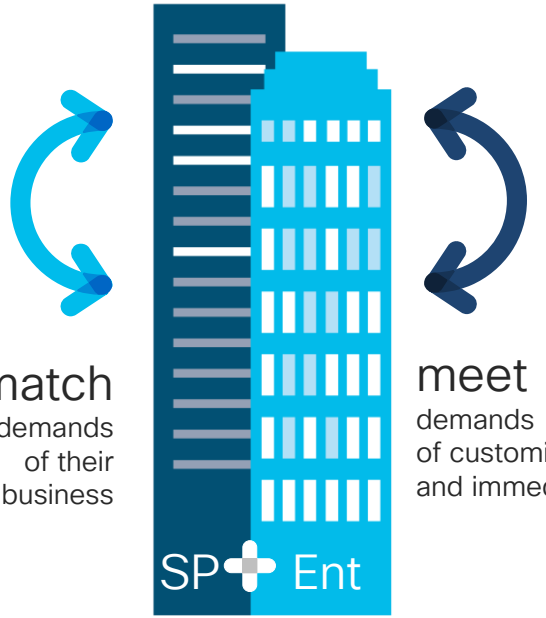
Enterprise and Edge

Enterprise 5G Opportunities

Pursuit of Productivity
through digitization



Greater Expectations



Expanded relationship
of transparency and integration

Enterprise Verticals and Use Cases

Manufacturing

- L *Low Latency secure robotic communication*
- M *Operation & support remote secure access*
- S *Automated alerting*

Healthcare

- L *Life critical monitoring device location-based alerting*
- M *Clinical communication & collaboration*
- S *Medical expert video consulting*

Retail

- L *Augmented reality enables customer experience*
- M *Associate enablement connected tools*
- S *Personalized customer messaging & notification*

Industrial Sites

- L *Dedicated Low Latency priority traffic routing for Industrial control systems*
- M *Emergency communication policies*
- S *Automated remote monitoring*

Transportation

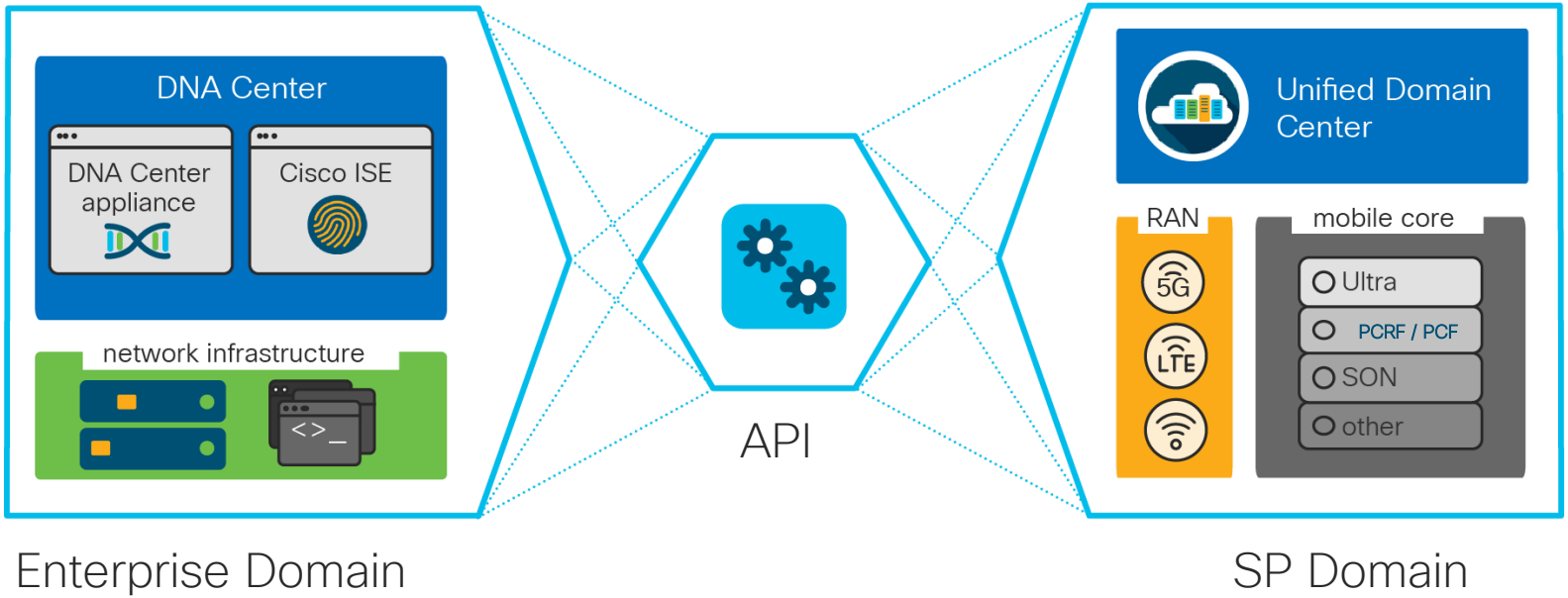
- L *Asset management & tracking*
- M *Communication services for remote work*
- S *Automated dispatch services*

Public Sector

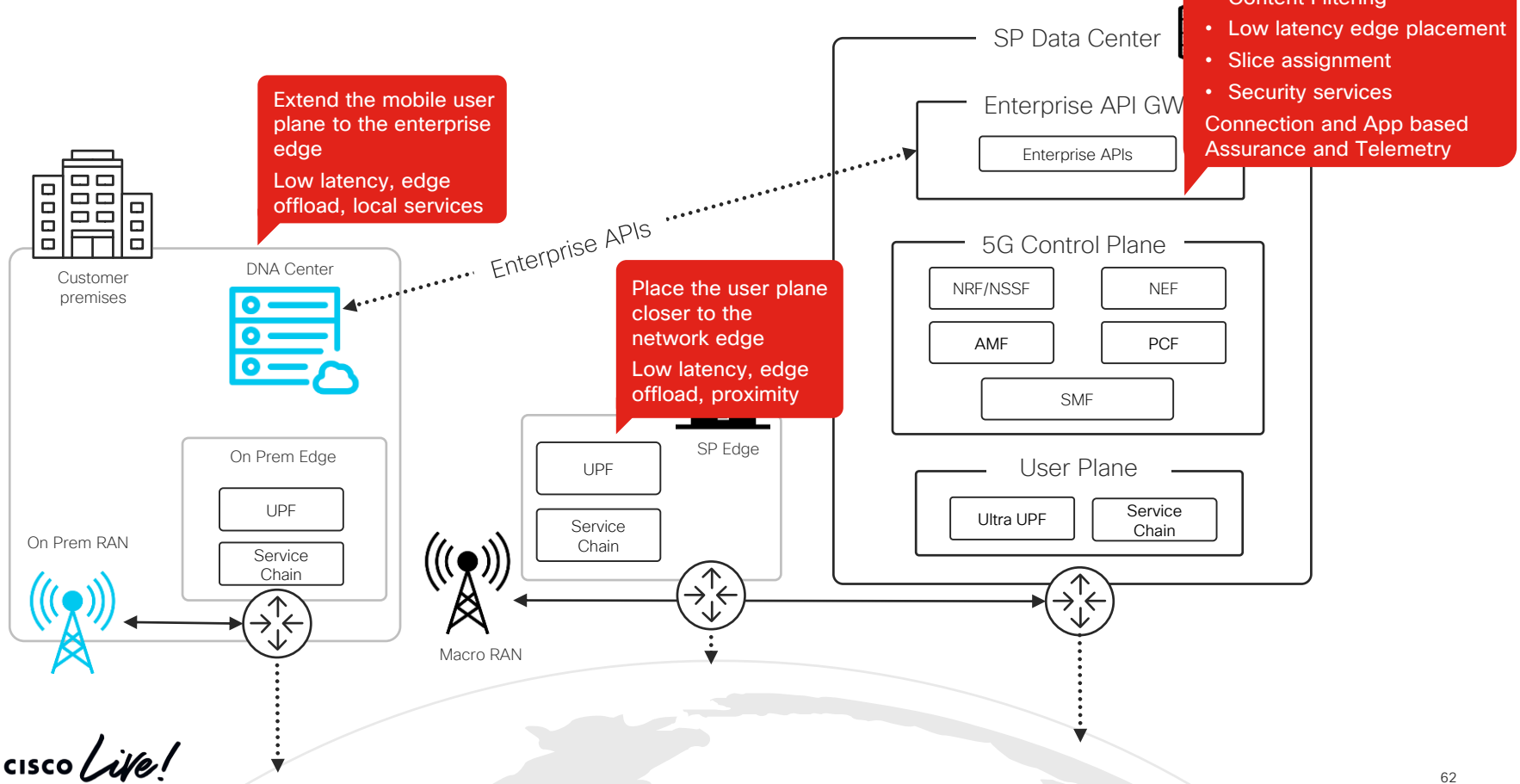
- L *Collaboration services for inter-agencies*
- M *environmental safety & emergency mobile services*
- S *Communication services for public safety*

Cisco Unified Domain Center

Enabling the Mobile Enterprise with intent based APIs

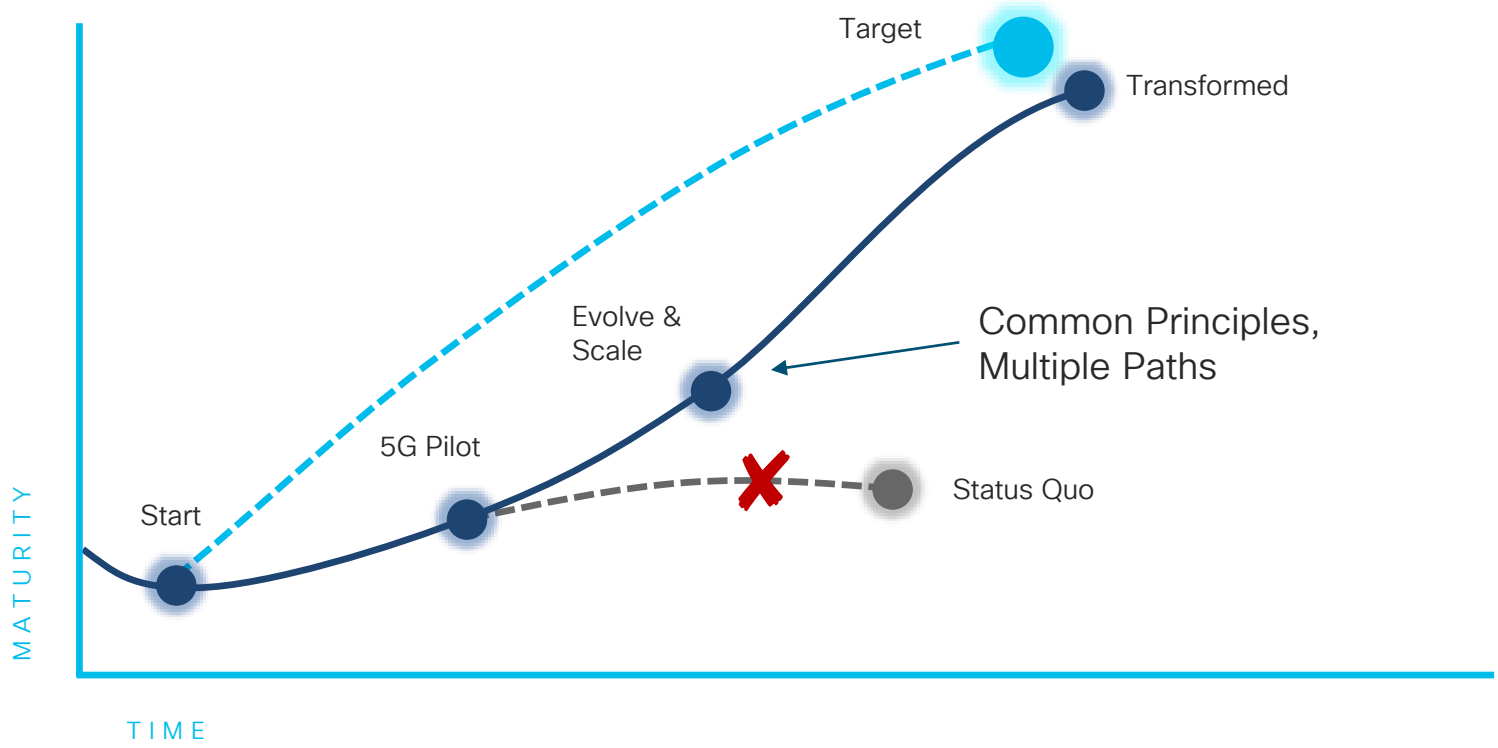


Cisco Enterprise Mobile Core



Summary

Navigating the Journey to SDMN



The Software-Defined 5G Network

- A Better End-to-End Network: More Flexible, Lower-Cost, Service-Optimized
- Network Defined by Applications, Not by Access Technology
- Build the Platform Now that Enables Flexibility vs. Locking In Extension of Legacy

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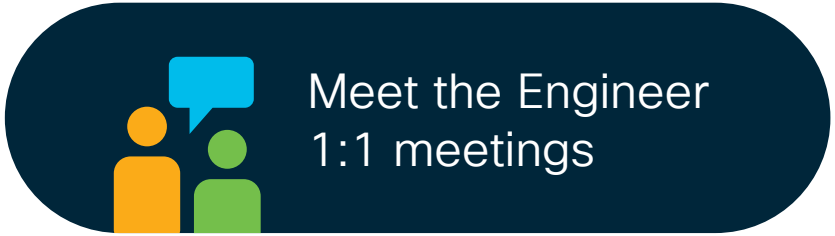

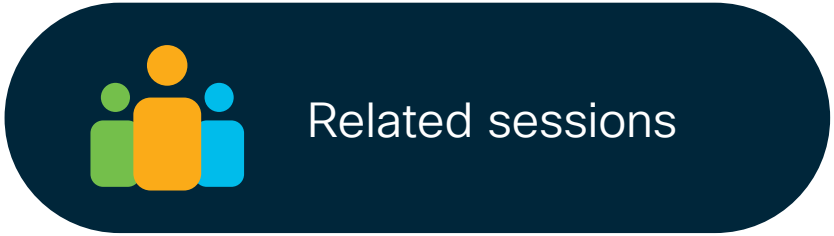

Thank you

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