4G and 5G for Private Networks

SP Cloud Native Applications

Mark Rankin
DSA
BRKSPG-2027

Agenda

- Market & Technology Trends

- The Enterprise Opportunity

- Cisco Strategy

- Summary & Close

Market & Technology Trends

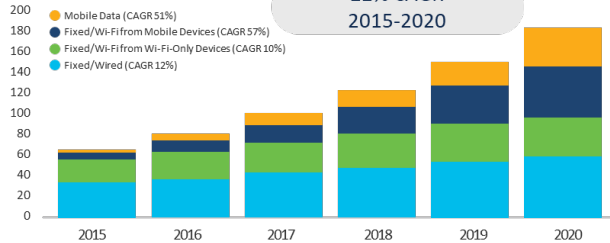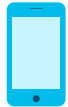# Traditional "IT" Trends

Enterprise Data Growth

Exabytes per Month

22% CAGR 2015-2020

Legend:
- Mobile Data (CAGR 51%)
- Fixed/Wi-Fi from Mobile Devices (CAGR 57%)
- Fixed/Wi-Fi from Wi-Fi-Only Devices (CAGR 10%)
- Fixed/Wired (CAGR 12%)

Years: 2015, 2016, 2017, 2018, 2019, 2020

12 billion mobile devices by 2021

Over 3 billion Wi-Fi devices hit the market every year

Enterprise apps migrating to Multi-Cloud environment

Data center → Multi-Cloud
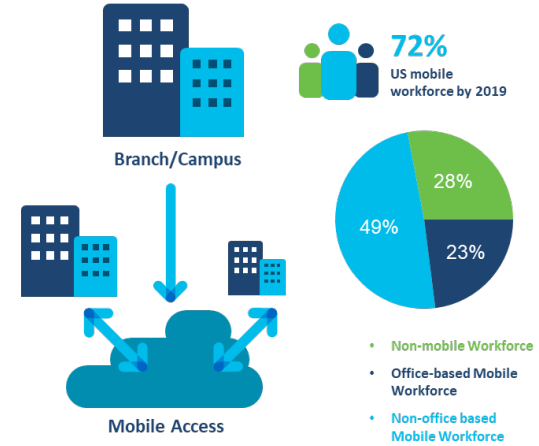
2016:
- 60% Non-cloud
- 40% IT Cloud Workload
  - 14%
  - 8%
  - 6%
  - 12%

2019:
- 40% Non-cloud
- 60%
  - 14% On-Prem Private cloud
  - 9% Hosted Private Cloud
  - 16% IaaS
  - 21% Saas
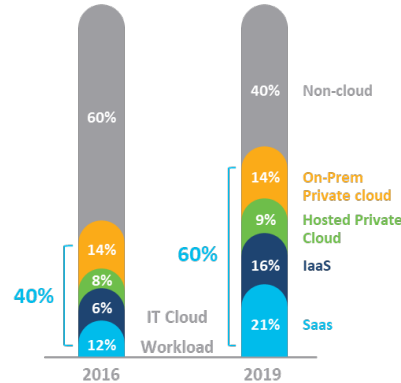
Source IDC (Mobile Workforce), RightScale (Cloud workloads)

Workforce going Mobile

Branch/Campus

Mobile Access

72% US mobile workforce by 2019

- 28%
- 23%
- 49%

- Non-mobile Workforce
- Office-based Mobile Workforce
- Non-office based Mobile Workforce

Digitization & "OT" Trends

Workplace

Common Spaces

Collaboration Spaces

Touch down /
focused spaces

Now need Activity Designed Spaces

BRKCOL-2023   17
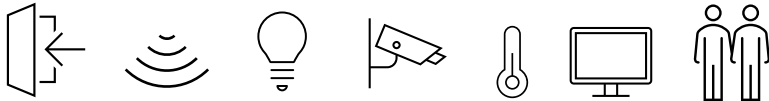
Vertical Markets

Smart+Connected Communities

Connected Industries

Sports & Entertainment
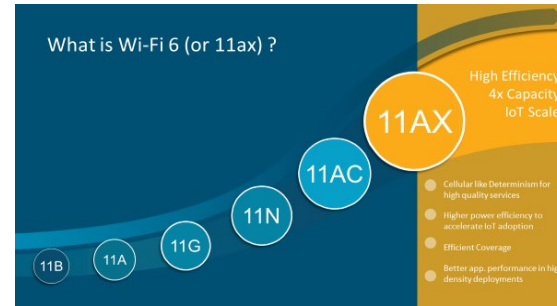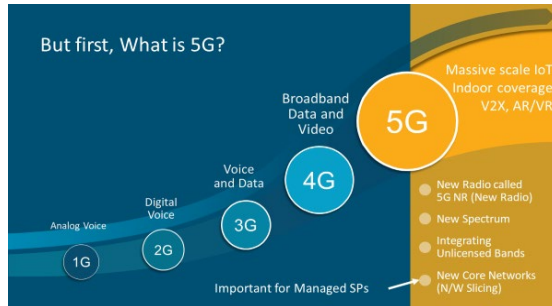
Connected Energy

Connected Transportation

Healthcare

Retail

Carpeted Space (General IT)

And 2 next gen wireless technologies...

Spectrum Allocation is Evolving
Private spectrum across the globe

=Spectrum Update:

- Europe
  - N77, N78 3.5-4.2 GHz
  - 5G SA

- USA
  - B48 (CBRS)
  - LTE

- APJC
  - N257, N258, N79 24.2 GHz, 28 GHz, 4.6 GHz
  - 5G SA

United States
150 MHz @3.5 GHz
CBRS

United Kingdom
3.8 GHz- 4.2 GHz
(100 MHz, low pwr)

Sweden
100MHz @3.7 GHz

Germany
100MHz @3.7 GHz

France
40MHz @2.6 GHz

Japan
4.6-4.9 GHz
28.2-29.1 GHz

Taiwan
4.8-4.9 GHz

Hong Kong
24.25-26.55; 27.75-28.35 GHz

Malaysia
26.5-28.1GHz

Shared spectrum

Local spectrum for enterprise

Local spectrum managed by SP

cisco Live!

#CiscoLive

Spectrum: Impact on Consumption Models

5G Spectrum Available for Private Use

↓

Germany, UK, France
Few other countries in planning

↓ ↓

Built on-prem and operated by Enterprise	Built on-prem and operated by SI or SP

Independent Private Network

Controlled/Co-controlled by Enterprise

5G Spectrum NOT Available for Private Use

↓

All other countries in EMEAR

↓ ↓

Built on-prem and operated by SP	Hybrid built and operated by SP

SP Shared Radio Access Network

SP in control
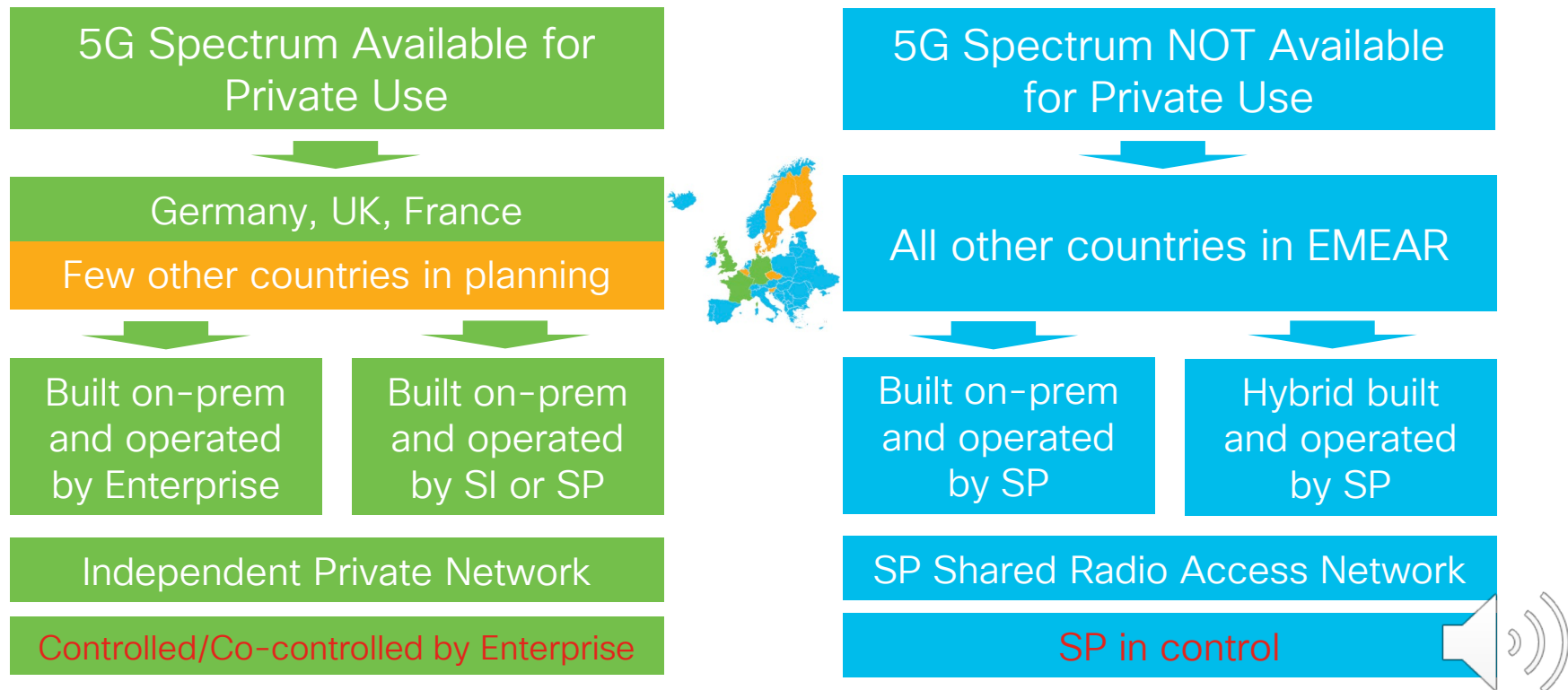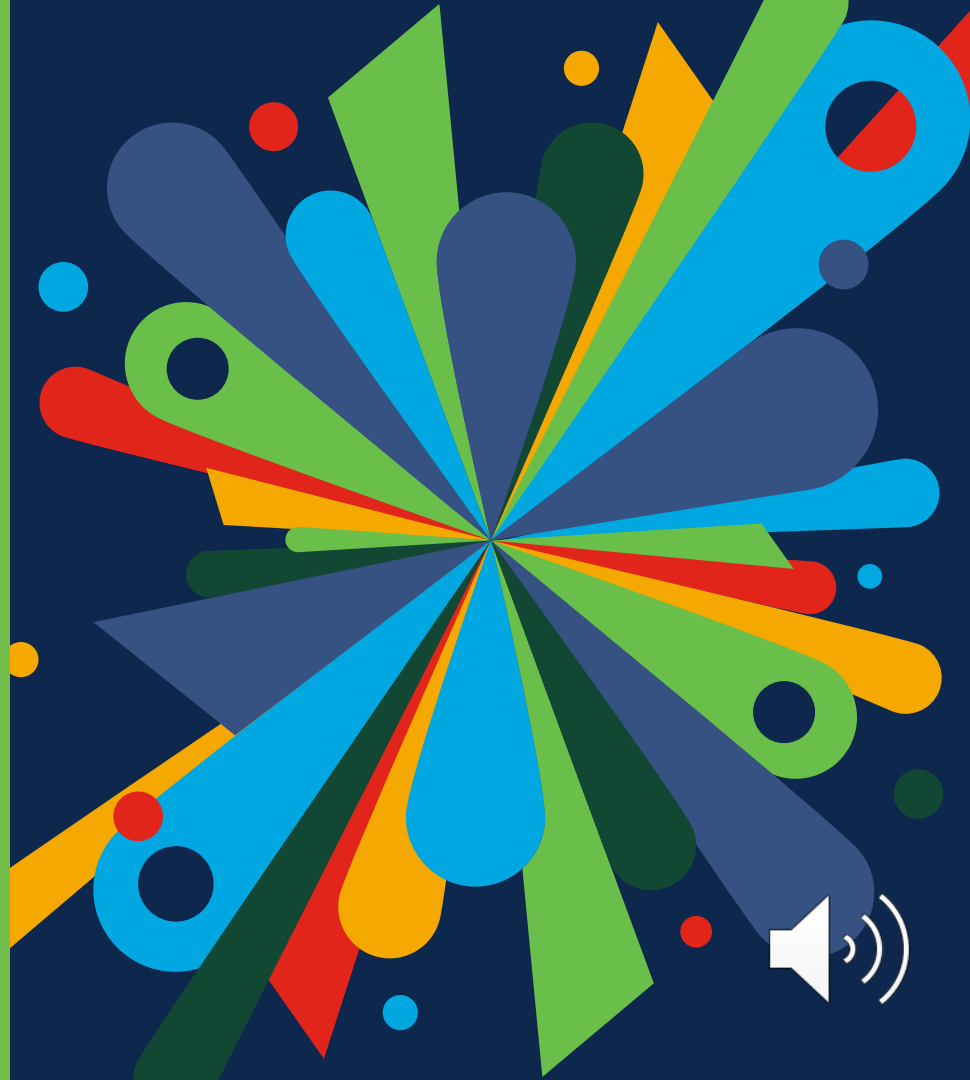
Enterprise view of 5G

Q: How important is 5G availability / coverage to your company's future business plans/ strategy?

Q: At what stage is your organization with respect to considering 5G for its future enterprise connectivity needs?
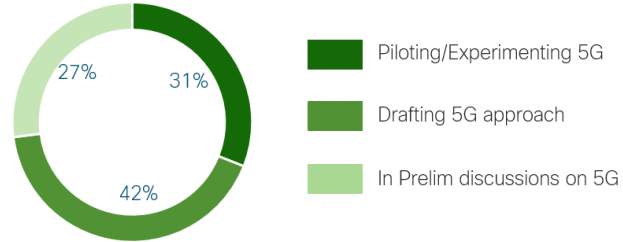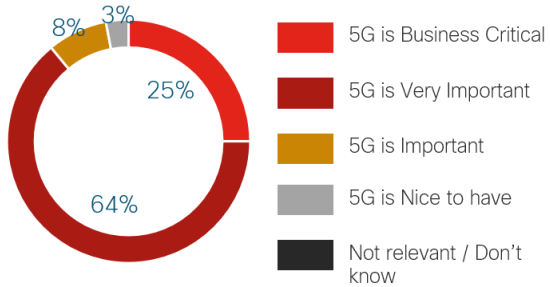

3%
8%
25%
64%

- 5G is Business Critical
- 5G is Very Important
- 5G is Important
- 5G is Nice to have
- Not relevant / Don't know

31%
27%
42%

- Piloting/Experimenting 5G
- Drafting 5G approach
- In Prelim discussions on 5G

~ 50 Interviews:

Enterprise C-level Business executives / CIOs

Industry analysts

Followed By

~1,300 Survey of IT & LOB Decision Makers
Global survey: 11 countries across the Americas, EMEA, APJC

US	Can	UK	Ger	Itly	Jap	Kor	Chn	Aus
300	100	100	100	100	100	100	100	100

#CiscoLive

The two next generation wireless technologies
…..in the context of Private Networks

	Wi-Fi 6	5G
Spectrum	Unlicensed: 2.4 GHz, 5 GHz, 6 GHz (in the future) International with regional regulations	Per country e.g Germany 3.7-3.8, UK 3.8-4.2 (Band n77) Local License & rules but not always available
Radio	OFDMA, Massive MIMO & Beamforming	
Infrastructure	1024 QAM Self contained Access Points no complex transport WLC control plane only	256QAM, mixed numerology within carrier RUs with complex sync requirements on transport (PTP) CNF based Packet Core both control and user plane
ID/Authentication	Typically enterprise ID and Authentication	ID: SUPI & SUCI mechanism (address 3/4G vulnerabilities) Auth: EAP-AKA or 5G-AKA
Air I/F Security	Encryption: Galois/Counter Mode Protocol(GCMP-256) Key HMAC-SHA384	Encryption: SNOW 3G, AES-CTR, and ZUC. Key AHMAC-SHA-256.
Targeted Use Cases	High Data Rates, Massive IoT, Low Latency	EMBB, mmTC, URLLC

Key Factors Influencing Move to 5G

Spectrum
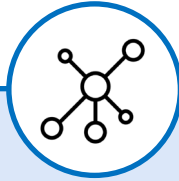
Clean/Reduced Interference

Higher Power Tx/Rx (Fewer Radios)
Physical separation for Mission Critical Apps

Mobility

Macro Coverage

Robust Mobility More "Seamless"

Standardised "Roaming"

Security

SIM based Identity and Authentication

Vertical Market Focus

Release 16 and beyond capabilities
mmWave
URLLC
mmTC
NIN
TSN Int
5G LAN

Other Influences

Digitization
Increase efficiencies, new working methods, automation and insights

New Business Models
Reduce/manage cost, simplification, aaS etc

New Consumption Models
Enterprise Managed or MNO Managed

CXO Level Interest
Direction from the board of directors to the IT/OT department

Industrial IoT	**Hospitality**	**Public Venues**	**Retail**	**Healthcare**

Verticals for Use cases / monetization

Potential new service creation opportunities for Enterprises

Manufacturing

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

Industrial Sites

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

EMBB

- Data Shower
- Surveillance Cameras
- AR/VR
- AGV

URLLC

- Process control and automation
- Non IP Protocols
- Remote Expert

mMTC

- Sensor Networks

Optimised for **THROUGHPUT**	Optimised for **LATENCY & RELIABILITY**	Optimised for **DENSITY**
TARGET: 10-20 Gbs (mmWave)	TARGET: 1ms (one way RAN)	TARGET: 1M per sq km
USE CASE: 100Mbs	USE CASE: 10ms	USE CASE: much less

Factors driving technology choice

WiFi -> WiFi 6
- General Purpose
- Local Data Mobility
- Self-Management
- Streaming Media

4/5G Private Shared (2.5–4.2Ghz)
- General Purpose
- Local Data Mobility
- Self-Management
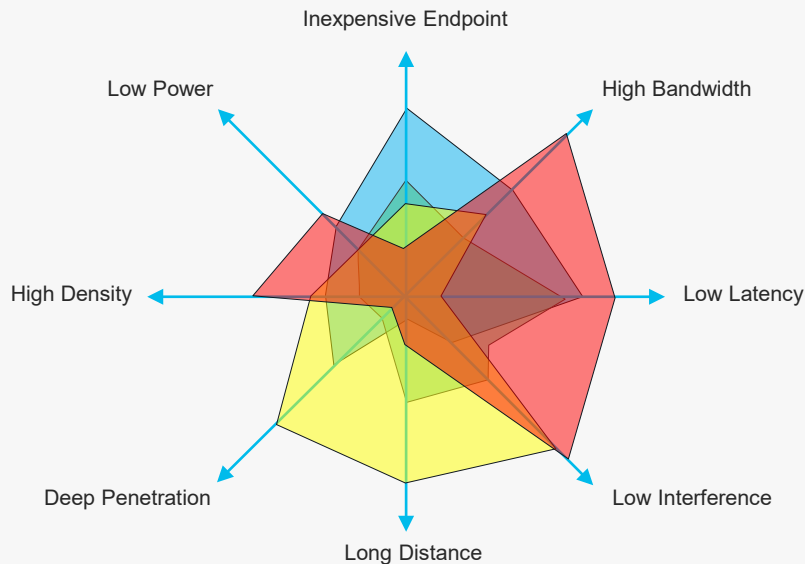- Interactive Media

5G mmWave
- Fixed Wireless
- Wireless Backhaul
- Interactive Media
- Network Slicing

Carrier LTE-A / 5G Sub-6Ghz
- Macro Mobility
- Protected Coverage
- Voice and Messaging
- Streaming Media

User Data Profiles

Radar chart axes: Inexpensive Endpoint, High Bandwidth, Low Latency, Low Interference, Long Distance, Deep Penetration, High Density, Low Power

Clear differences between WiF6 & 5G

Neutrality	Data Perimeter	Device Support	Consumption	Cost
Global compatibility – BYOD, Guest **No Lock-In**	Enterprise has full control over data perimeter	WiFi6 Aps can support previous generation devices	Any consumption model possible DIY, aaS, MS. No spectrum dependence	Lost cost devices and low cost infrastructure
Geo specific bands with device **Lock-In** to carrier	Depends on if Private network or if SP service what SP offer	4G devices **not compatible** with 5G networks	Models driven by availability of spectrum	Higher cost devices and higher cost, more complex, infrastructure

Overview

Design, manufacture and assemble precision forged and machined components for companies lie Airbus, Boeing and Rolls Royse. Applications:
- 4K video streaming
- large scale file transfers,
- messaging and voice/video communications
- initial stage of IoT sensor and AR testing

Cisco Solution

WiFi6 & LAN Infrastructure including
- Catalyst 9100 access points
- WLC
- POE Catalyst switches)

Benefits/Results

In extremely challenging Radio environment achieved
- 700Mbit/s throughput with 80MHz channels
- <6ms end to end latency for video streaming and calling
- WiFi roaming for real time applications
- AR use cases for real time walk by monitoring

"The Wi-Fi 6 infrastructure installed as part of the trials has exceeded our expectations in terms of performance reliable connectivity and consistent coverage across the target area"
Dave Green, Head of IT

Cisco Strategy

: 5G and Wi-Fi 6 are complementary

Flexibly deploy both WiFi 6 -and- 5G

Wireless Technology	Enterprise 5G	5G or WiFi 6E	WiFi 6 (802.11ax)
Optimized For	Reliable Coverage, Ultra-Low Latency, Consistent Handover, Consistent QoS	Clean Spectrum, High Data Rates, Low Latency	Capacity, Client Density, Mobility Moderate Latency

Primary Use-Cases

Wide Area Coverage
Large indoor and outdoor coverage (10,000+ sqft per cell)

Process Automation
Five-9's to Six-9's HA & SLA
E2E latency ≤10ms

Automated Guided Vehicle
Eliminate Interference
Roaming delays of ≤ 50ms w/ 5G

Enhanced Mobile Broadband
2Gbps+ download file transfers and immersive experience

Digital Health
Advanced care through Tele-medicine and mobile health

Digital Campus
AR/VR/MR-based Education and expanded E-learning
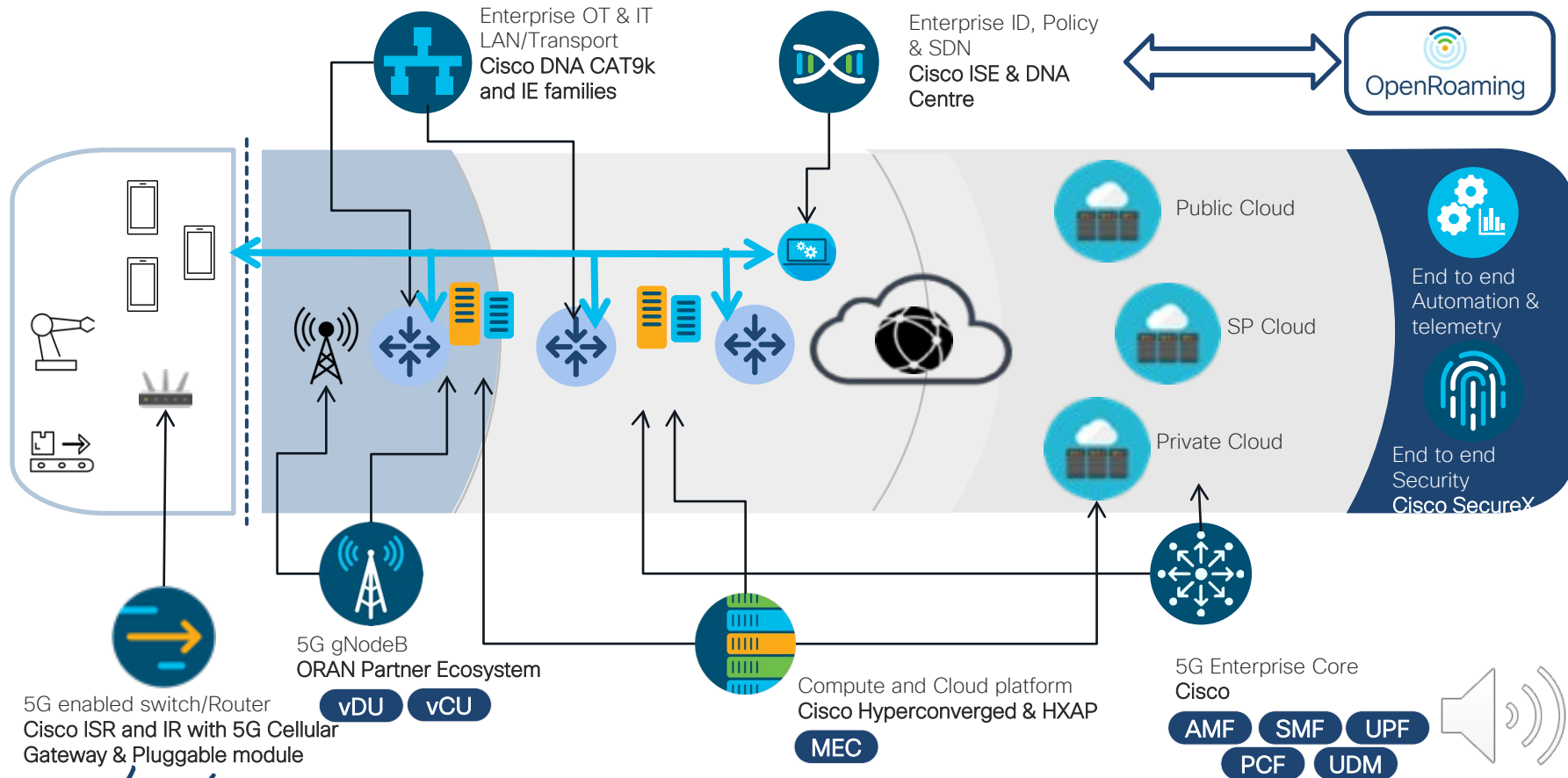
Performance | IOT Scale | Capacity | Security

Enterprise 5G Will Requires Cross Domain Leadership

Enterprise OT & IT LAN/Transport
Cisco DNA CAT9k and IE families

Enterprise ID, Policy & SDN
Cisco ISE & DNA Centre

OpenRoaming

Public Cloud

SP Cloud

Private Cloud

End to end Automation & telemetry

End to end Security
Cisco SecureX

5G gNodeB
ORAN Partner Ecosystem

vDU · vCU

5G enabled switch/Router
Cisco ISR and IR with 5G Cellular Gateway & Pluggable module

Compute and Cloud platform
Cisco Hyperconverged & HXAP

MEC

5G Enterprise Core
Cisco

AMF · SMF · UPF
PCF · UDM

Enterprise 5G – Flexible vRAN Deployment
Considerations for latency, scale or mobility
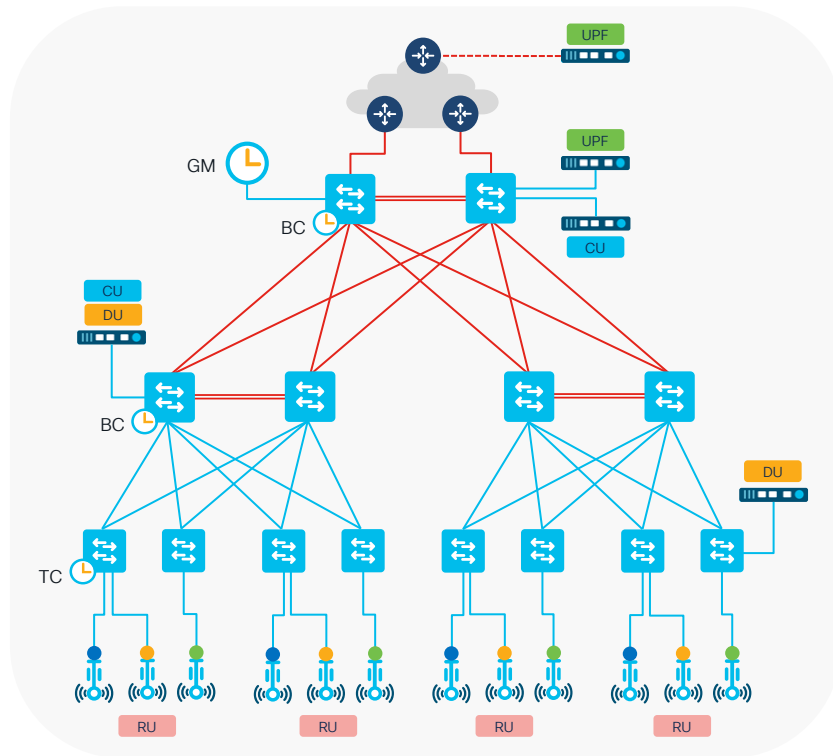
Latency

- Split the CU & DU and move **DU closer to the RUs**
- **Access for lowest latency** or Distro medium or Core high
- **Local UPF for lowest latency**, Remote for medium-high

Scale

- Split the CU & DU and centralize compute nodes
- Distribution for medium scale or **Core for highest**
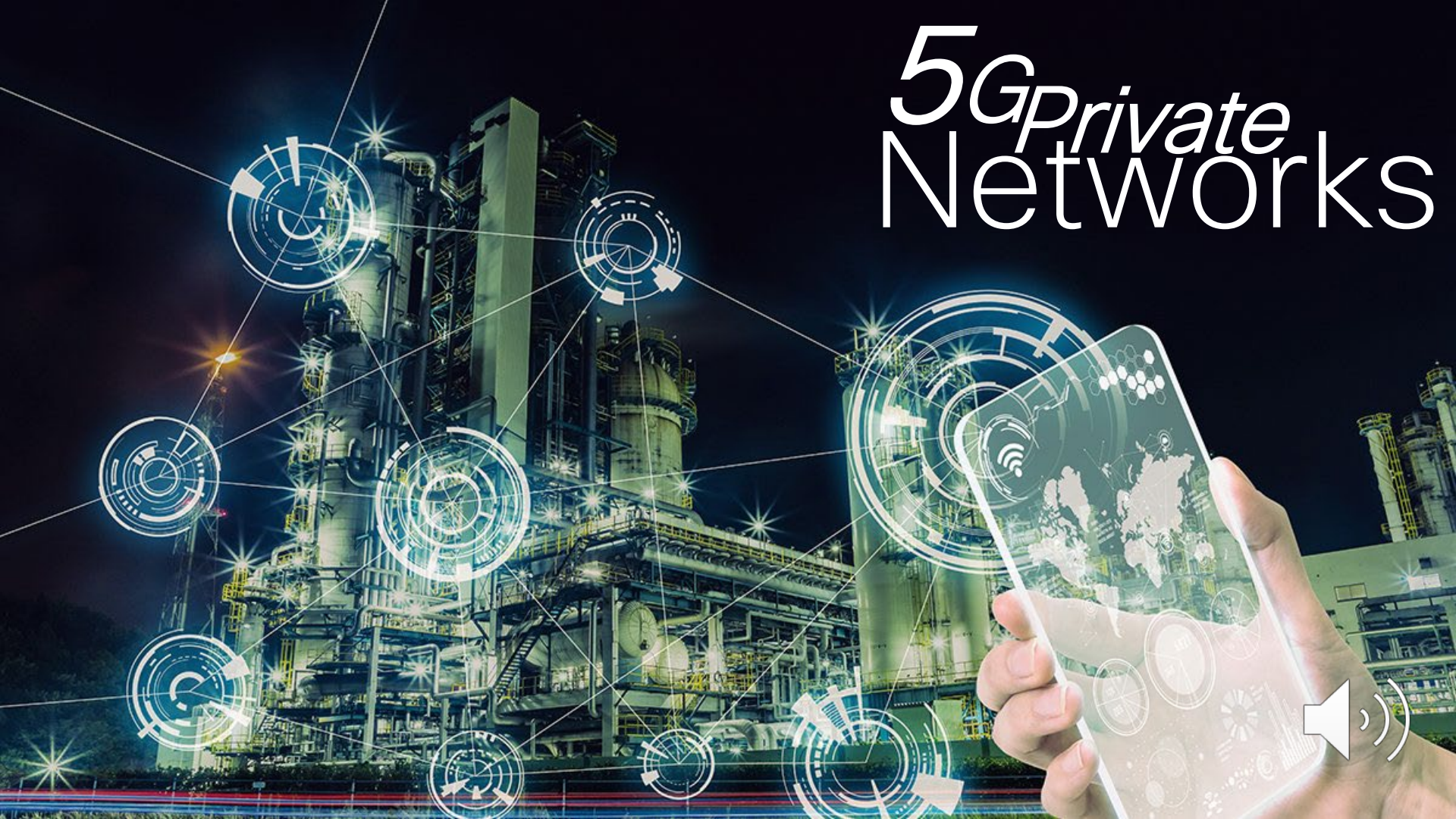- **Local UPF for highest scale**, Remote for small-medium

Mobility/Cost

- **Combine CU/DU** to cover multiple groups of RUs
- Distribution for medium mobility or **Core for highest**
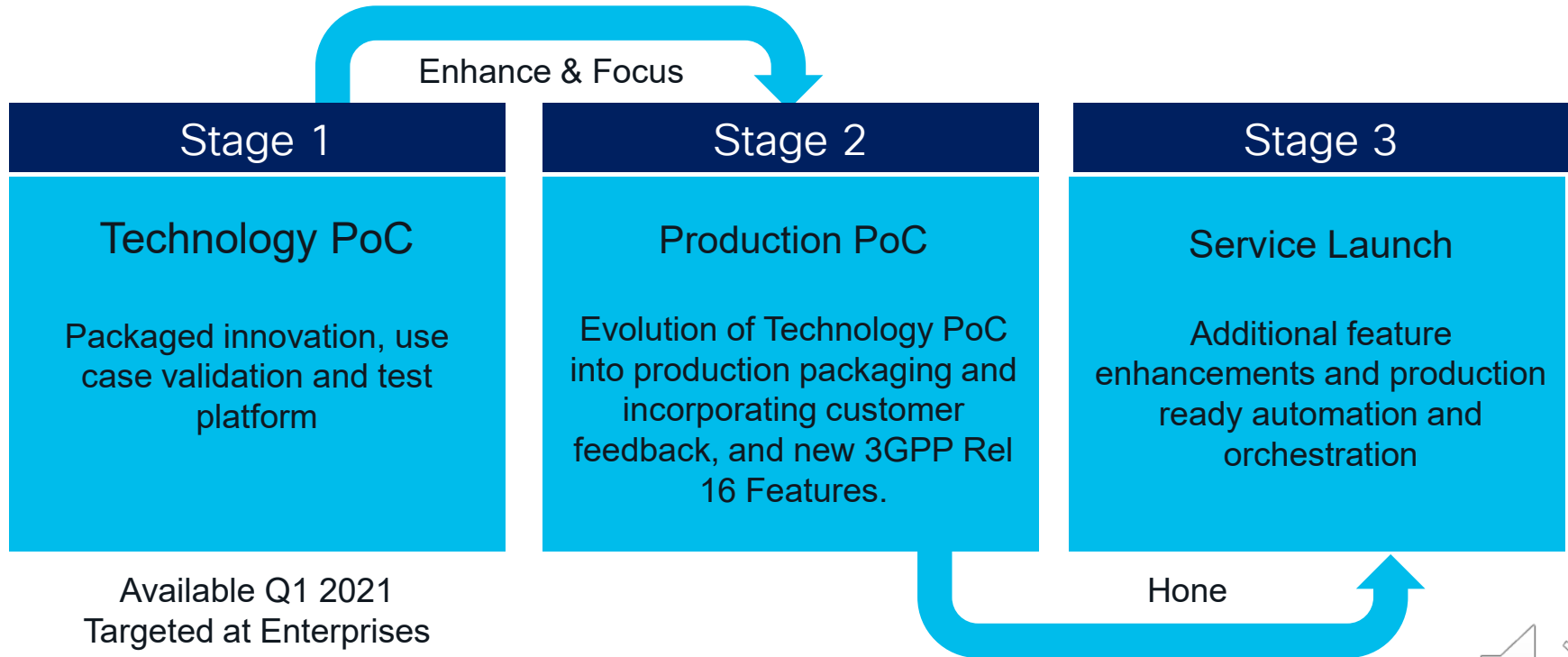- **Local UPF for highest mobility**, Remote for small-medium

Distributed
(Split)

Centralized
(Combined)

5G *Private* Networks

Path to production

Enhance & Focus

Stage 1	Stage 2	Stage 3
Technology PoC	**Production PoC**	**Service Launch**
Packaged innovation, use case validation and test platform	Evolution of Technology PoC into production packaging and incorporating customer feedback, and new 3GPP Rel 16 Features.	Additional feature enhancements and production ready automation and orchestration

Available Q1 2021
Targeted at Enterprises

Hone

Three Approaches to 5G Private Networks

Full Private Deployment

Mgmt & Orch

Mgmt & Orch

Local or SP Spectrum

5G CNFs

AMF SMF UPF
PCF UDM xxF

gNode B

Enterprise LAN

Edge Router & FW

Public, Private or SP Cloud
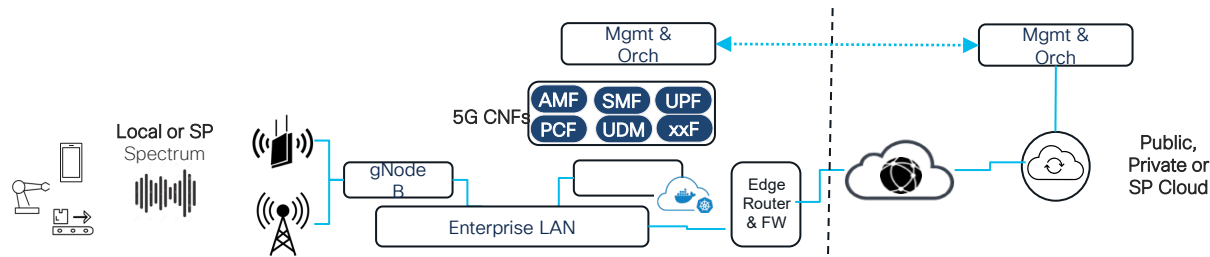
Hybrid Cloud Private Deployment

Local or SP Spectrum

EDGE PoD

AMF SMF PCF UDM

UPF

yyF

Mgmt & Orch

gNode B

Enterprise LAN

Edge Router & FW

Public, Private or SP Cloud
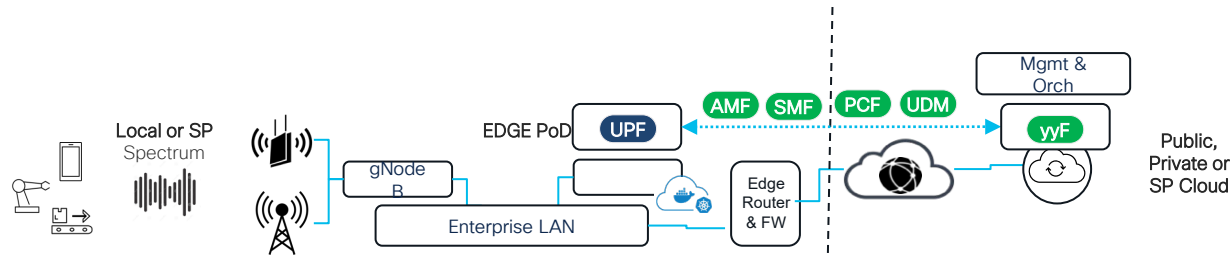
Macros Slice Deployment

"Enterprise" Slice

SP Spectrum

gNode B

UDM

NSSF

AMF

SMF UPF PCF

SMF UPF PCF

Enterprise Traffic

Public "Consumer" Slice
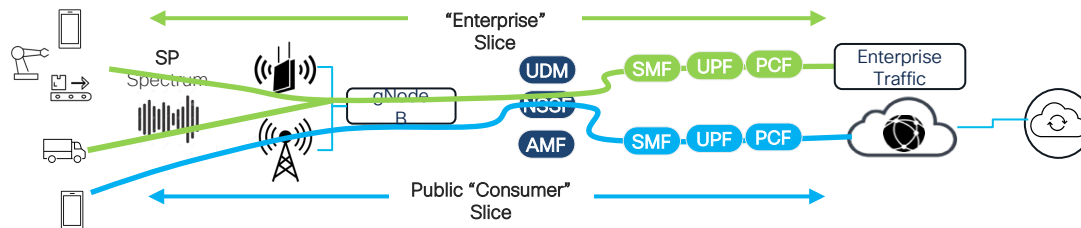
Cisco Private Cellular – Hybrid Cloud
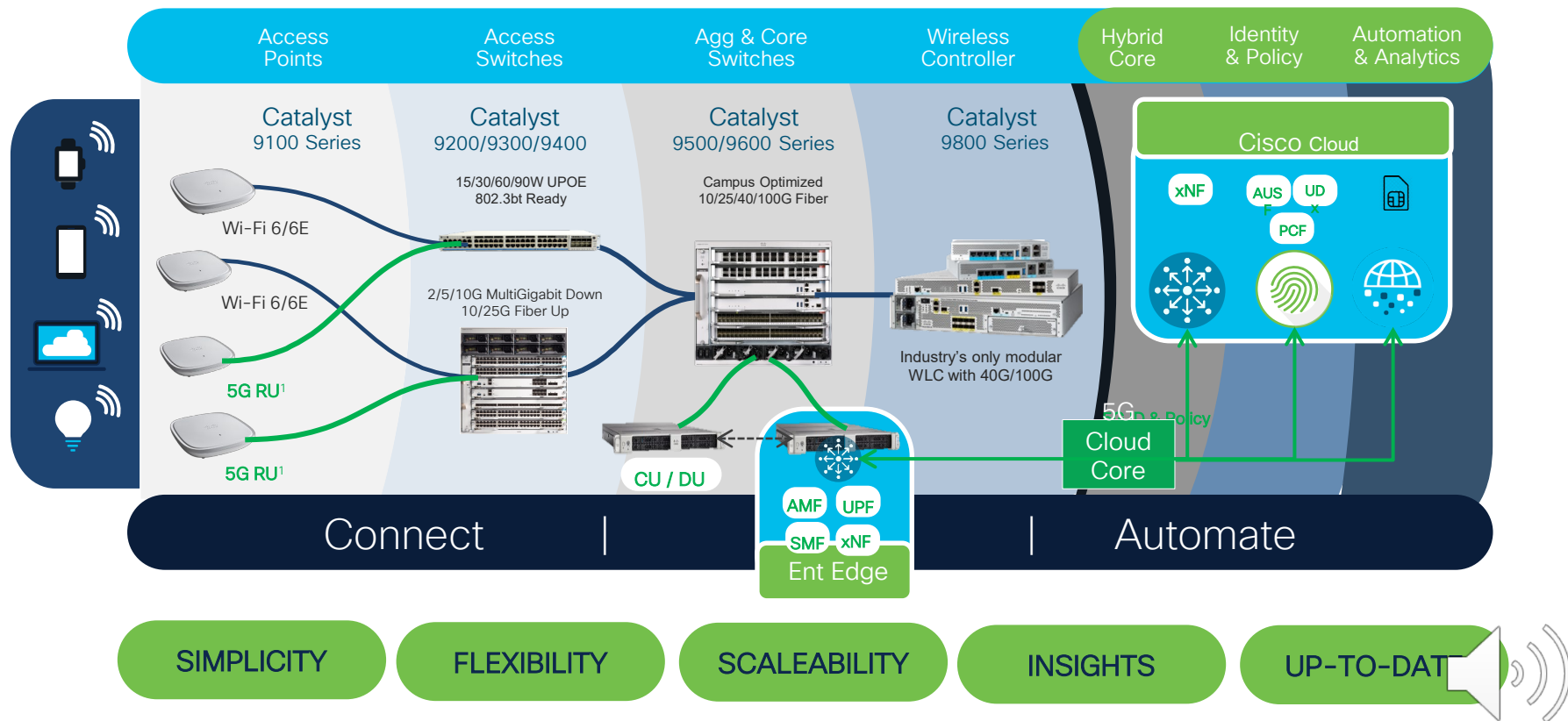
Access Points	Access Switches	Agg & Core Switches	Wireless Controller	Hybrid Core	Identity & Policy	Automation & Analytics

Catalyst 9100 Series

Catalyst 9200/9300/9400

Catalyst 9500/9600 Series

Catalyst 9800 Series

Cisco Cloud

xNF   AUSF   UDX   PCF

15/30/60/90W UPOE
802.3bt Ready

Campus Optimized
10/25/40/100G Fiber

Wi-Fi 6/6E

Wi-Fi 6/6E

2/5/10G MultiGigabit Down
10/25G Fiber Up

Industry's only modular
WLC with 40G/100G

5G RU[1]

5G RU[1]

CU / DU

5G

Cloud Core

AMF   UPF
SMF   xNF
Ent Edge

Connect | **Automate**

SIMPLICITY   FLEXIBILITY   SCALEABILITY   INSIGHTS   UP-TO-DAT

cisco Live!

Cisco Control Centre for IoT

Devices

Service Provider Networks

Deep Network Integrations

Cisco IoT Control Center

Core capabilities

Lifecycle automation

Analytics and diagnostics

Comprehensive security

Cost management

Backend integration

Private 5G · NEW

Global API

Intuitive UI

Enterprise backend integration

CRM — Traditional IT

MDM — Traditional IT

ERP — Traditional IT
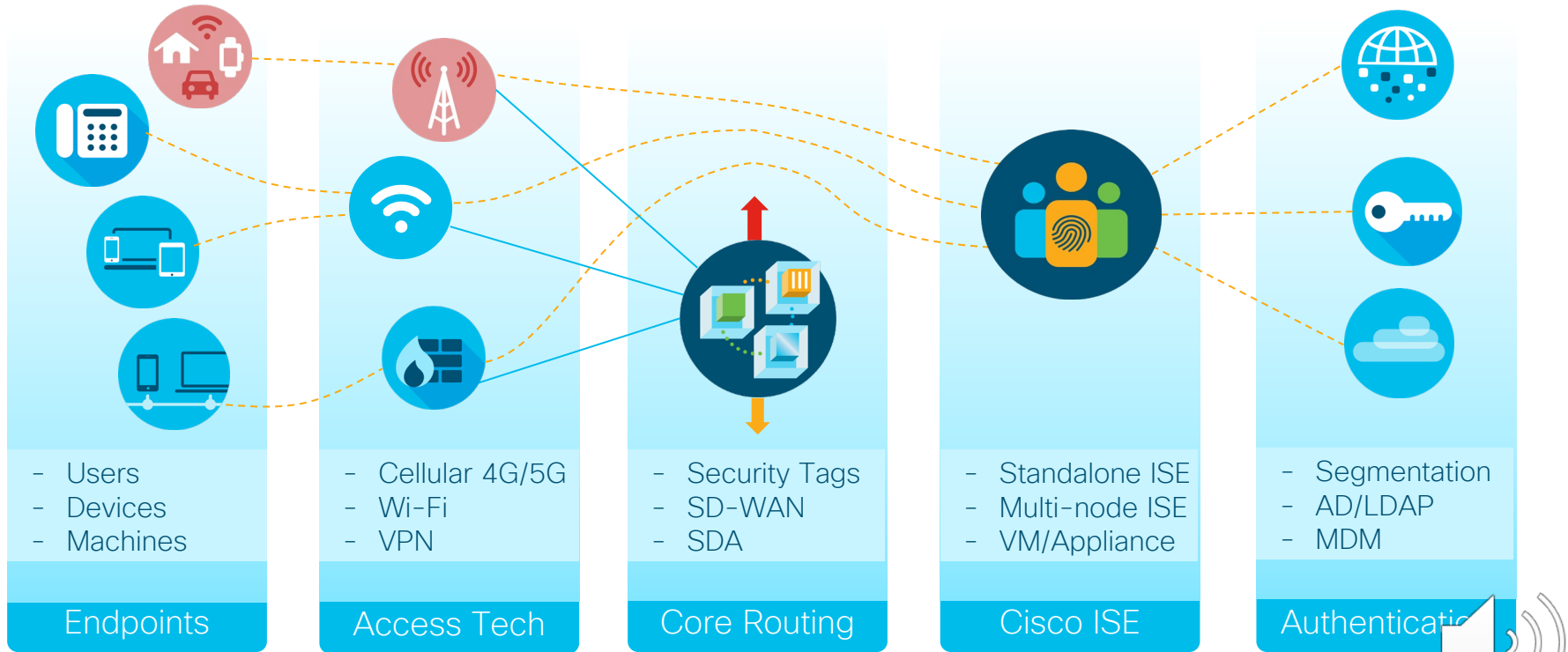
R&D

Operations

Finance

Partners

50+ Service Providers
30,000+ Enterprise Customers

165M+ Connected Devices
4M+ new devices connected per month

Market Leader for the Connected Car Vertical

Integrating 5G Access to Enterprise SDN

Endpoints	Access Tech	Core Routing	Cisco ISE	Authentication
– Users – Devices – Machines	– Cellular 4G/5G – Wi-Fi – VPN	– Security Tags – SD-WAN – SDA	– Standalone ISE – Multi-node ISE – VM/Appliance	– Segmentation – AD/LDAP – MDM

Summary & Close

CISCO *Live!*

Summary & Close

- It is **very early days with 5G and Enterprise applications** – technology and use cases will evolve and mature over next few years

- Cisco are uniquely positioned to get **both an SP and Enterprise view of Private xG** and the evolution of the Enterprise Network

- **We have unique insights e.g.**
  - The way very large industrial enterprise want to consume may not be aligned with current SP offers & GTM
  - Enterprise integration along with control and visibility will be key

- Our strategy is not bound to any particular access technology more focused on **the right technology for the use case**

- Cisco's approach is **different**
  - Integrate into Enterprise DNA and cater for enterprise owned offers
  - Leverage technology and experience with SP Mobility platforms and Managed Enterprise services to meet customer needs
  - Leverage the cloud and "aaS" delivery models with continuos development and integration

Thank you

TURN
IT
UP

CISCO Live!

#CiscoLive