5G Monetization and Edge Transformation

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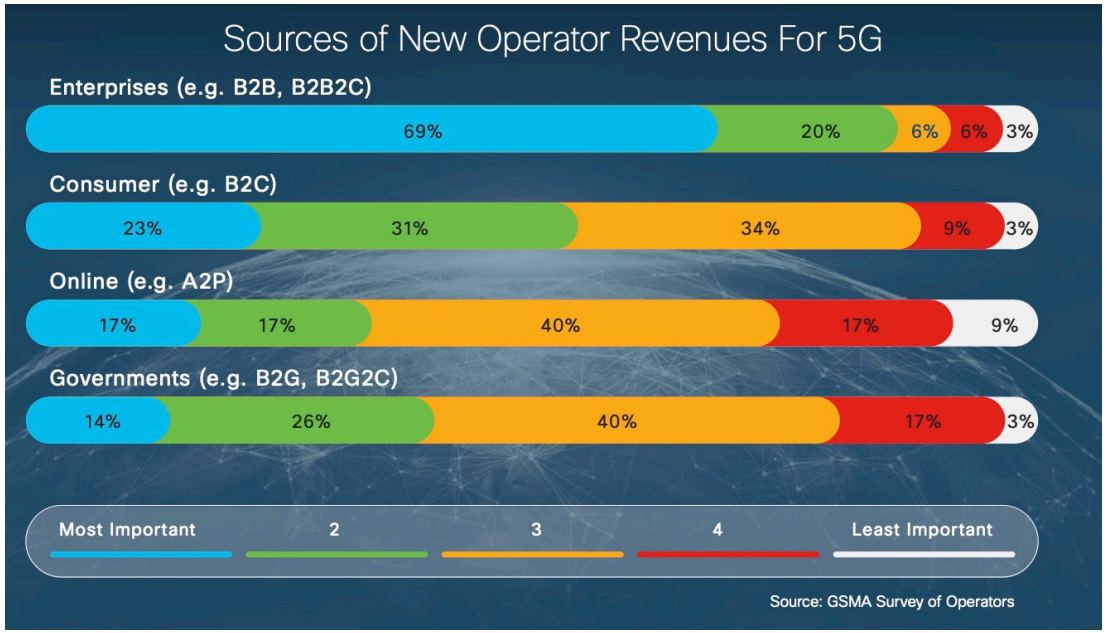
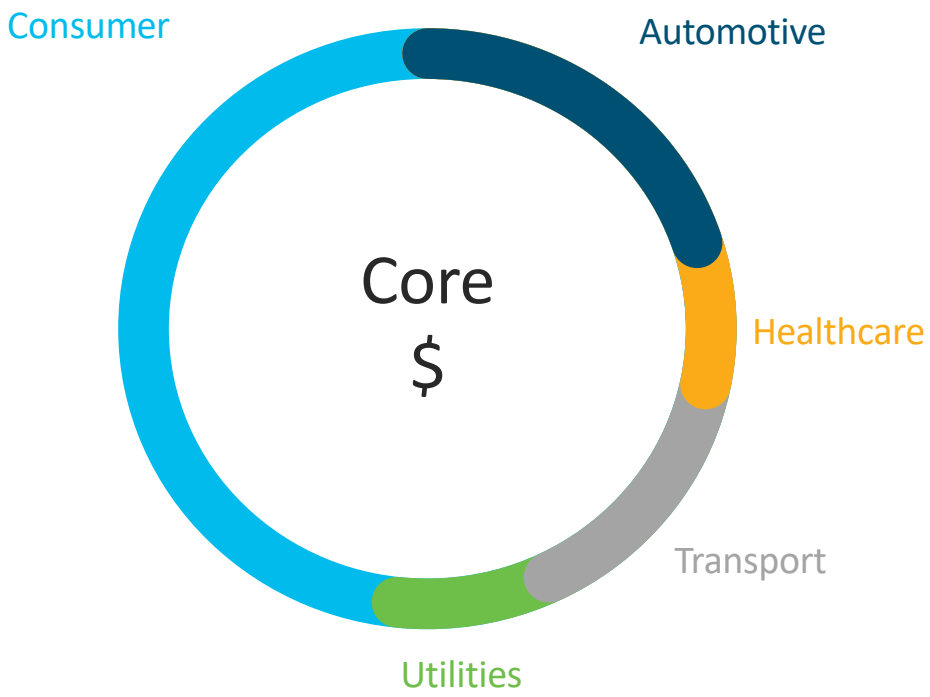
Market Expectation from 5G

Service Providers



GSMA Survey to SP: Source of revenue growth expectation for 5G by service providers



2025

Vertically targeted services will accelerate operator business growth

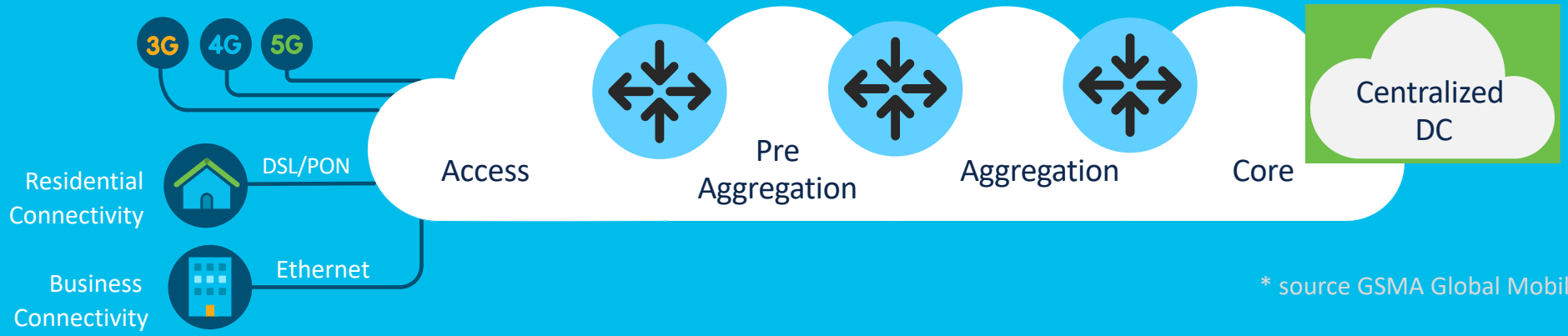
Source: European Commission Report

Making 5G Profitable with Enterprise

69%

of SP CEOs Agree*

Enterprises are Key to Monetizing



* source GSMA Global Mobile Trends 2018

5G Architecture Evolution

For distributed, agile infrastructure & services

remove complexity and lower OPEX

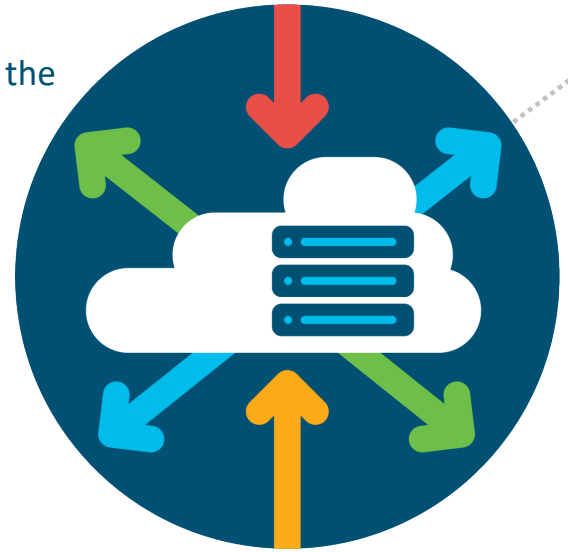
collaborative ‘service mesh’ matching resources to the dynamic needs of the mobile network

scale flexibility with cloud

dynamic microservices built for visibility, fine-grained control and service continuity

reduce time-to-value, fast-fail innovation

flexible architecture speeds deliveries with CUPS, network slicing and 4G/5G integration



90%
TTM improvement

20x
performance 400Gbps/server

> *“We can further our 5G plans with more flexibility and agility to deliver new services to our customers”*

Neville Ray, CTO, T-Mobile

5G RuralFirst telenor kt

Example of Verticals Benefiting from 5G

Transportation
Autonomous Vehicles
Automotive

IOT

Augmented Reality
Virtual Reality

Smart City
Traffic Management
Emergency Services

Manufacturing
Robotics
(Industry 4.0)

Tactile Internet

Health
Fitness & Healthcare

Smart grid
Utilities

Government

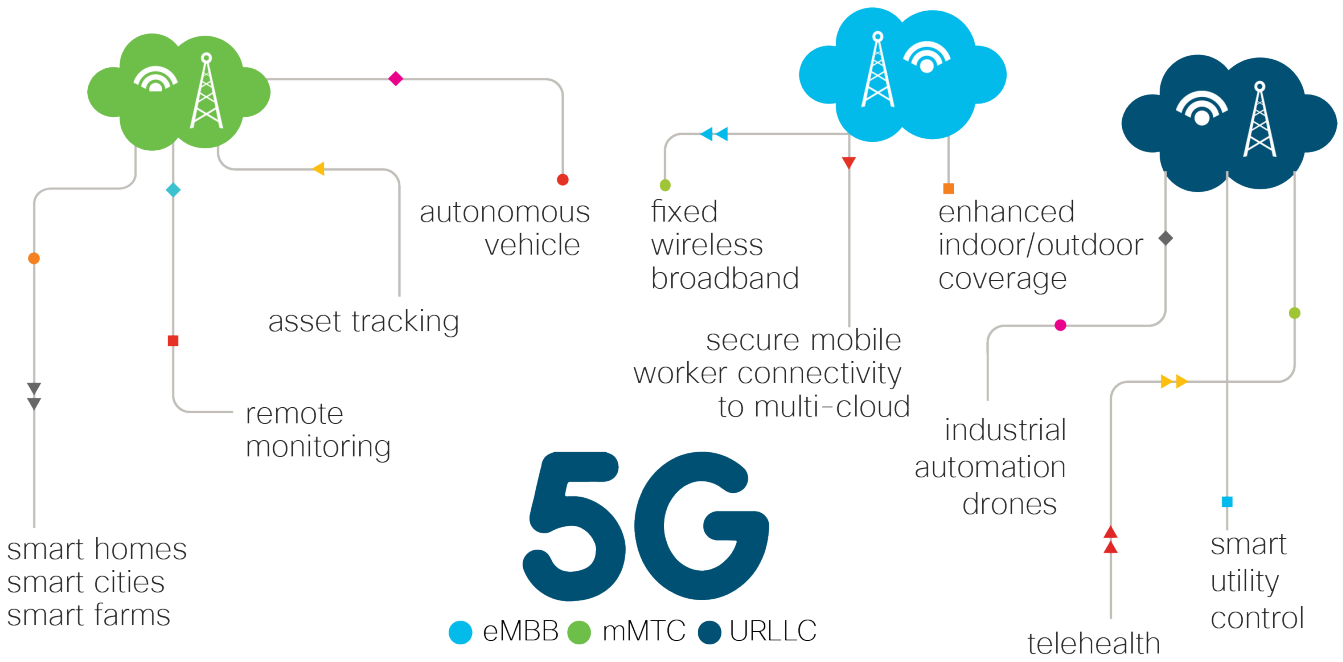
Smart Office

Building Value Added Solutions for Enterprise Beyond Connectivity

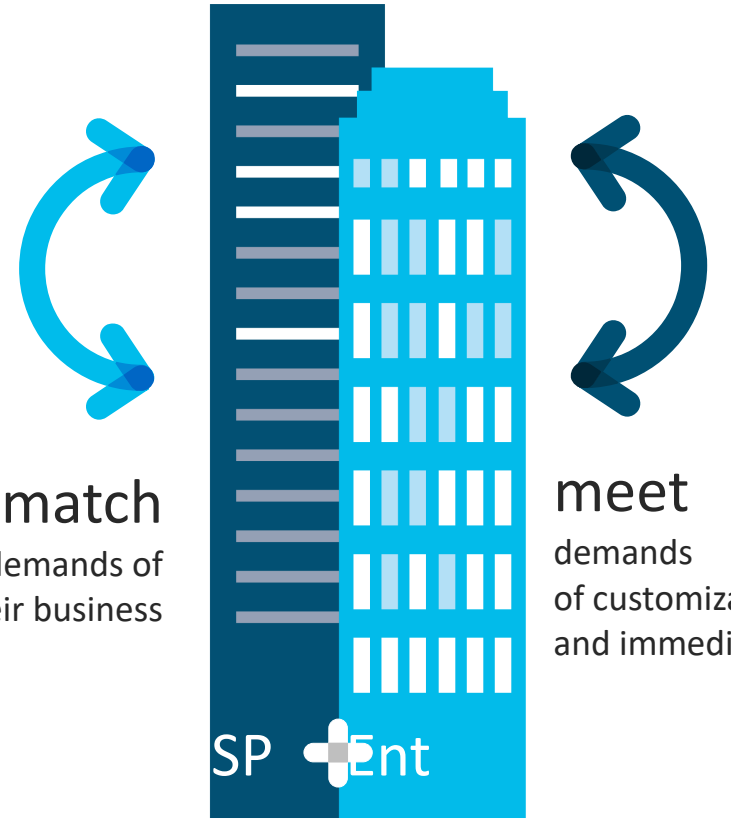
Enterprise 5G Opportunities

Pursuit of Productivity

through digitization



Greater Expectations



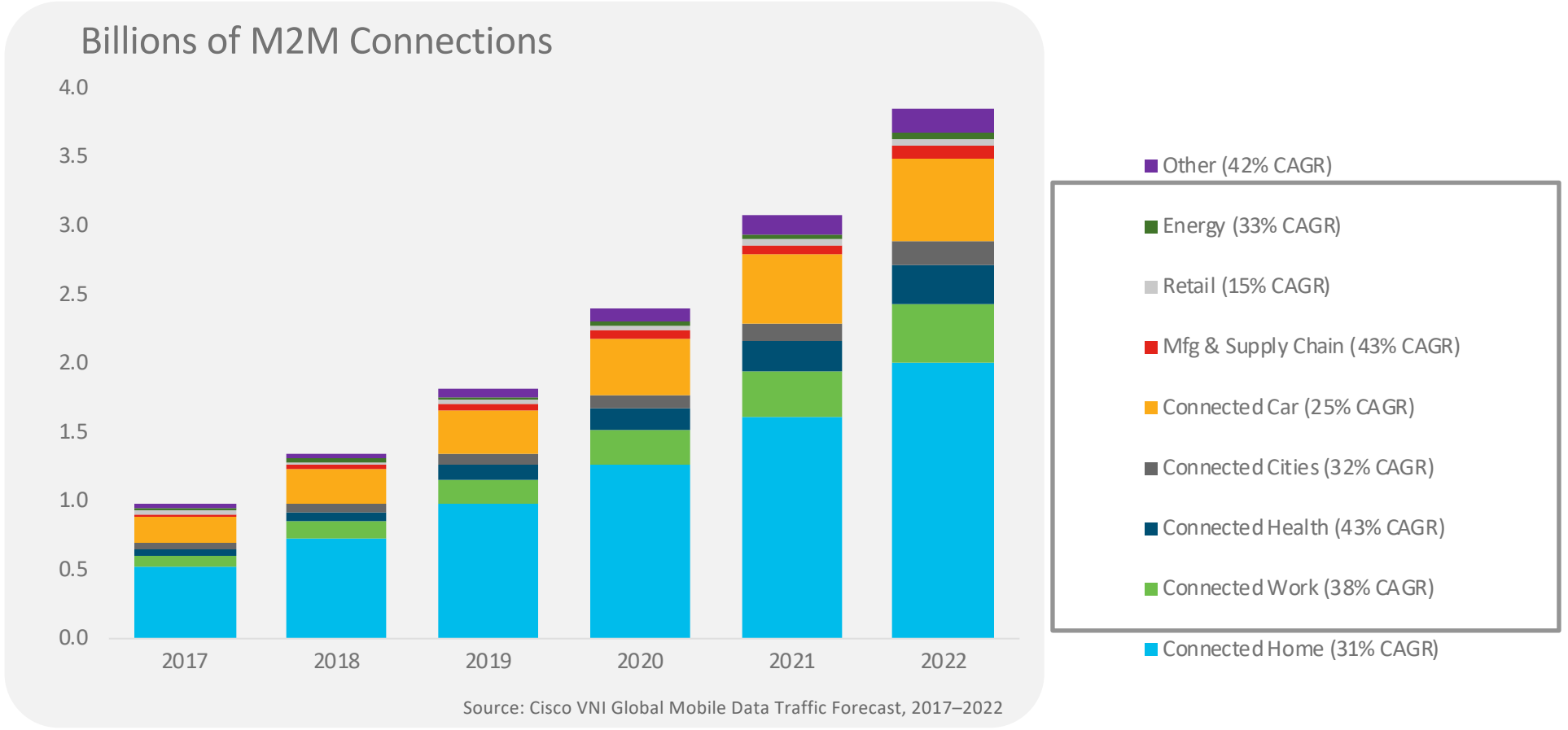
match
the demands of their business

meet
demands of customization and immediacy

Expanded relationship

of transparency and integration

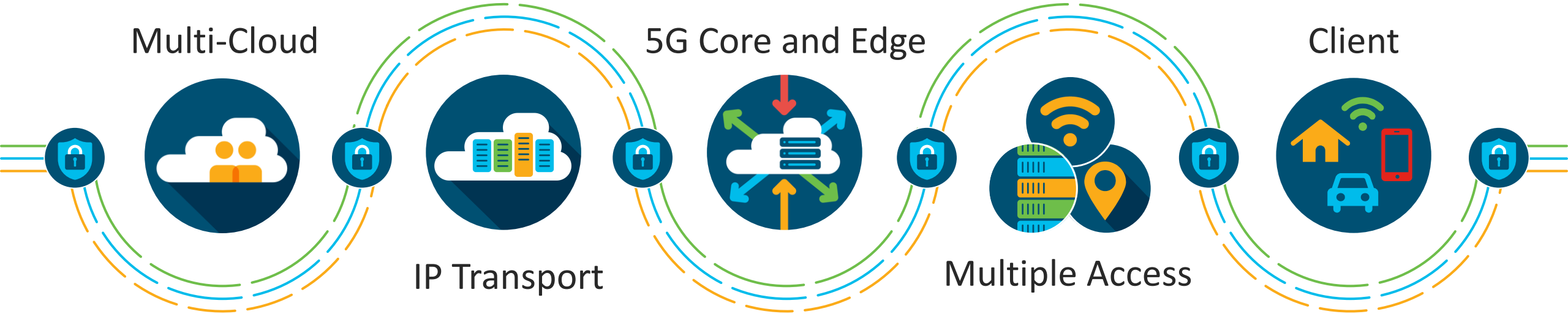
m2m Driving New Service Opportunities



Source: Cisco VNI Global Mobile Data Traffic Forecast, 2017–2022

Cisco 5G and Enterprise Vision

Cisco 5G Architecture



Accelerate Automation

Decentralize Data Center

Proliferate Peering

Shift Subscriber Services

Converged Connectivity

Secured Trusted

Cisco Innovations for Enterprise

Multi-Access w/ Seamless Mobility

(5G NR, WiFi6, OpenRoaming)

Network Exposure and Slicing

(Mobile Network as a Service)

New Flexible Deployments

(MEC/Edge, Control User Plane Separation)

Mobile SDWAN

(as a Service)

Edge Services

(Secure Internet Gateway)

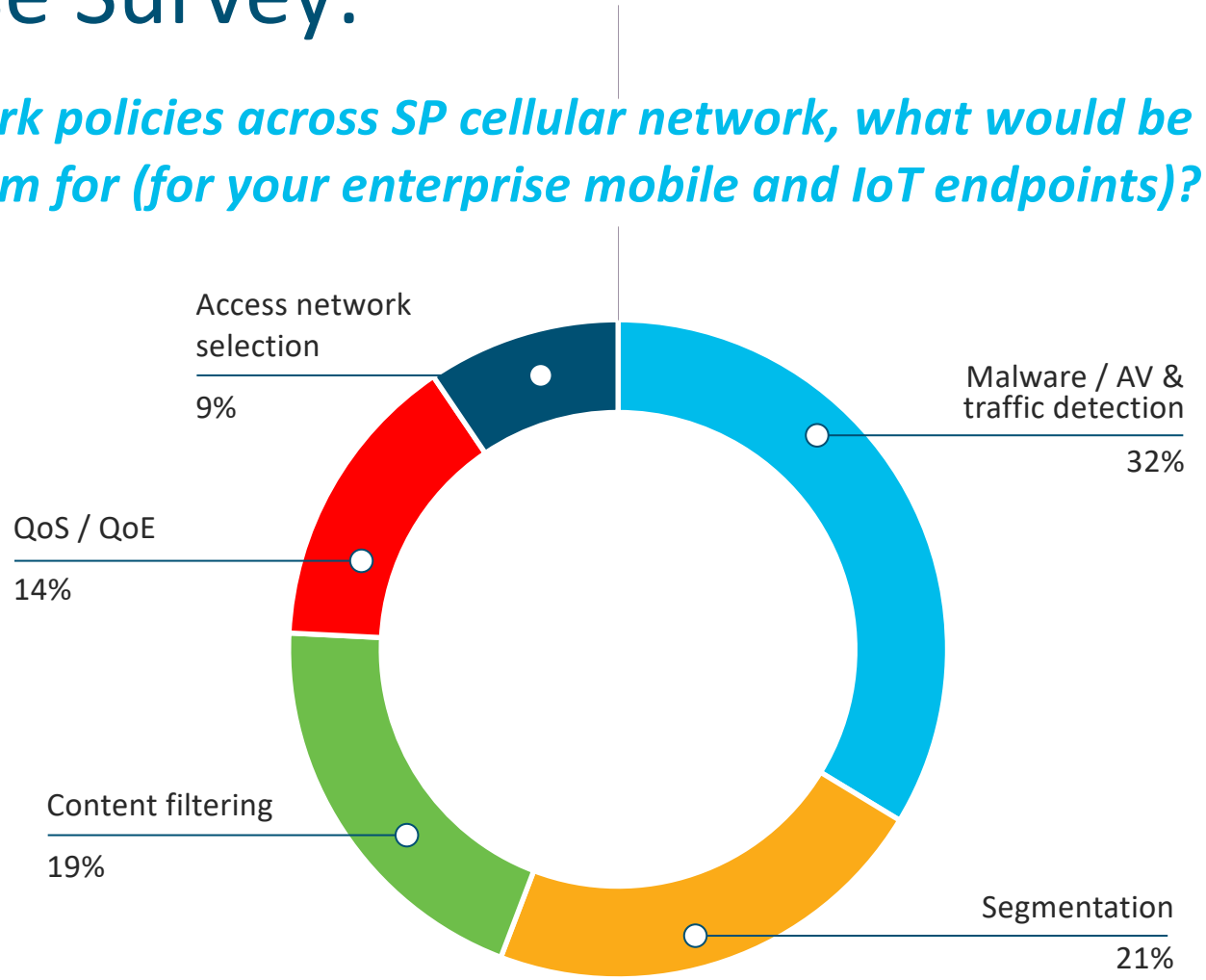
Extending Intent Based Networking

Cisco Conducted Enterprise Survey:

Q42. If you could extend your enterprise network policies across SP cellular network, what would be the top 2 services that you would pay a premium for (for your enterprise mobile and IoT endpoints)?

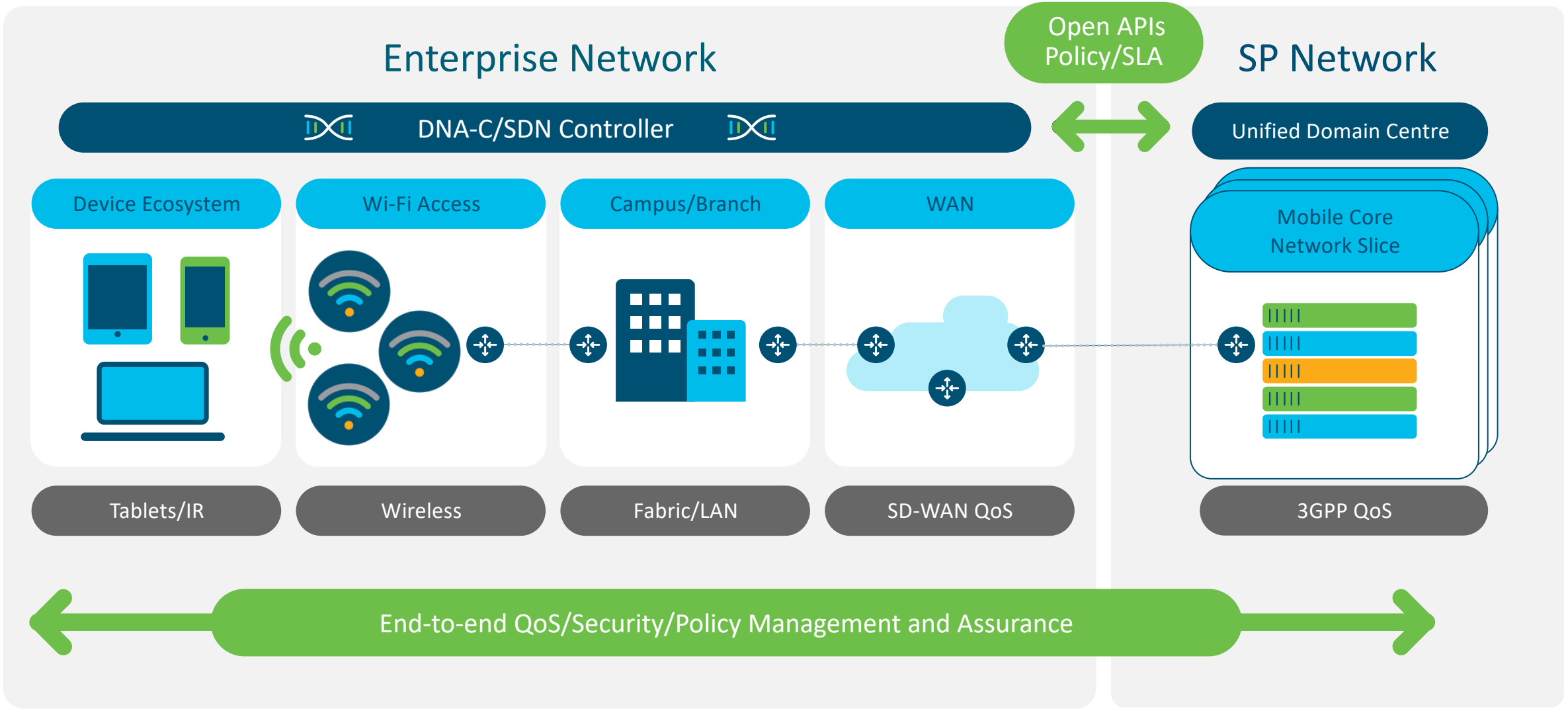
Enterprise would pay premium in order to extend their control of their network to the carrier network

Services in order of selection when Enterprise Network policies are extended across SP cellular network (%)



Extending Intent-based Networking

Policy management across heterogeneous networks



Use Cases
Enterprise services will drive 5G’s incremental potential

Industrial Verticals have the most challenging requirements due to their complex applications and use cases

Public and Private 5G:
Private 5G embedded into Enterprise Infrastructure

Wirelessly integrate security

Local MEC cloud
improved responsiveness
Local IOT preprocessing
5G Infrastructure

Wireless enabled automated production line

5G Enabled Digital Platform

Wireless enabled automated warehousing

Wireless enabled automated logistic loading

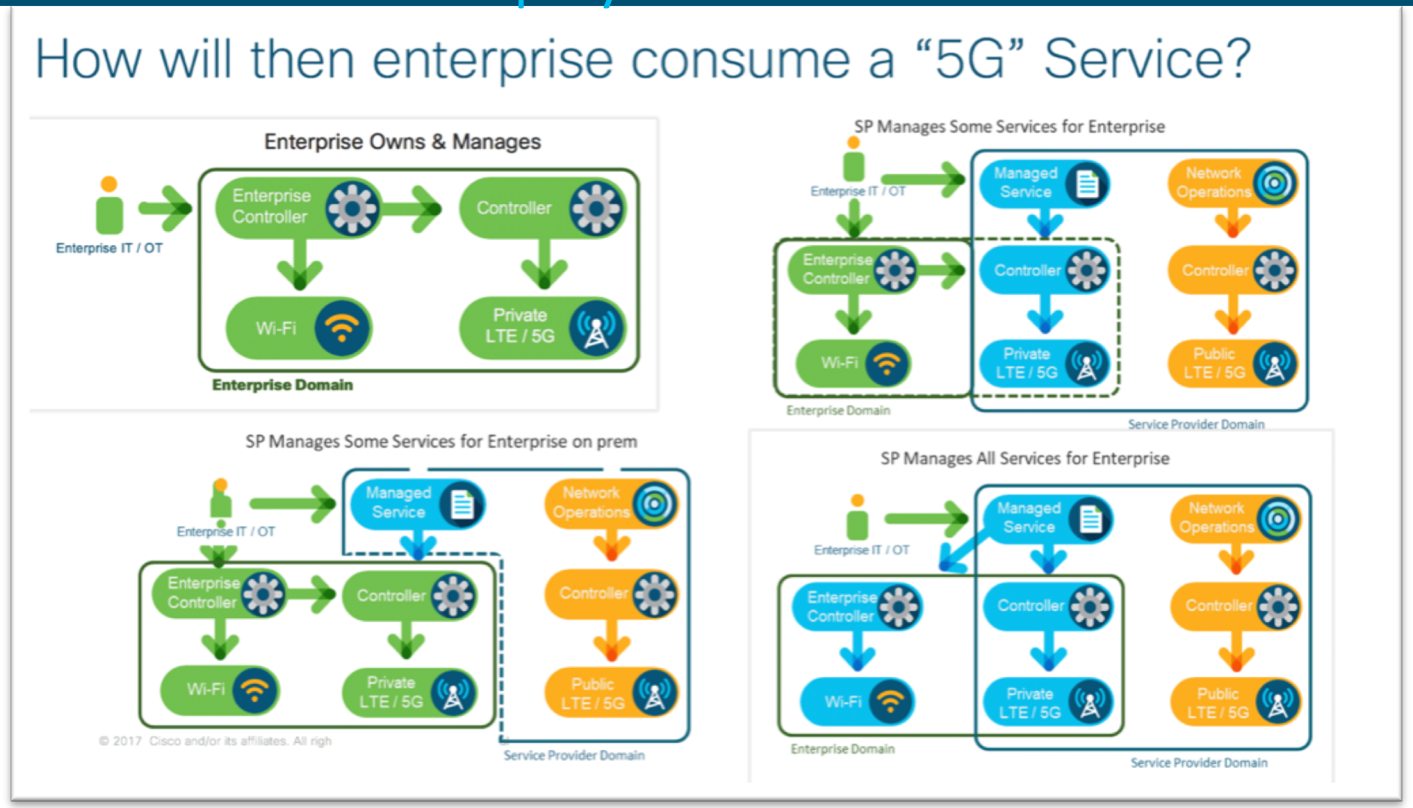
Private 5G/LTE: Enterprise or SP Hosted ?

Enterprise Hosted & Managed

Many other Flavors

SP Hosted & Managed

Deployment Models



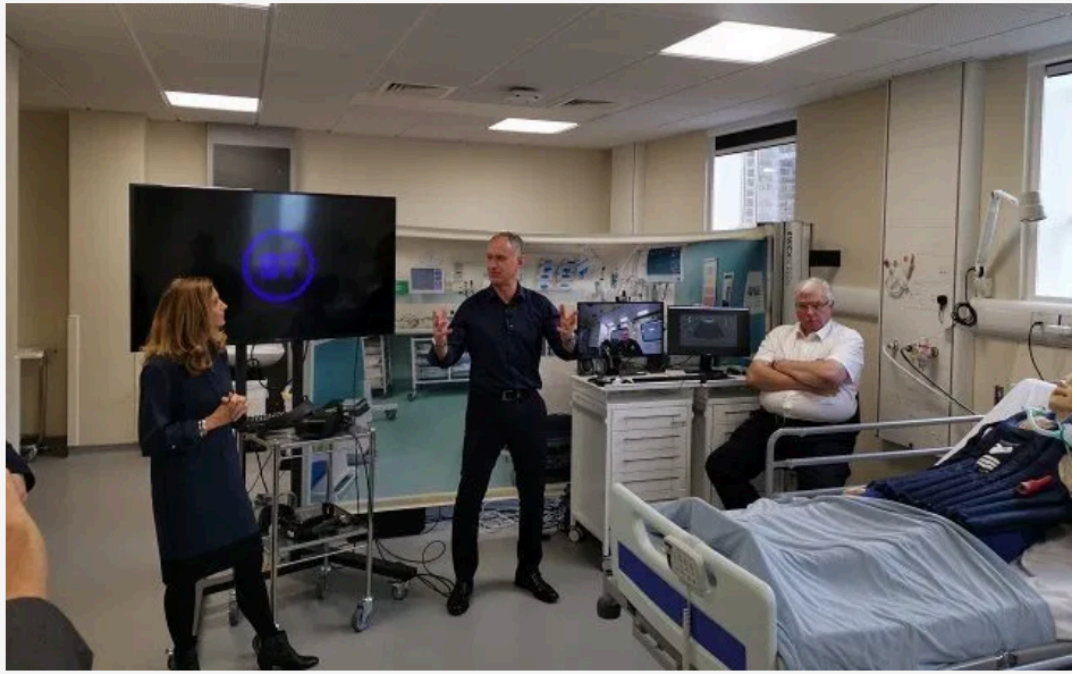
BT demos remote 5G healthcare use cases

BT provided an update to its 5G healthcare technology at University Hospitals Birmingham (UHB) in the UK, showcasing VR and AR technology used in an ambulance based two miles away.

Adding to remote-controlled ultrasound capabilities revealed in June, a clinician was equipped with a VR headset to remotely view a dummy patient, medical records and vital signs, to make a diagnosis.

With these use cases, BT and clinicians argue patients are diagnosed faster and surgical theatres can be prepped in advance if needed. The techniques can also cut queues for emergency services and reduce outpatient attendance.

UHB chief executive David Rosser said 5G offers "the potential to create more efficient use of healthcare resources, particularly with regards to easing the burden on Accident and Emergency services which are facing unprecedented demand".



Fotis Karonis, CTIO of BT Enterprise and the operator's 5G adviser (*pictured, centre*), said the service can be deployed in rural areas when standalone networks are widely available.

Honeywell *Connected Worker*
Intelligent Wearables

realwear | Honeywell

Honeywell's new technology uses the latest in hands-free mobile computing, augmented reality, Industrial Internet of Things (IIoT) and mobility software. It combines the RealWear HMT-1Z1™ hands-free wearable computer with Honeywell's Movilizer platform, an industry leading, cloud-based workflow solution, to support field service operations, specifically in hazardous locations.

"Together with Honeywell's software and services we enable digital transformation that drives higher productivity and safety for people working in hazardous locations and across the industrial sector."

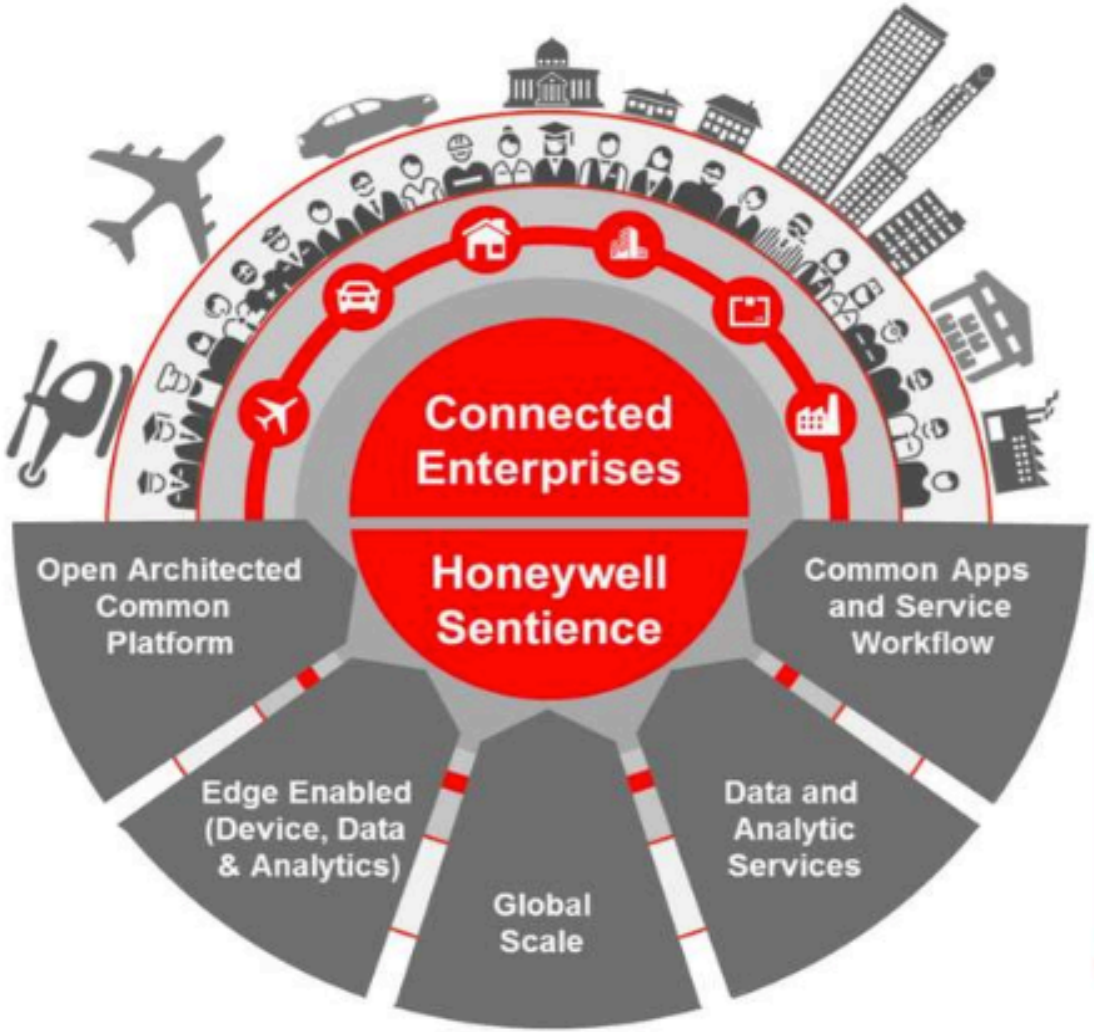
Sanjay Jhawar, co-founder and president of RealWear

Key experience features:

- Operator task automation
- Visualization of live data
- Video capture and playback
- Expert on call
- Geo-localization, navigation and asset visualization
- Rapid emergency evacuation

Connected Worker is just the tip of the iceberg

Connected Enterprises | Critically Connected Solutions



CONNECTED AIRCRAFT
130K TOTAL AIRCRAFT

CONNECTED BUILDING
10M GLOBAL INSTALLED BASE

CONNECTED PLANT/CYBER SECURITY
10K+ GLOBAL INSTALLED BASE

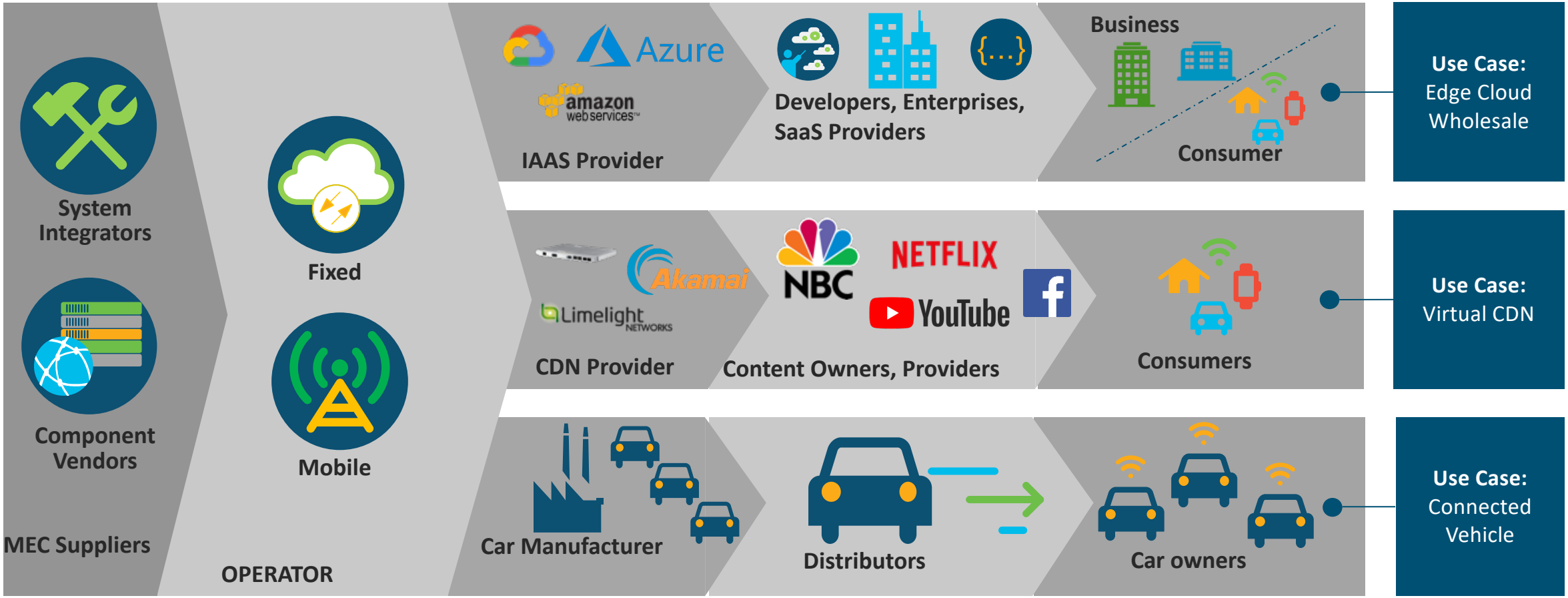
CONNECTED WORKER
550M GLOBAL PPE USERS

CONNECTED SUPPLY CHAIN
500M+ DELIVERIES ENABLED

CONNECTED DISTRIBUTION CENTER
$6B AUTOMATION INSTALLED BASE[1]

Edge Computing: Will 5G Make it a Reality?

Edge Computing Requires an Ecosystem



Source: STL Partners + Cisco Changes

Edge in Standard and Open Source Forums

- Too many to establish critical mass!
- ETSI MEC Ref arch: http://www.etsi.org/deliver/etsi_gs/MEC/001_099/003/01.01.01_60/gs_MEC003v010101p.pdf
- OpenFog Ref Arch: https://www.openfogconsortium.org/wp-content/uploads/OpenFog_Reference_Architecture_2_09_17-FINAL.pdf
- IEEE P1934 Working Group: http://techblog.comsoc.org/tag/p1934/

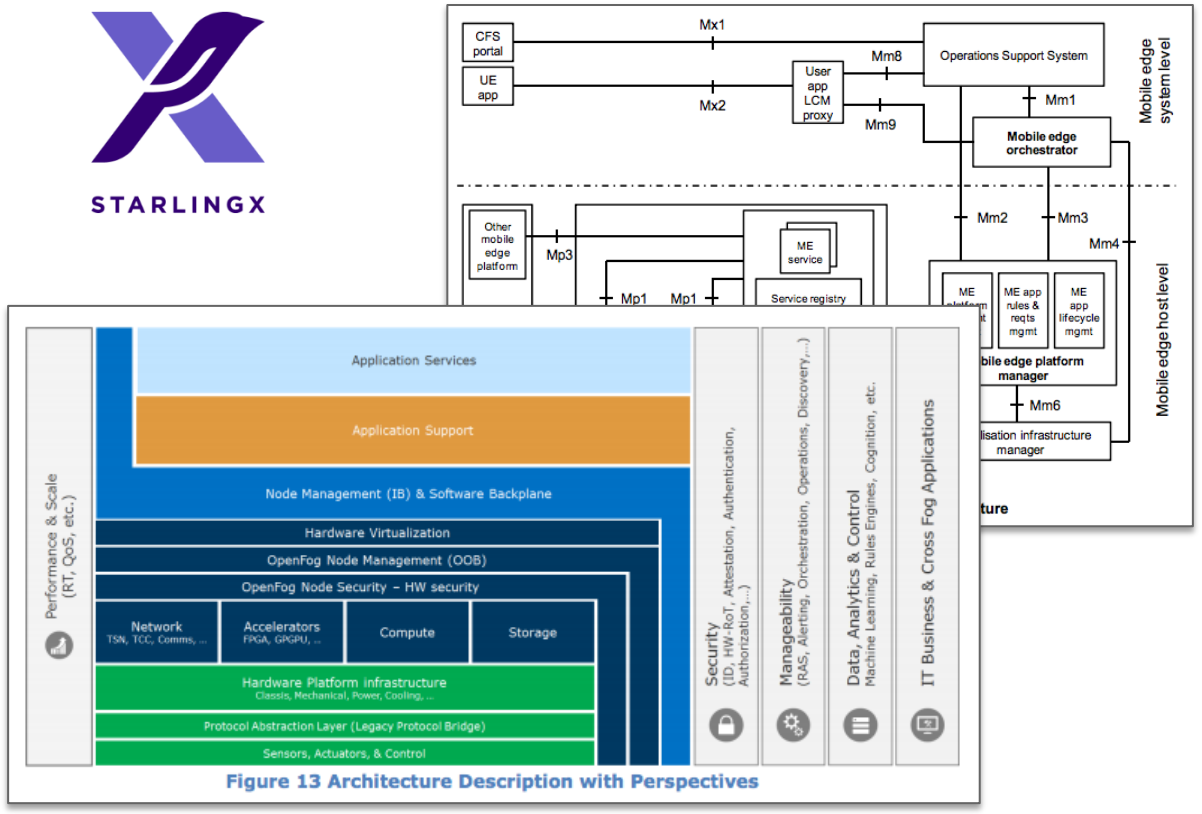
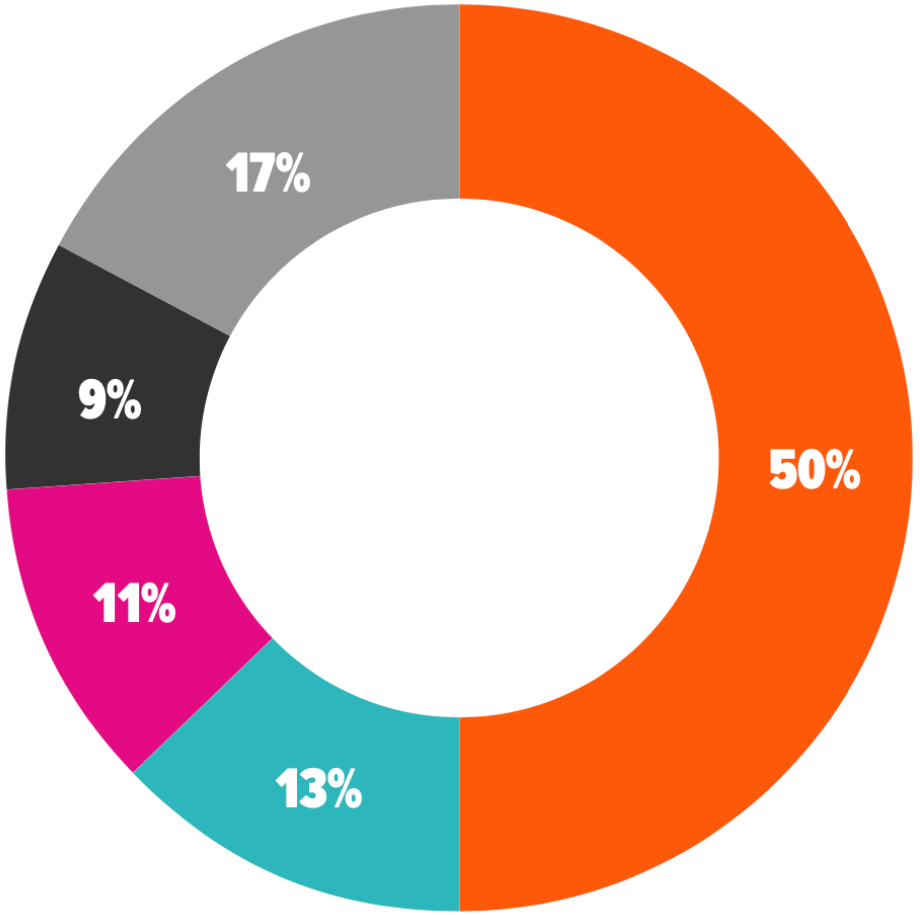


Figure 13 Architecture Description with Perspectives

Who Should “Own” The Edge



- Telecom Operators 50%
- Data Centre Operators 13%
- Content Delivery Network Providers 11%
- Cloud Providers 9%
- Other 17%

Source: Telecom.com in collaboration with Edge Computing congress

THE CURRENT STATE OF PLAY

- Verizon tested edge computing on its 5G network at the beginning of this year, shortly after the 5G network went live. The carrier claimed that it was able to cut latency in half during tests. Shortly afterwards it unveiled a MEC platform from which it expects to generate B2B revenues starting in 2021

- AT&T is developing a 5G-based MEC solution for a retail environment in partnership with Badger Technologies. It will enable in-store robots to perform tasks that boost efficiency and improve the customer experience. The partnership was formed shortly after AT&T embraced HPE's Edgeline Converged Edge Systems for the enterprise market: its aim is to create use cases for business customers that allow applications to operate at customer premises for lower-latency processing.

- Deutsche Telekom's approach is more cautious. After a two-year internal analysis and assessment, the leading German operator established a separate entity, MobiledgeX, to develop edge computing on its behalf. The independent company has subsequently worked with other mobile operators to develop a software platform, Edge Navigator, which developers can use to write applications that take advantage of edge computing.

- Telefonica is promoting edge computing on its open access, or OPA, architecture. Its focus is
to disaggregate the equipment components so that a single baseband unit can be connected through an open interface in a multi-vendor radio equipment environment

THE CURRENT STATE OF PLAY... CONT'D

Azure

- Among the webscale cloud operators, Microsoft was the first to make it possible for customers to replicate the cloud environment on a smaller scale in their own data centres with its Azure Stack, which was launched in 2017.

- The latest arrival in the market is Google Cloud's Anthos, which can run applications on-premises but also leverages the power of Google's cloud computing. What sets Google apart from Microsoft and Amazon is that Anthos can run on top of VMware vSphere, which means VMware customers using hardware from the mainstream original equipment manufacturers, like Cisco, Dell/ EMC, HPE, and Lenovo, do not need to buy new equipment, making implementation of Anthos more cost-efficient.

aws

- Amazon has made some of the boldest moves. In 2018, AWS, the company's cloud service, launched Outposts, a scaled-down cloud solution that
  uses AWS functions but provides an on-premises managed service for enterprise customers. Previously, AWS launched Greengrass, which forms small-scale clouds by linking IoT devices
- in clusters and delivering a localised computing service. There has even been speculation that one of the motives for Amazon's acquisition of Whole Foods was to gain access to dispersed properties where it can set up local data centres in the future.

Cloud Gaming:
Google's streaming game platform Stadia has implications for 5G

- Google made waves in the streaming video world last week when it unveiled its new cloud-based gaming platform Stadia.
- Users will be able to stream Stadia on a variety of connected devices, such as tablets, laptops and TVs, without needing a special game console. They can play the game with either existing controllers or Google's own Stadia controller.
- Google says that its cloud servers will allow Stadia to stream games in 4K ultra-high definition resolution at 60 fps and, in the future, Google said it will be able to support 8K and higher than 120 fps.
- At Sprint's press conference at MWC 2019 to announce its initial rollout of 5G, executives said they thought one of the first big use cases for 5G would likely be gaming.
- Increasingly sophisticated video game visuals will require more powerful GPUs than those currently available, but the need for low latency means that edge servers will be required to process the visual effects close to the end user

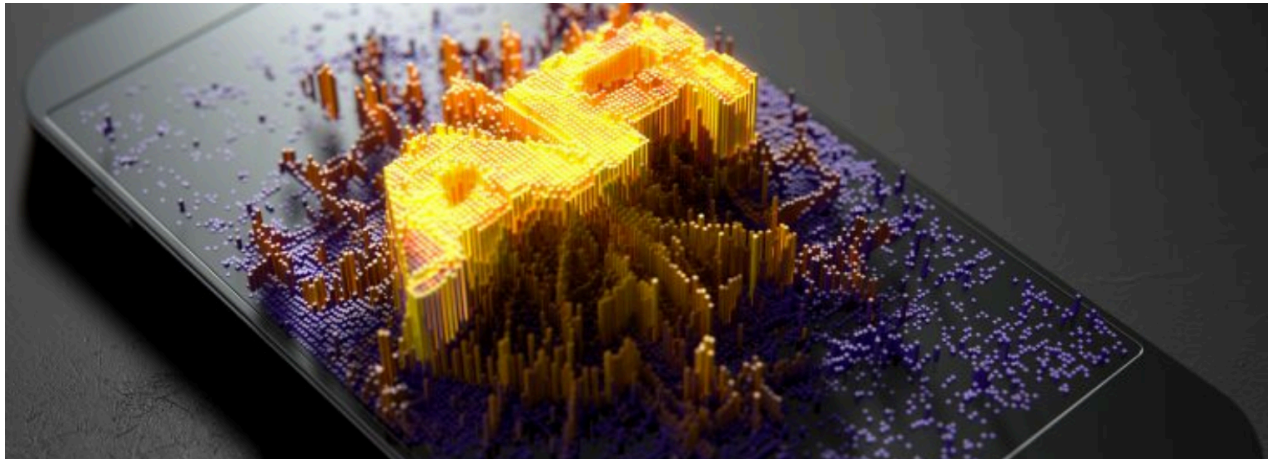
- Cloud Gaming

Google Stadia may be the first good use for 5G phones

eXtended Reality “XR”

- Verizon and Snap ink 5G AR deal
- **Verizon has announced a tie-up with Snap to deliver augmented reality (AR) features and experiences in the 5G labs**
- We are thrilled to partner with Verizon to move the industry forward through the development of creative and innovative 5G experiences on Snapchat
- Snapchat was the first social media app to introduce the concept of Stories and is now leading the augmented reality (AR) revolution.
- Snapchat has transformed tourism with Landmarkers.
- AR/VR/xR apps enable visitors to experience, explore and learn about cultural heritage in a new way – lost, invisible and fragile cultural heritage, as well as heritage under special protection regimes, can thus be experienced in its full and enriched glory. The technologies also allow the visualisation in combination with remaining or connected elements of tangible and intangible

- AR/VR/XR apps



The real and virtual worlds are increasingly blending – AR/VR/xR apps are enabling the rich cultural heritage to live on in the mixed reality era.


謝謝
DZIĘKUJĘ CI
TAPADH LEIBH
KEA LEBOHA
NGIYABONGA
БАЯРЛАЛАА
MISAOTRA ANAO
GRÀCIES
SALAMAT
TEŞEKKÜR EDERIM
WHAKAWHETAI KOE
DANKIE
TERIMA KASIH
DANKON
TANK
TAPADH LEAT
buíochas
KÖSZÖNÖM
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GRAZIE
MATUR NUWUN
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