



**Hewlett Packard
Enterprise**

5G

A new Ocean of Opportunities

For CMOS, MEMS and Photonics and much more ...

July 2018

Marie-Paule Odini, HPE Distinguished Technologist



**Hewlett Packard
Enterprise**

**LETI
INNOVATION
DAYS**
JULY 4-5, 2018
GRENOBLE, FRANCE



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Marie-Paule Odini – HPE Distinguished Technologist

In charge of HPE CMS innovation and strategy evolution to 5G in CMS CT Office

Industry Expert:

Co-Chair of TIP End to End Network Slicing Project

Co-founder of ETSI NFV and Vice Chair until mid 2017

Ex Chair of ETSI NFV TST Group (Testing and Opensource)

Chief Editor of IEEE Newsletter and special edition on network slicing

Co-author of 5G Americas paper on Network Slicing

Co-author of 5G Americas upcoming paper on V2X and 5G

Co-founder of ETSI ISG LTN , Low Throughput Network (LPWAN)

European Commission Telecom Expert (SDN, NFV, IoT, 5G)

Member of 5G Labs Advisory Board

An Evolution

Or

A Revolution ... ??

One of the key Challenges today: Mobile Data Traffic growth

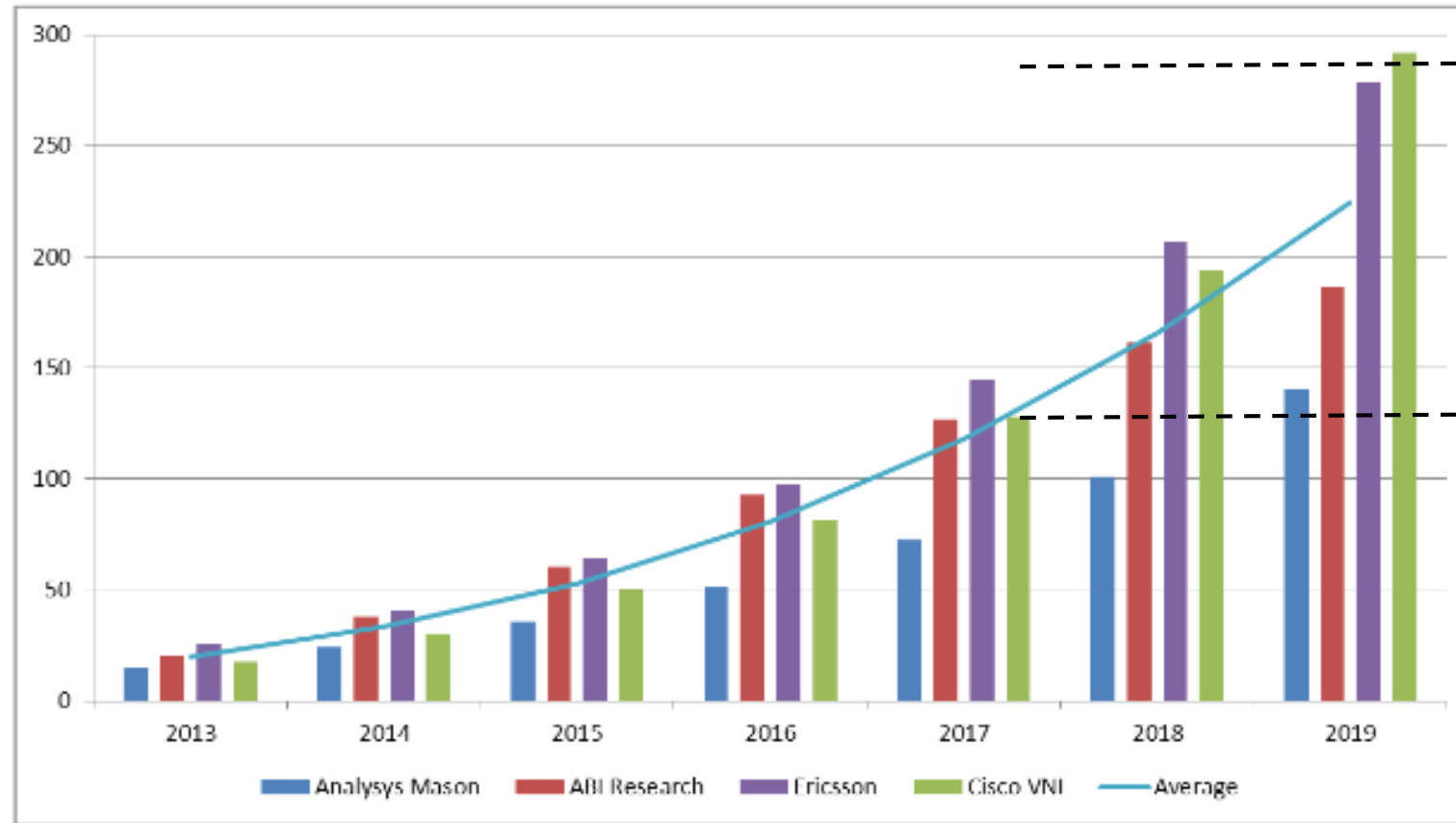


Figure 2: Annual global mobile data traffic (in Exabytes)

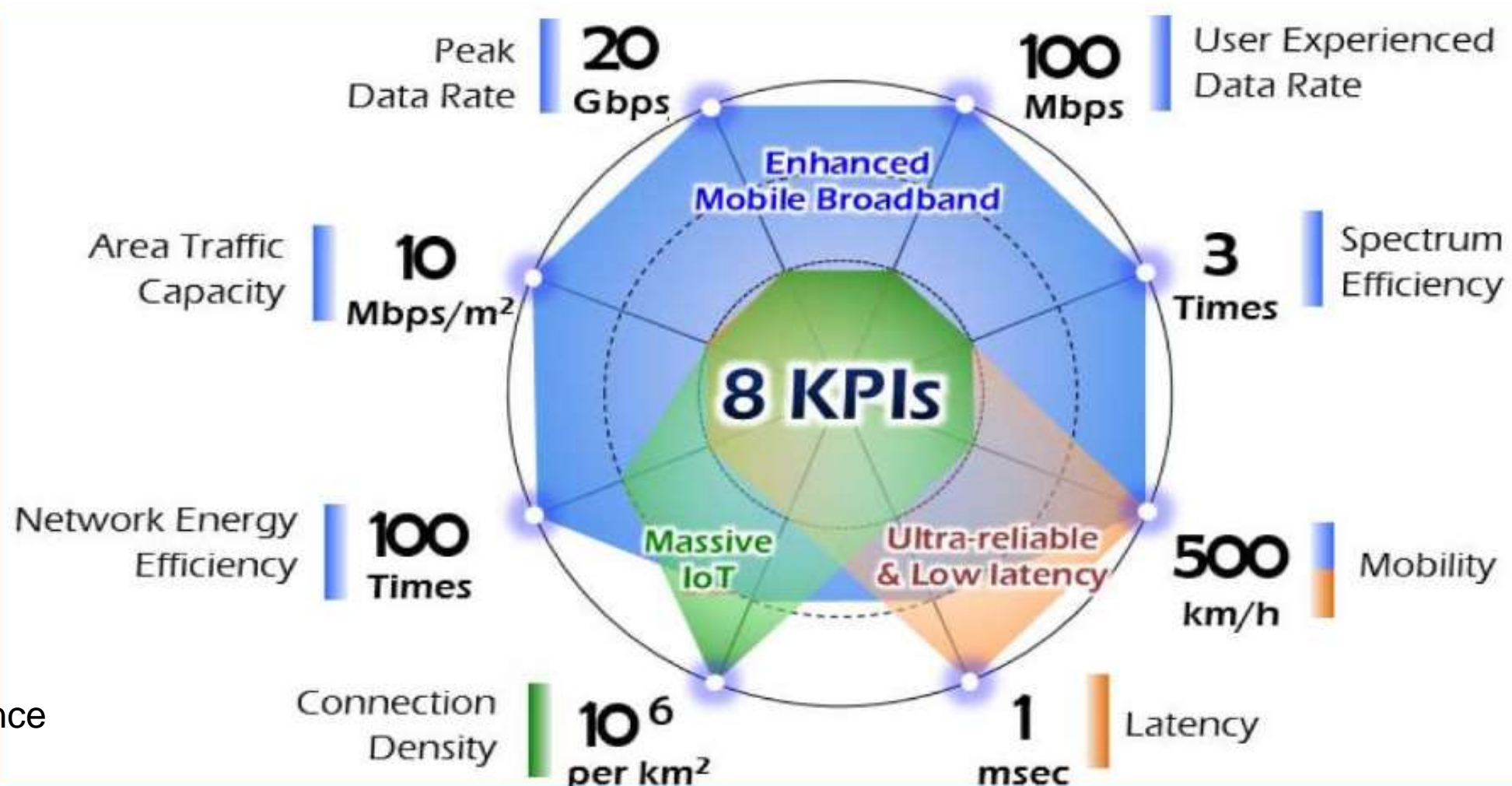
X 2 in 2 years!

Mobile Data Traffic per month per subscriber by 2019:

13 GB in South Korea
(source: [Cisco VNI](#))

5.7 GB in Europe
(source: [GSMA](#))

What 5G will bring ... a more Efficient Network



Key
Performance
Indicator

Enable new Use Cases



Massive IoT - mMTC

*Smart City – Sensors – eHealth
Smart Agriculture - Environment
Smart Home - Smart Building
Smart Industry – Oil - Mining*



eMBB - Enhanced Mobile Broadband

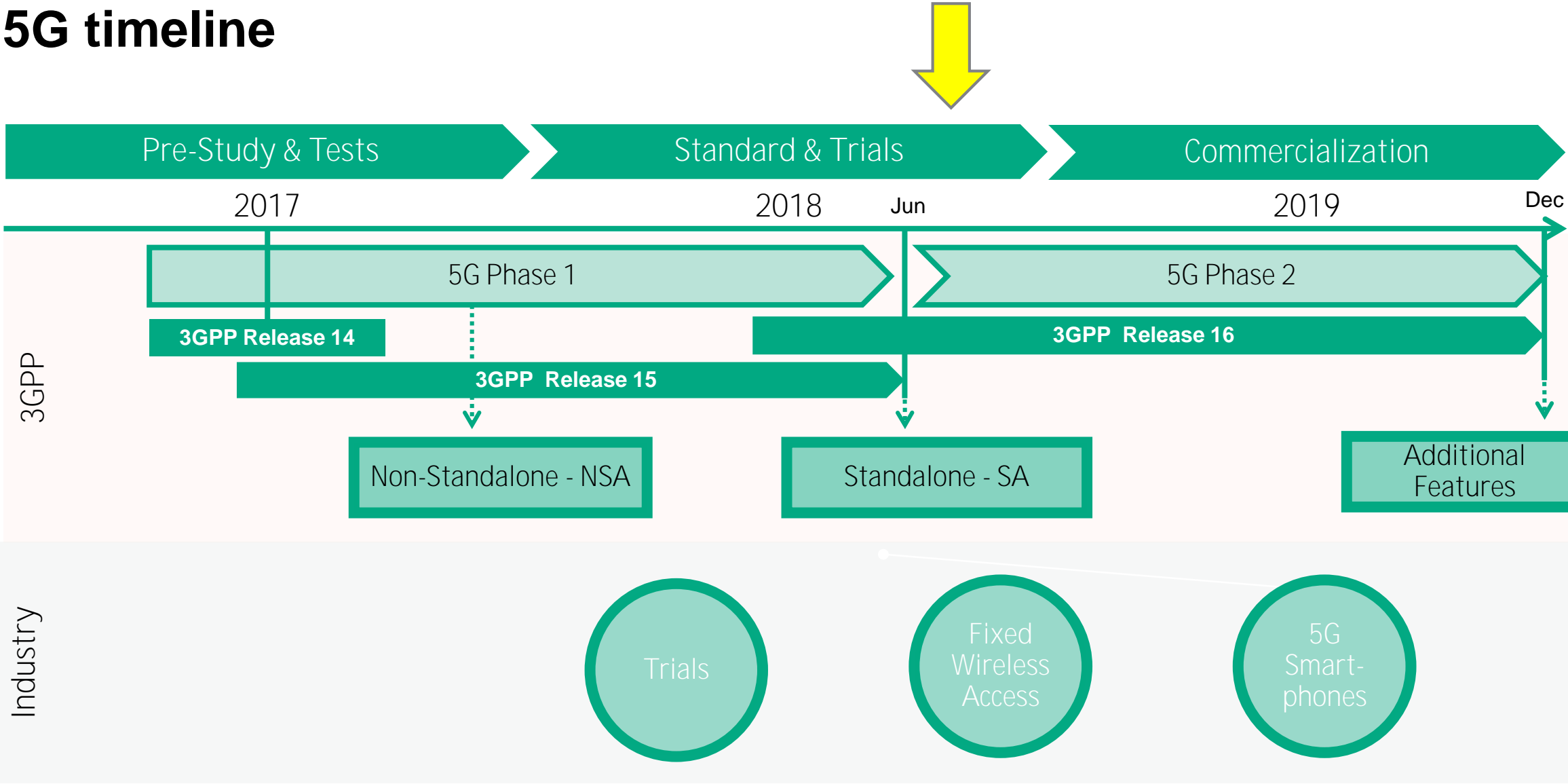
*Augmented Reality – AR
Virtual Reality – VR
Gaming – HD Video
Holograms – Train - Plane*



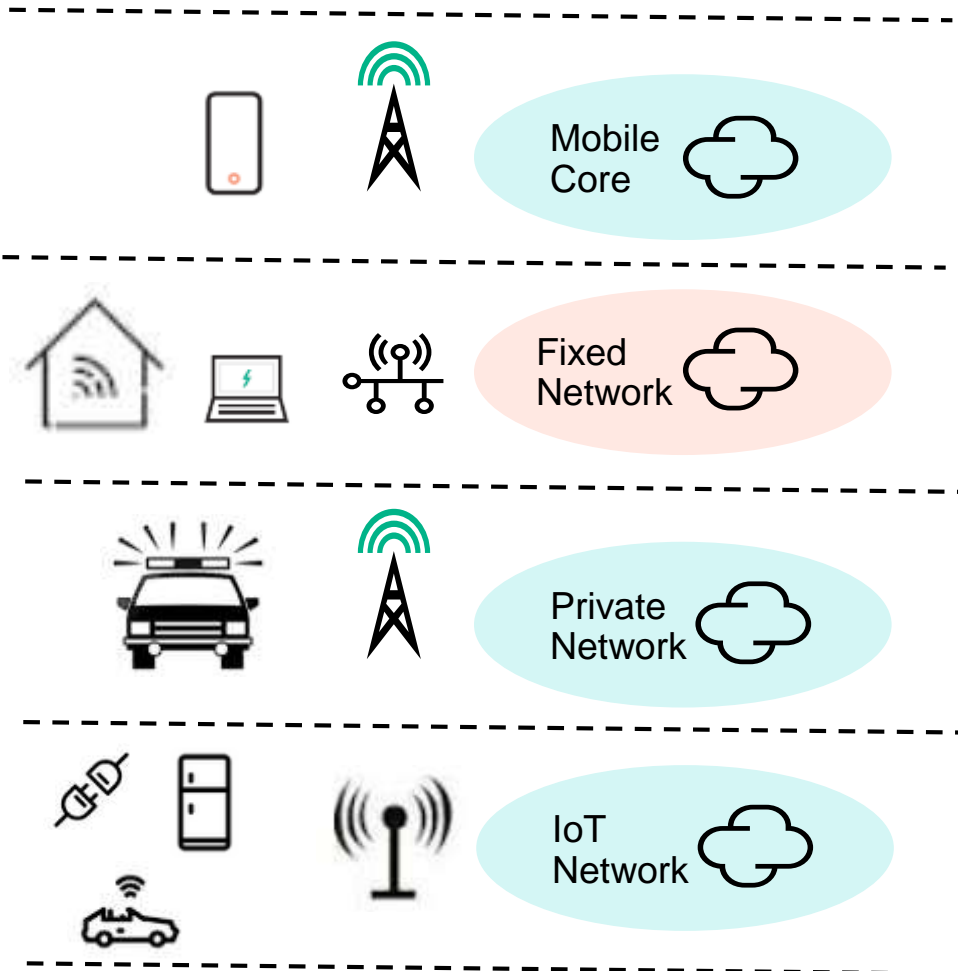
Ultra Reliable Low Latency uRLLC

*Remote Surgery w. haptic fbk
Remote Driving – Self Driving
Remote robotic, motion control
Online Gaming, real time*

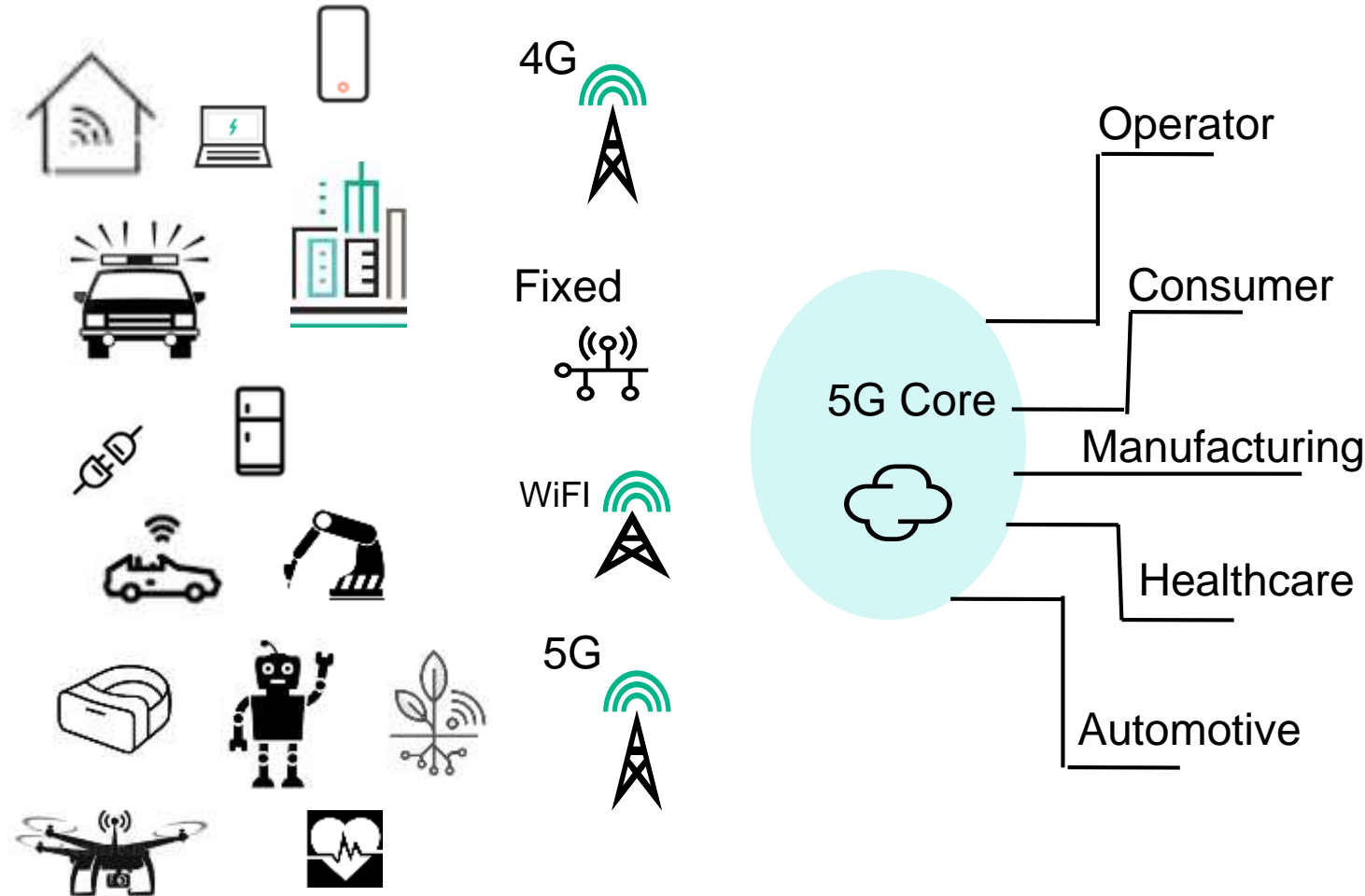
5G timeline



Before



After



**Heterogeneous
devices**

**Heterogeneous
Access**

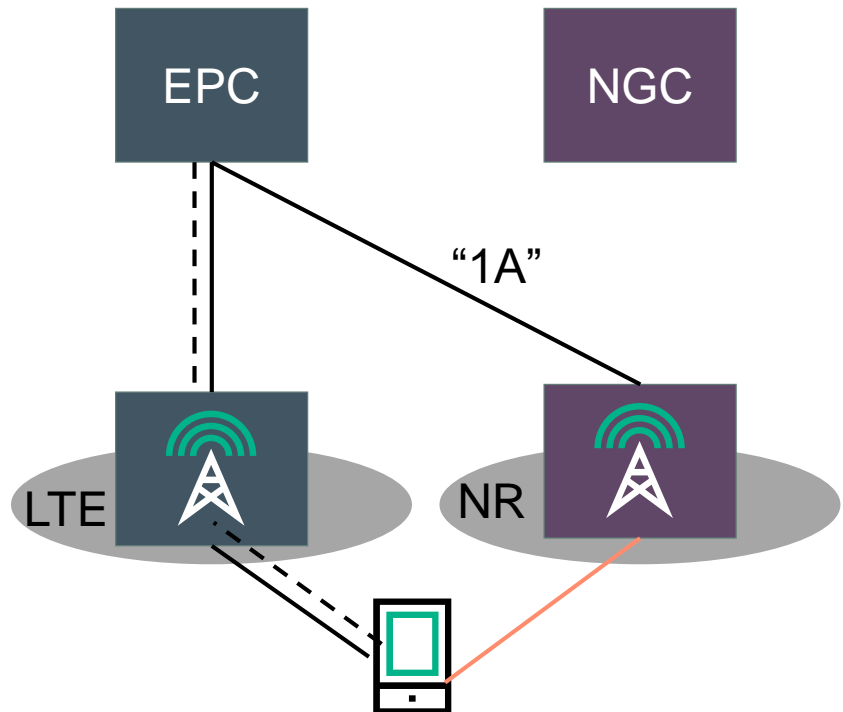
**One
Core**

Verticals

Deployment Options (12) – 3GPP Release 15 Focus

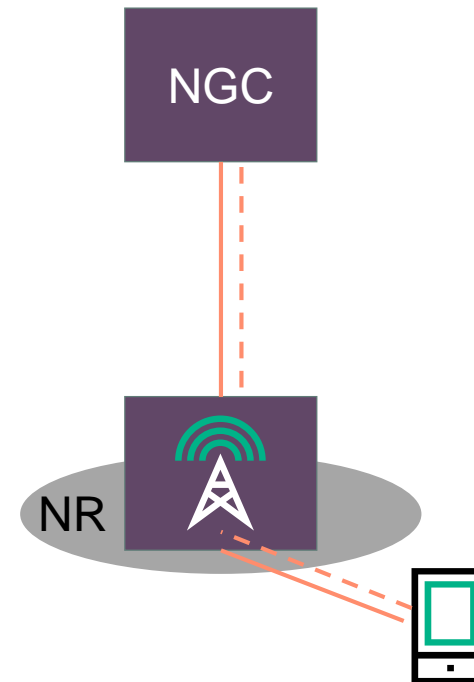
Released Dec 2017 - NSA

3a) Non-Standalone/"LTE Assisted" ; EPC Connected



Release June 2018 - SA

2) Standalone NR; NGC



Etc ...

12 deployment
Model options

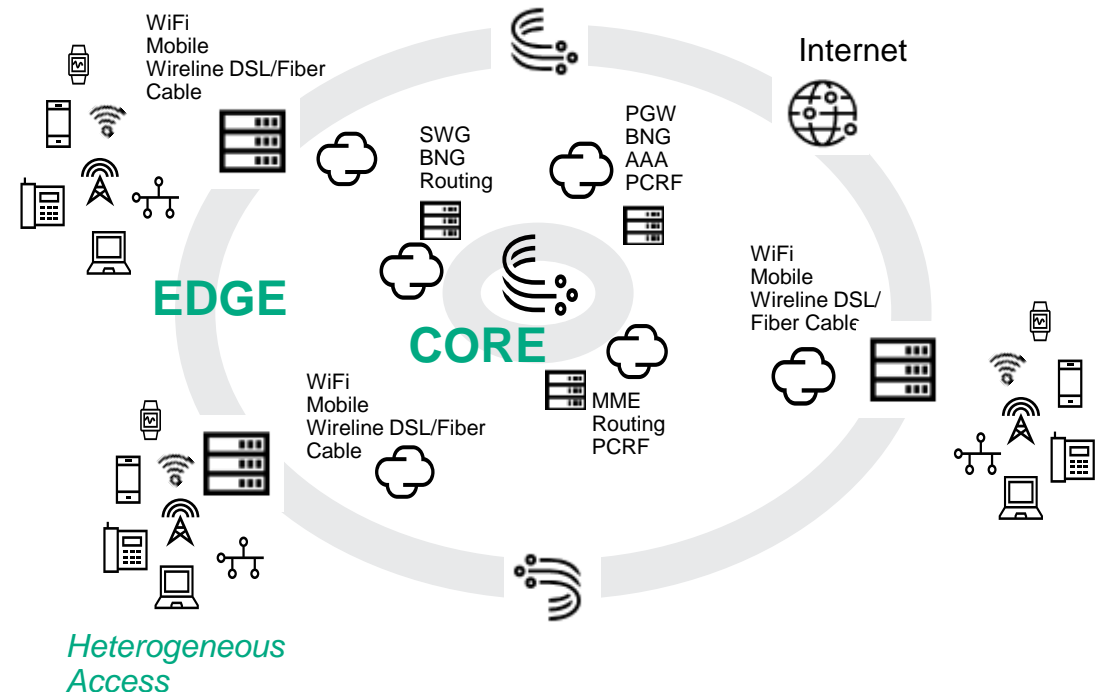
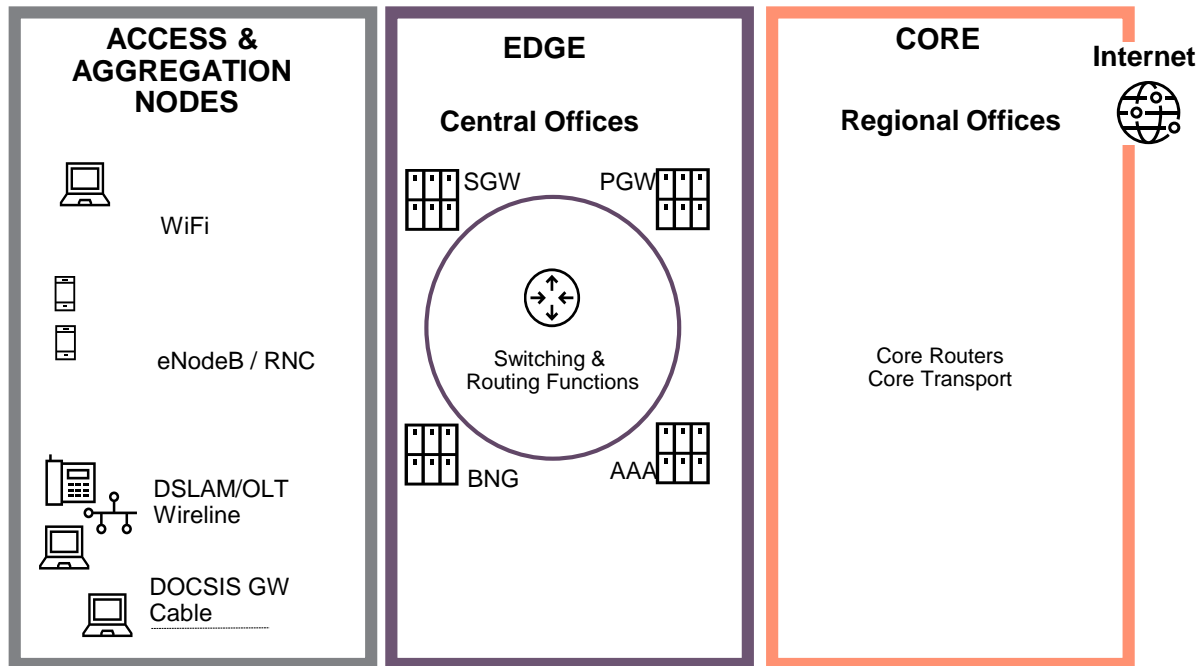
From Telecom Specifics to IT Capabilities

Compute capabilities are changing how networks are build

From a hierarchical network, where telecom functions are dedicated



To a flattened network, where software functions – **Operator or Enterprise** - are optimally placed, programmatically & dynamically, and where traffic is steered towards the most optimally placed service functions



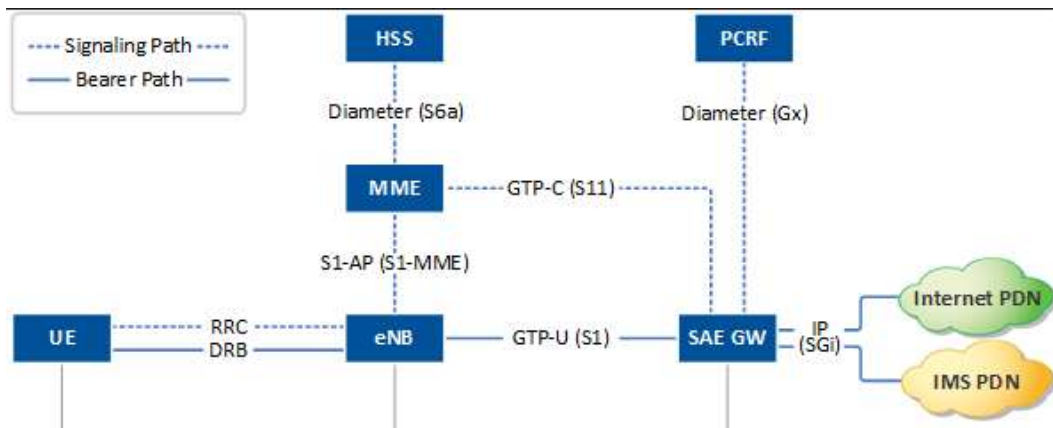
From Telecom Protocols to IT Protocols

5G

4G

Reference Point Architecture

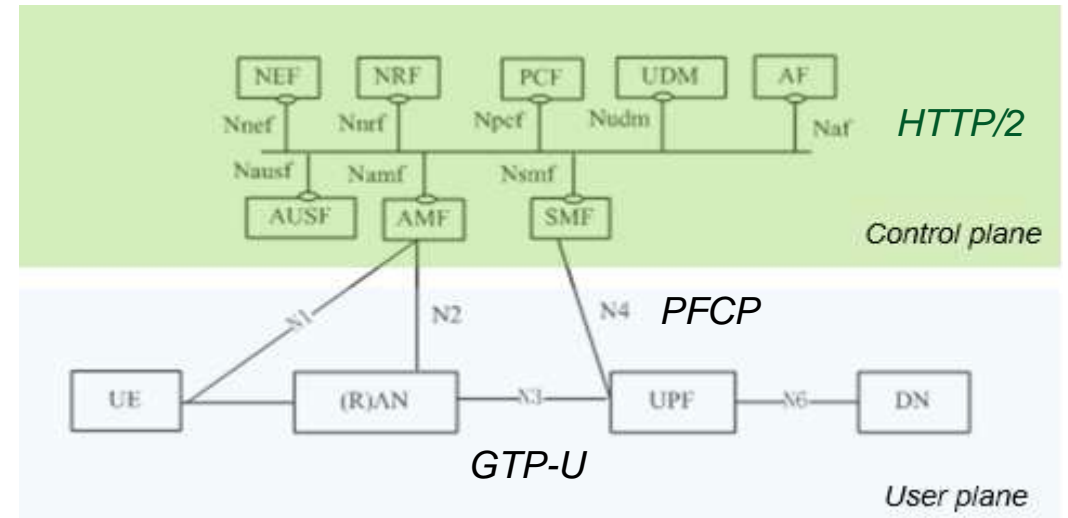
GTP-C and **Diameter** for Control Plane



Service Based Architecture - SBA

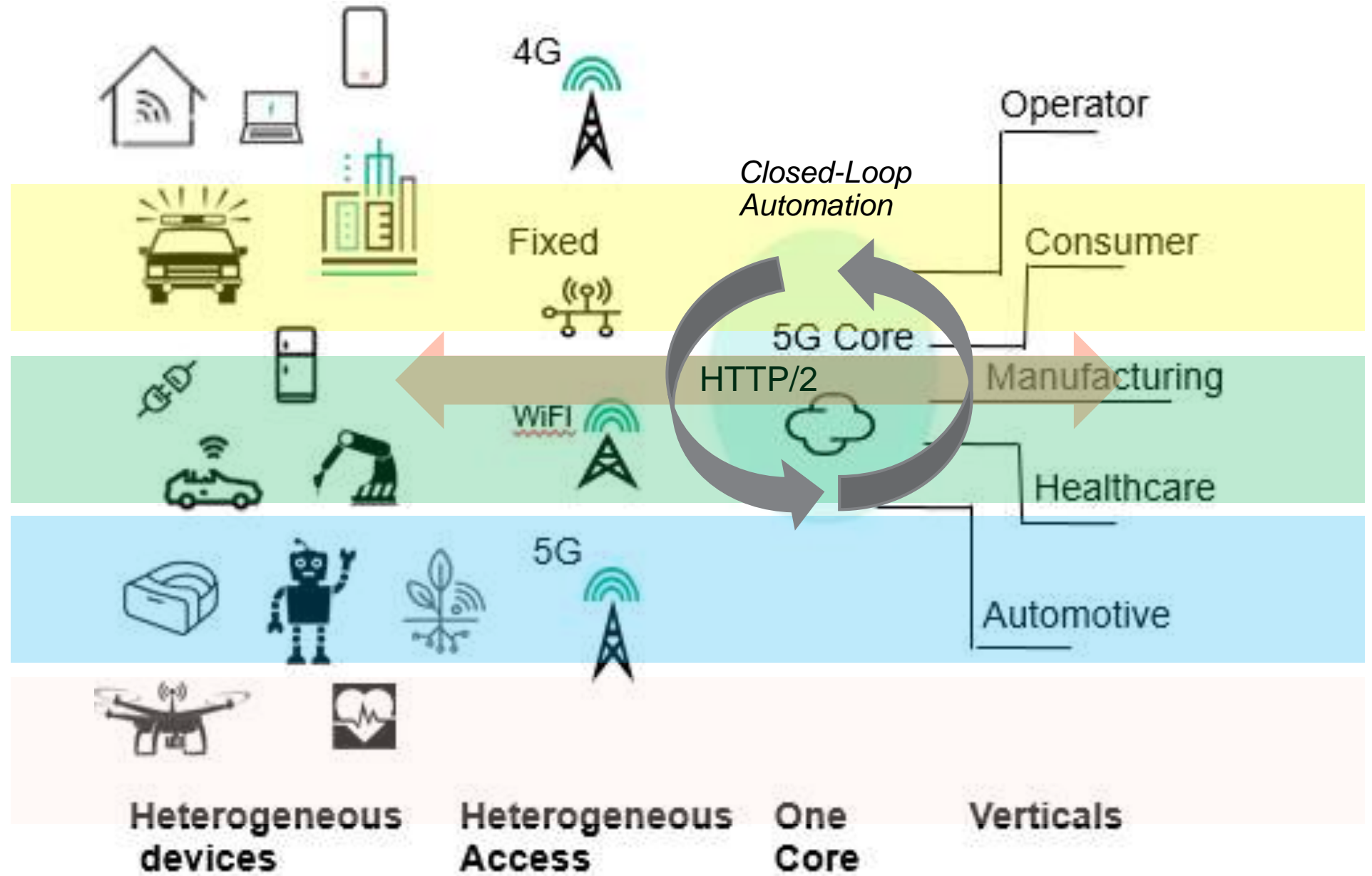
HTTP/2 – Subscribe/Notify – on Control Plane

PCF between UPF and SMF



GTP-U for User Plane **GTP-U** for User Plane

NR
 Devices
 Apps
 IoT
 NFV
 CUPS
 Cloud
 Native
 Stateless
 HTTP/2
 Slicing
 MEC
 Software
 0 Touch
 Security



Get Ready for a Revolution ... but it may take time

- 5G touches on the overall telecom network: Radio/Fixed + Core + Management + Applications/Verticals
- It moves to IT, Software, Cloud (NFV), programmatic, Automated
- It is distributed, Edge, Core with dynamic topology
- Everything connected including millions-billions of devices through a common Core
- Software based Isolation, virtual private network through slicing replace dedicated networks
- Many different deployment models
- Different operators choose different paths depending on their legacy and market traction
- 5G will co-exist with legacy 3-4G, Wifi and fixed networks



European countries 5G initiatives

Italy:

Telecom Italia plans 100% 5G coverage of San Marino by 2018/2019, 'Republic' of 30,000 inhabitants in the center of Italy. But Also Milano, Torino with VF. Open IoT Lab in Torino.

Spain:

5GTonic Lab: Telefonica + U.Madrid + Interop test 5G in Germany

Sweeden:

Ericsson & TeliaSonera to be one of the first operators to offer 5G, in 2018, initially in Stockholm and Tallinn

France:

ARCEP attributed 700MHz band in 2016 and new licence in 3.5GHz (lower band for radio, higher band for pure 5G) and 26GHz for 5G trials in 9 cities (or more if demand). Live 5G campus in Sophia Antipolis (lead Eurecom research institute) Orange Focus: Slicing, Energy, 5GCAR Government call for 5G Projects

Finland:

FINOCA (regulator) will put frequencies between 3.4 and 3.5GHz in use for 5G in 2019. NOW it has granted 13 licences for trials + a 5G test network is available in OULU for research and business trials.

Russia:

MTS to demo 5G during FIFA World Cup 2018

UK:

5GUK Project - Government allocated £740m for research and infrastructure and claims that 5G could add £173bn to Britain's GDP in the 2020s. In the meantime Ofcom is going to high court for delaying new spectrum allocation BT focus: Slicing, SDM/SDE

Germany

5G Lab Germany: consortium Trial 01/2017: DT-Huawei, 2Gbps, 3ms latency over 3.7GHz DT focus: slicing and zero touch Germany announced 5G Spectrum auction for 2018

5G-Ex



Design a cross domain orchestration system that provides wholesale XaaS services over multiple administrative and technology domains



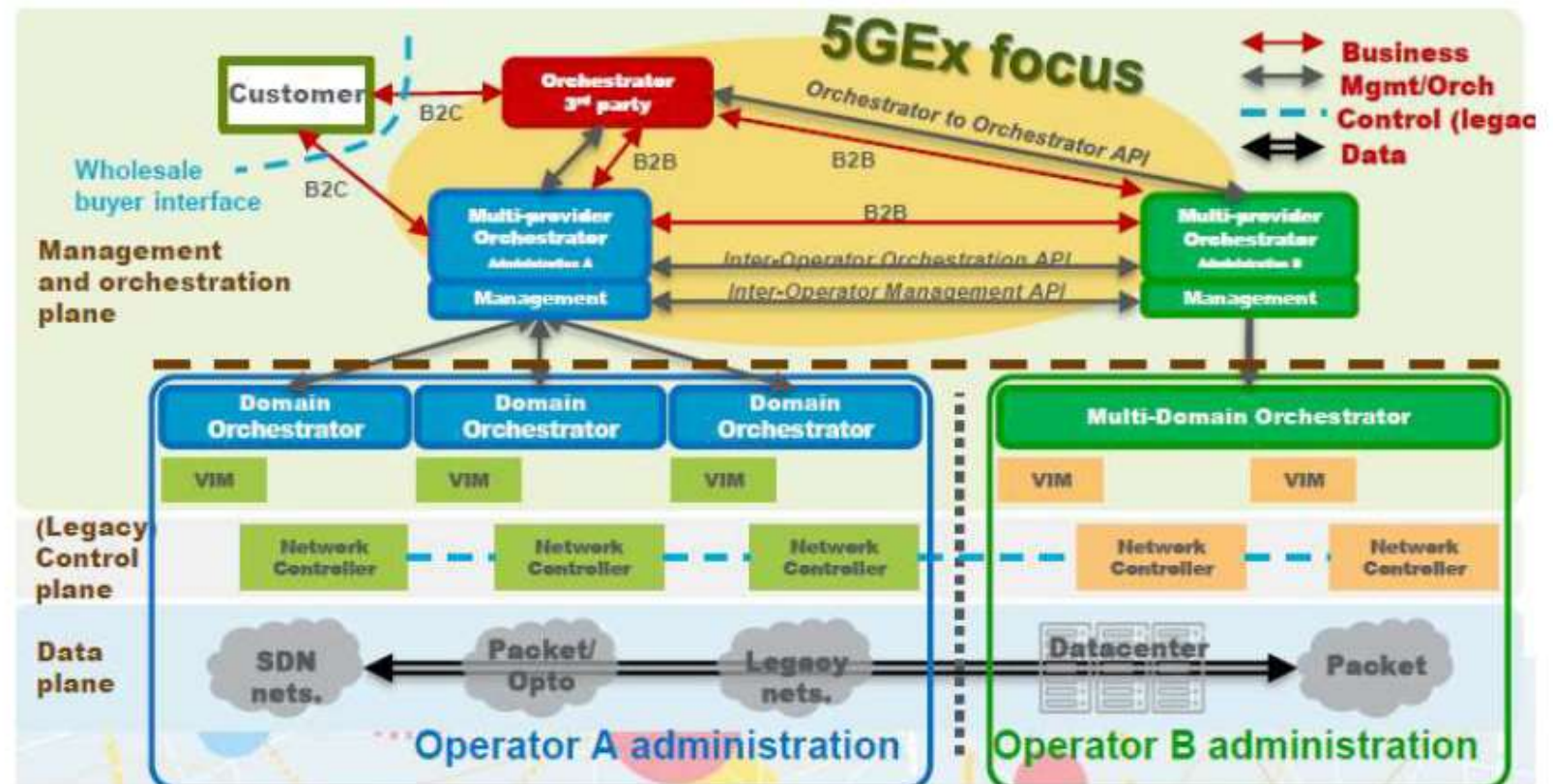
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Multi Domain
Domain Orchestrator
Multi-Provider Orchestrator
Inter Orchestrator API

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Network Slicing across multi-operator domain



5G PyeongChang Olympics – South Korea Feb'18



Sync view

360° VR

Interactive multi-view



Omni point view

5G autonomous driving

MR torch relay

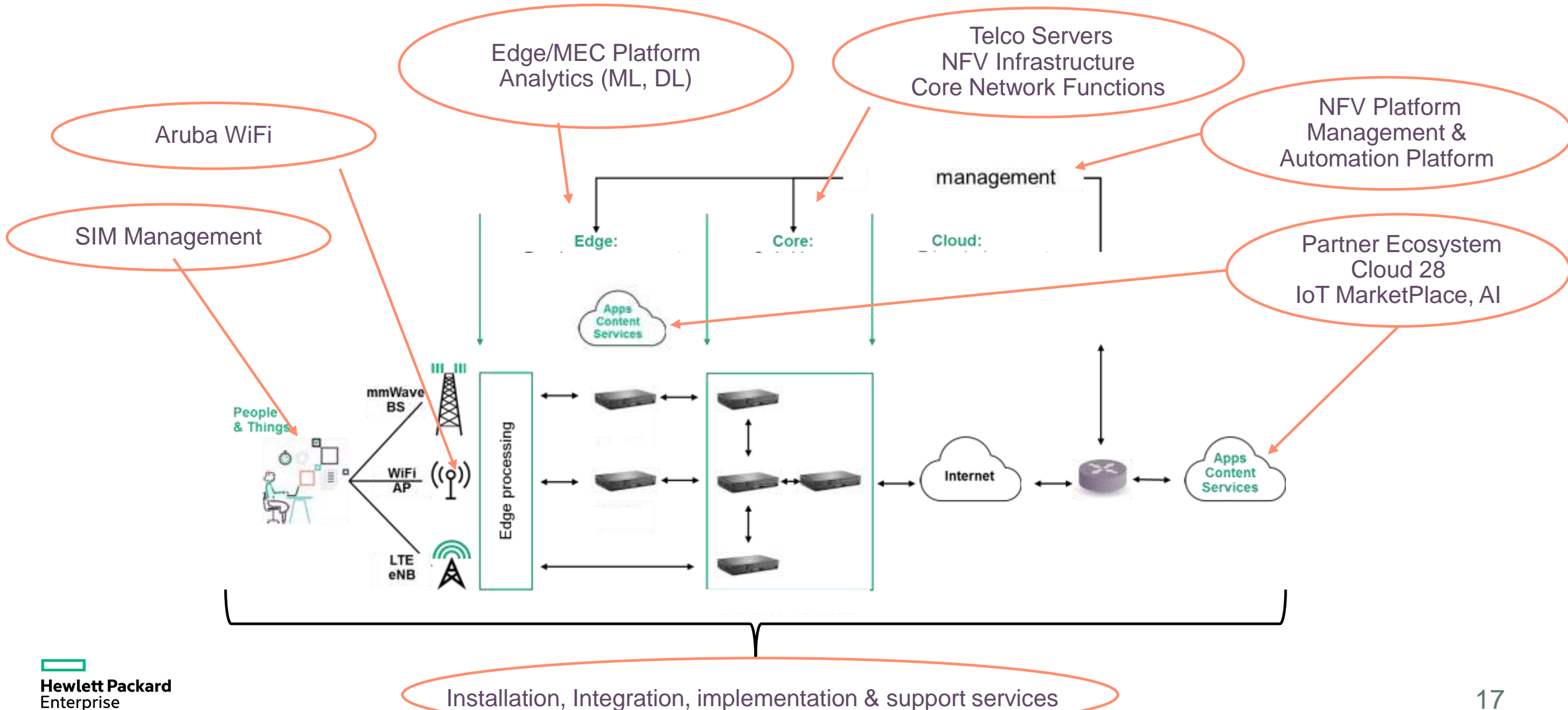
5G Safety

Items	Description
Underlying technologies	4G/5G/WiFi
No. of APs	Over 5,000
No. of active devices	Up to 250,000

- 5G Safety is a security service featuring facial recognition solution that combines drone and AI system.
- 360° VR is another realistic service that transmits 360 degree display in real time into multiple live channels through 5G mmWave Access
- Hologram Live is an ultra-high quality remote hologram service that uses 5G mmWave backhaul technology for transmission

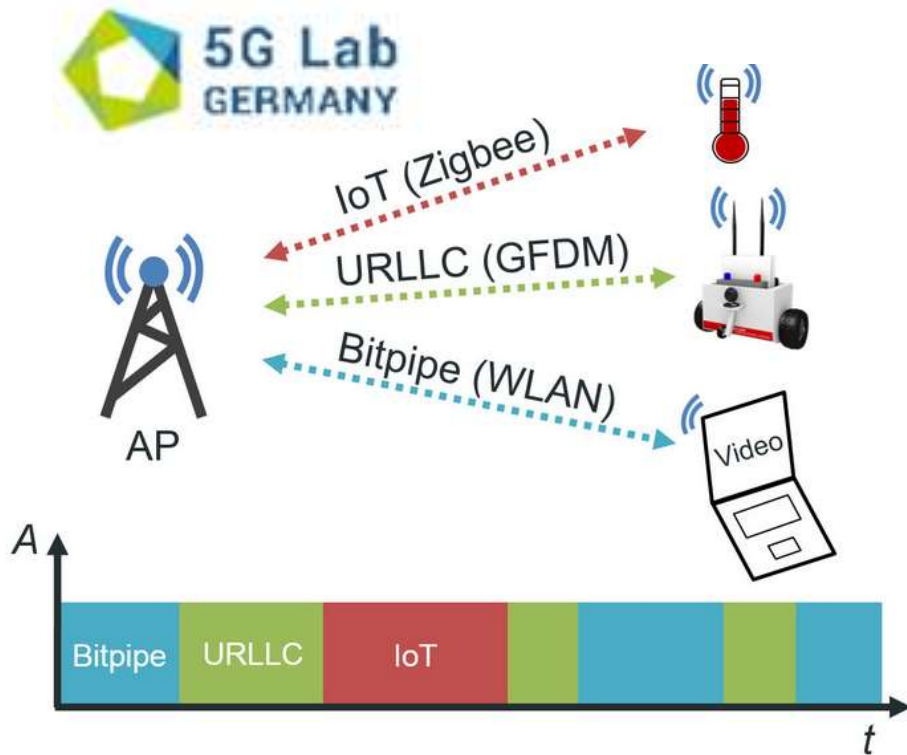
HPE focus in 5G – HW, SW and Services

From Edge to Core, with Cloud & Management / Automation



MEC & Network Slicing POCs (MWC'18 - HPE Booth)

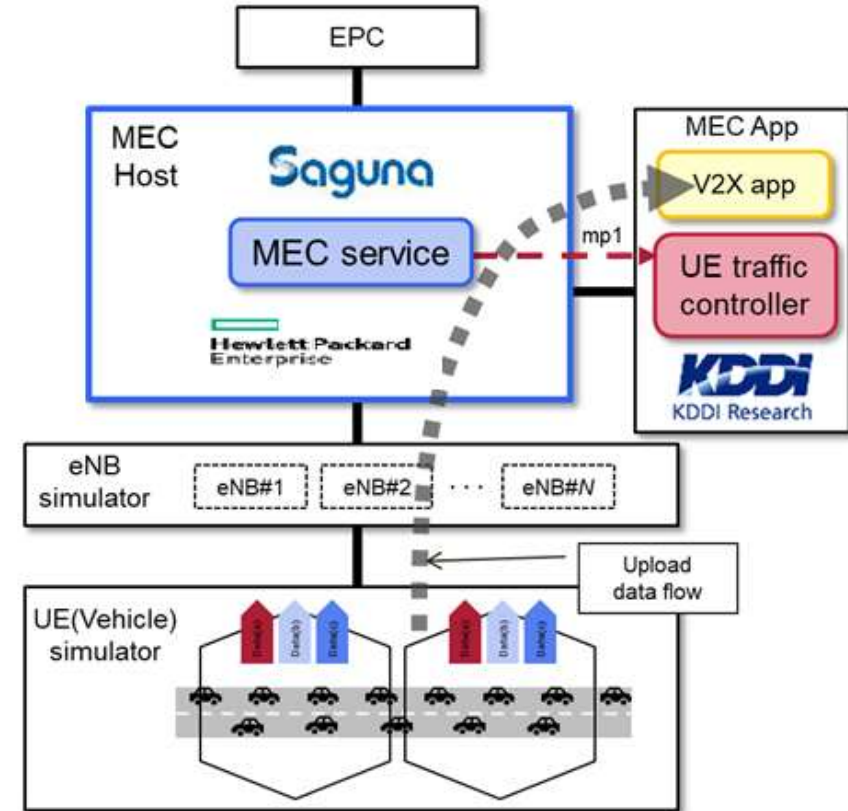
RAN slicing with 5G Lab Germany



[IEEE paper](#)

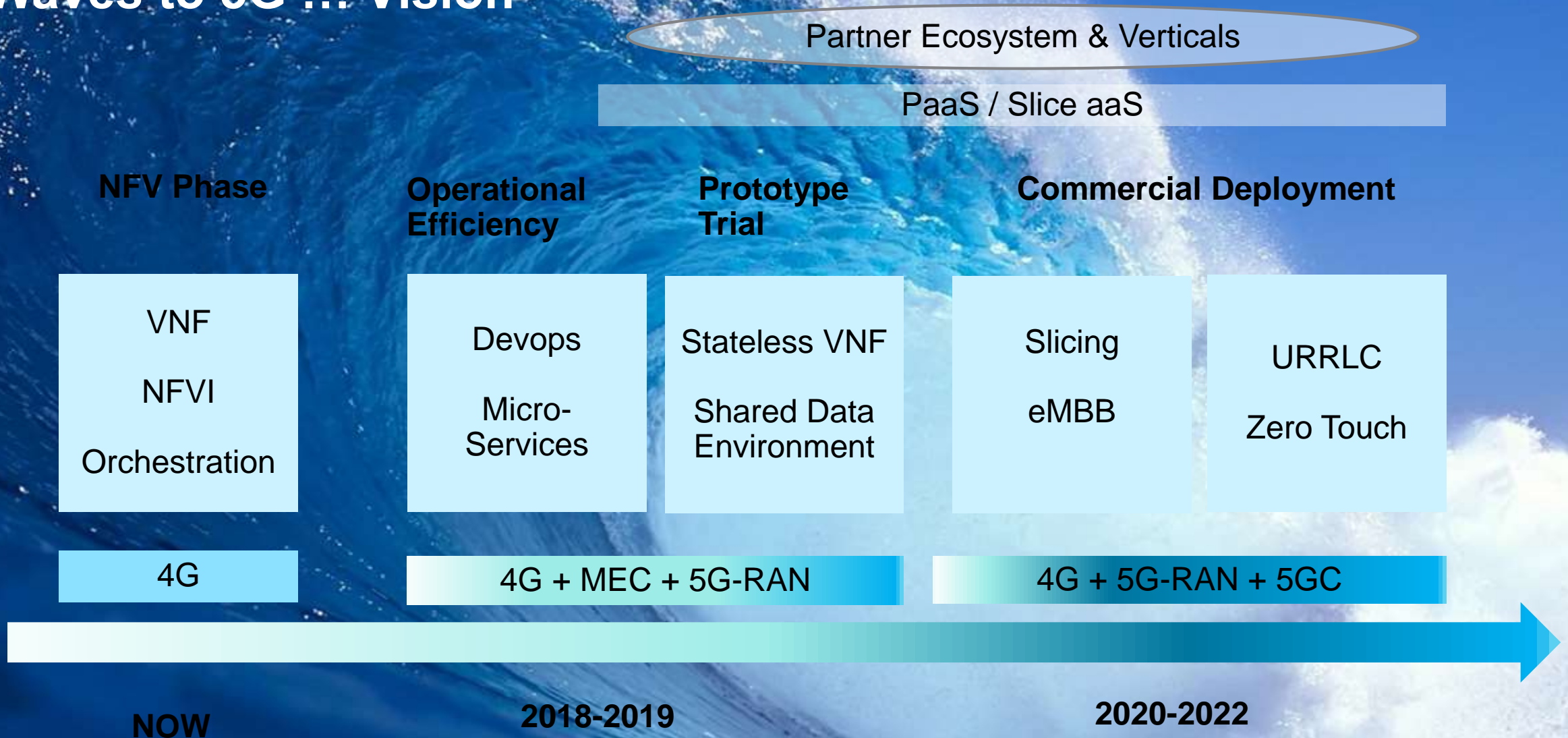


MEC and V2X with KDDI



[ETSI MEC POC](#)

Waves to 5G ... Vision



Further Reading on 5G

[SDN and NFV Evolution towards 5G, IEEE](#)

[Network Slicing Business Paper](#)

[IEEE SDN Newsletter : Network Slicing Edition](#)

[V2X and Network Slicing](#)

[5G, the game changer for IoT](#)

[TIP E2E Network Slicing](#)

[From Subscriber Data Management \(SDM\) to Shared Data Environment \(SDE\)](#)

[MEC in 5G Networks](#)

3GPP specs ... a few 100s !!





The MACHINE



the MACHINE

Our vision for the future of computing.



Thank You