

5G – Next Generation Mobile

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NATIONAL
CONVERGENCE
TECHNOLOGY CENTER

5G

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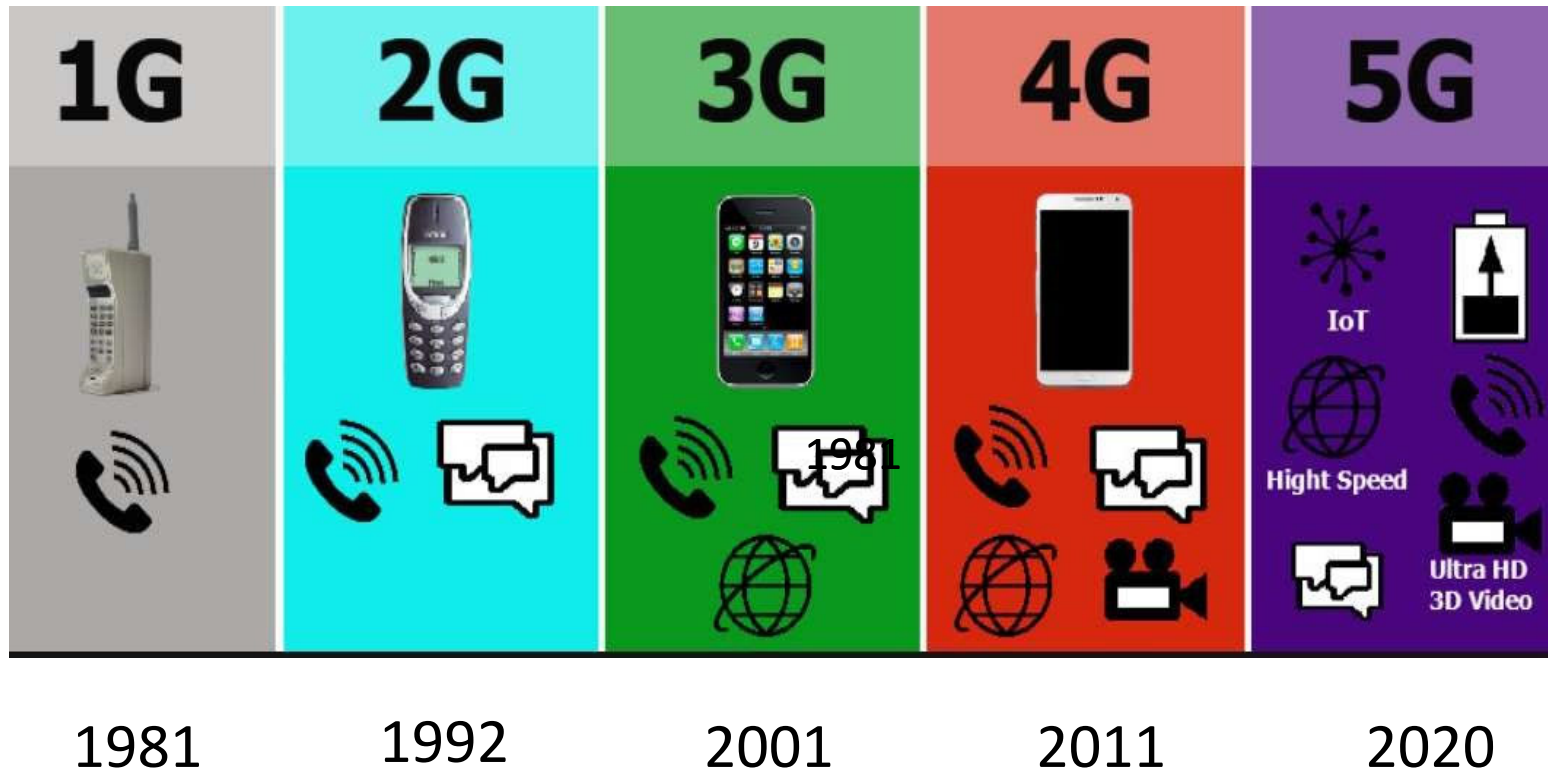
August 7, 2020

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Outline

- 5G Use Cases
- 5G Technology
- 5G Slices
- 5G Deployment Model
- 5G Configurations and Projects

Evolution Mobile Communications



5G Mobile Network Data Traffic Projections



Average Internet
Use

1.5 GB/day



Autonomous
Vehicle

4 GB/day
Up to TB



Connected
Planes

5 GB/day



Smart
Factory

1 PB/day

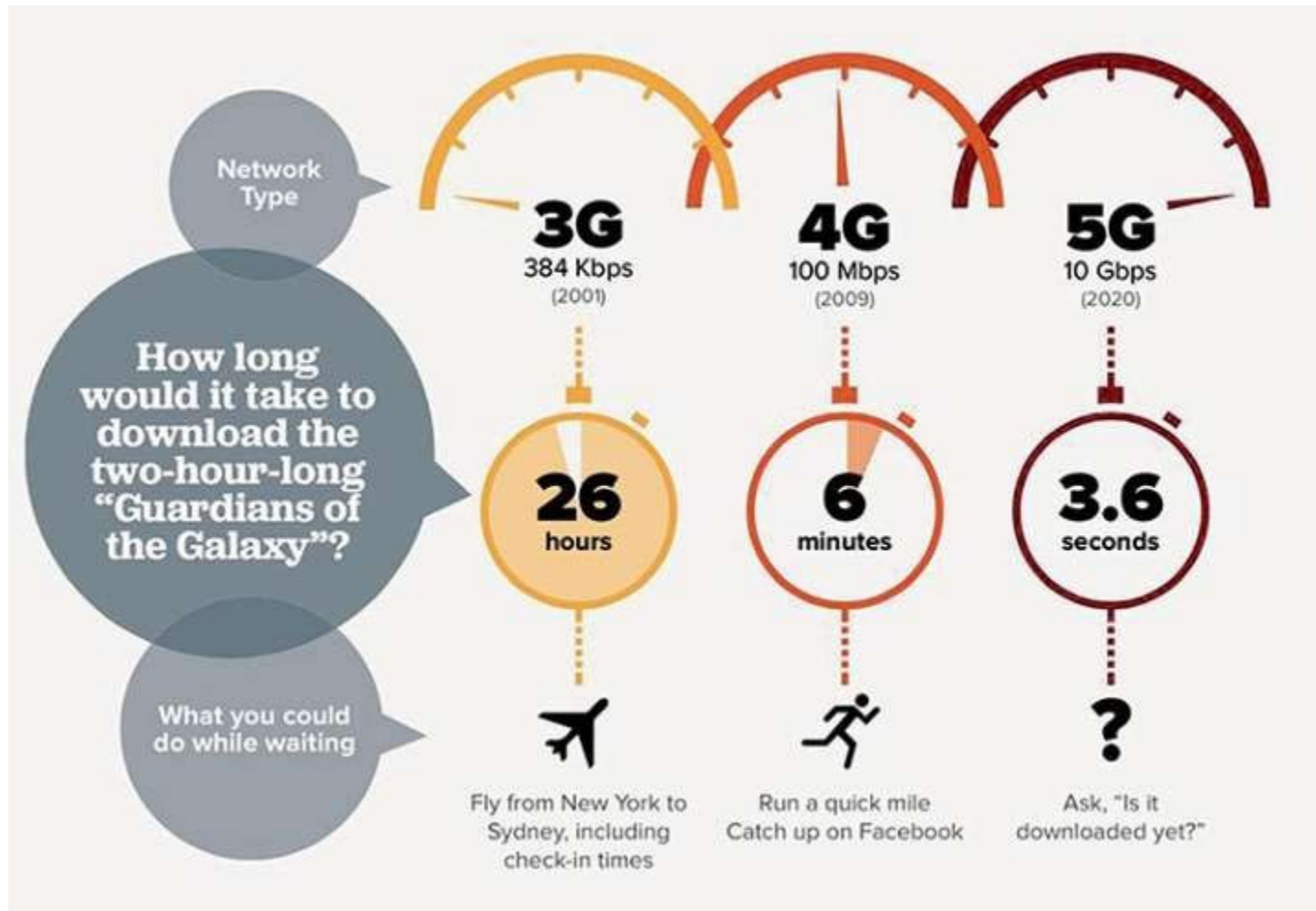


Cloud Video
Providers

750 PB/day

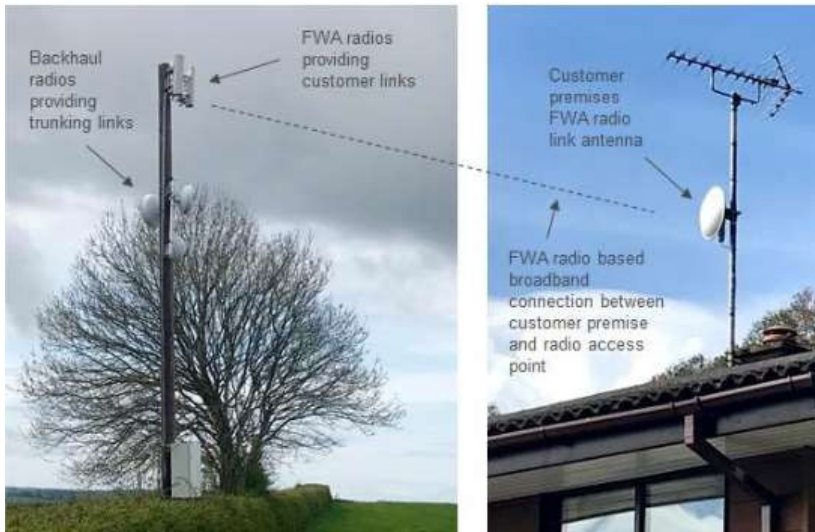
Source: Network of Tomorrow, 5G and Edge – Open Networking Summit Europe 2019

3G, 4G, 5G Comparison ... much faster !

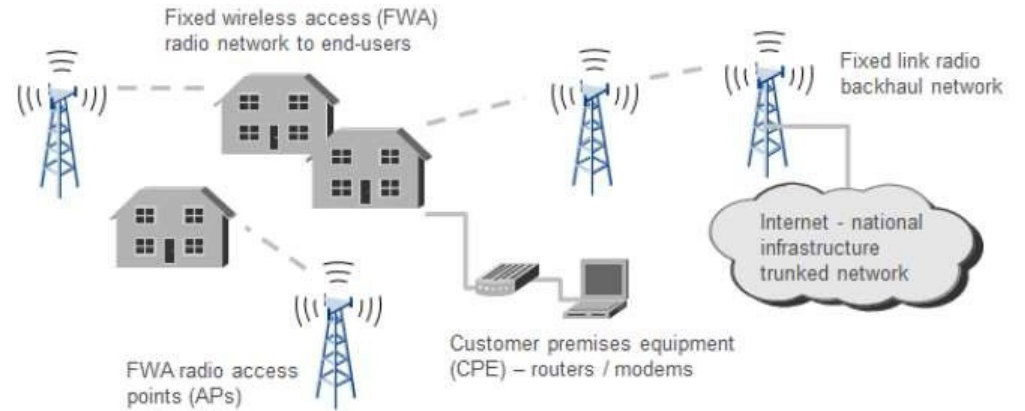


5G Use Cases

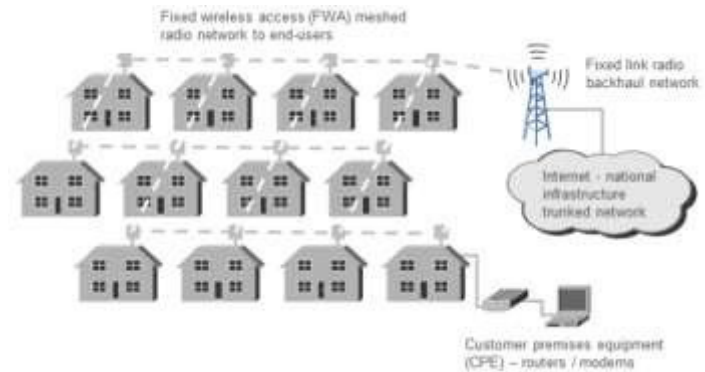
FWA – Fixed Wireless Access



Point to Multipoint



Meshed



Covering Market and 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*



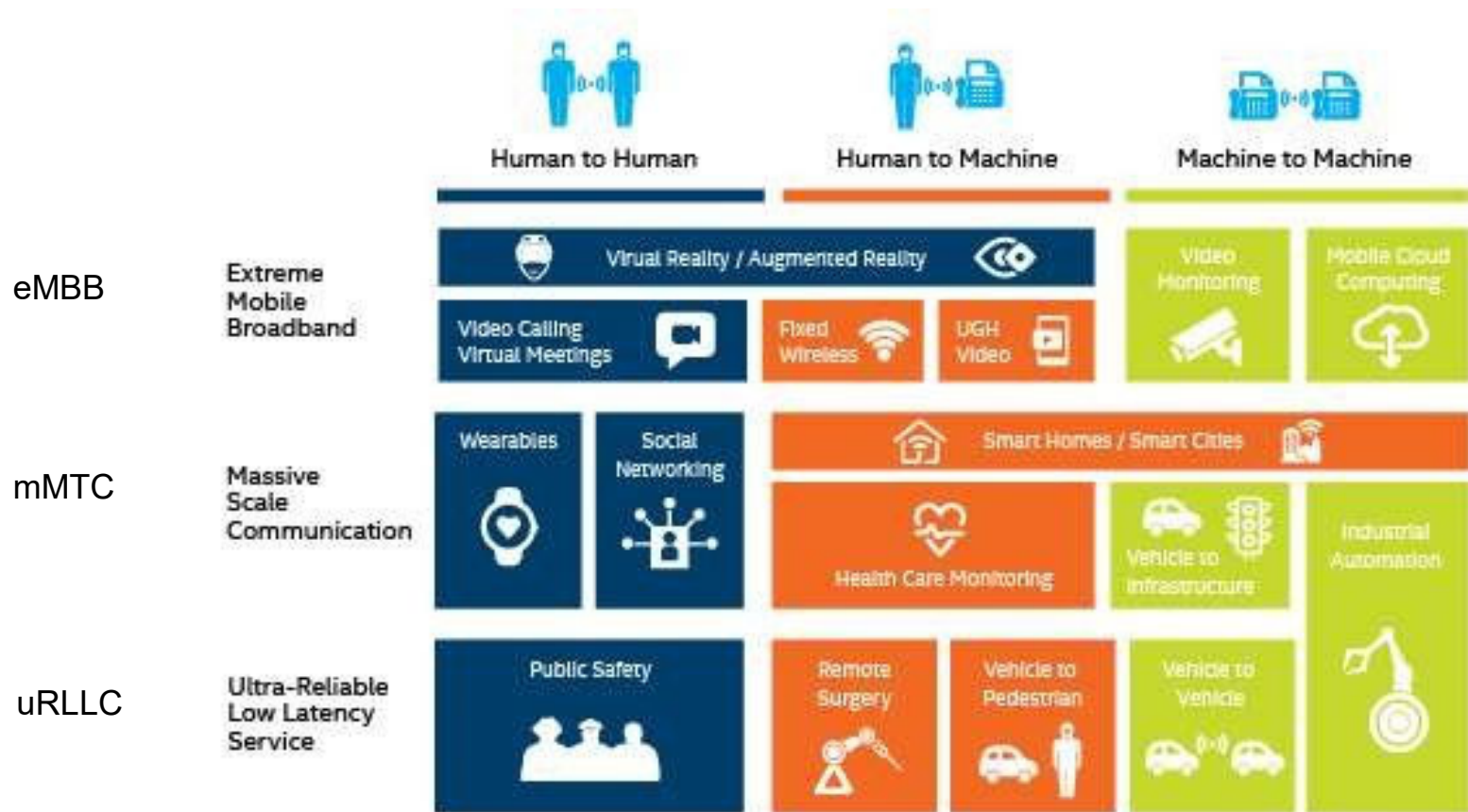
Ultra Reliable Low Latency uRLLC

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

26

3GPP TR 22.891 identifies **74 service** scenarios that should be enabled by 5G

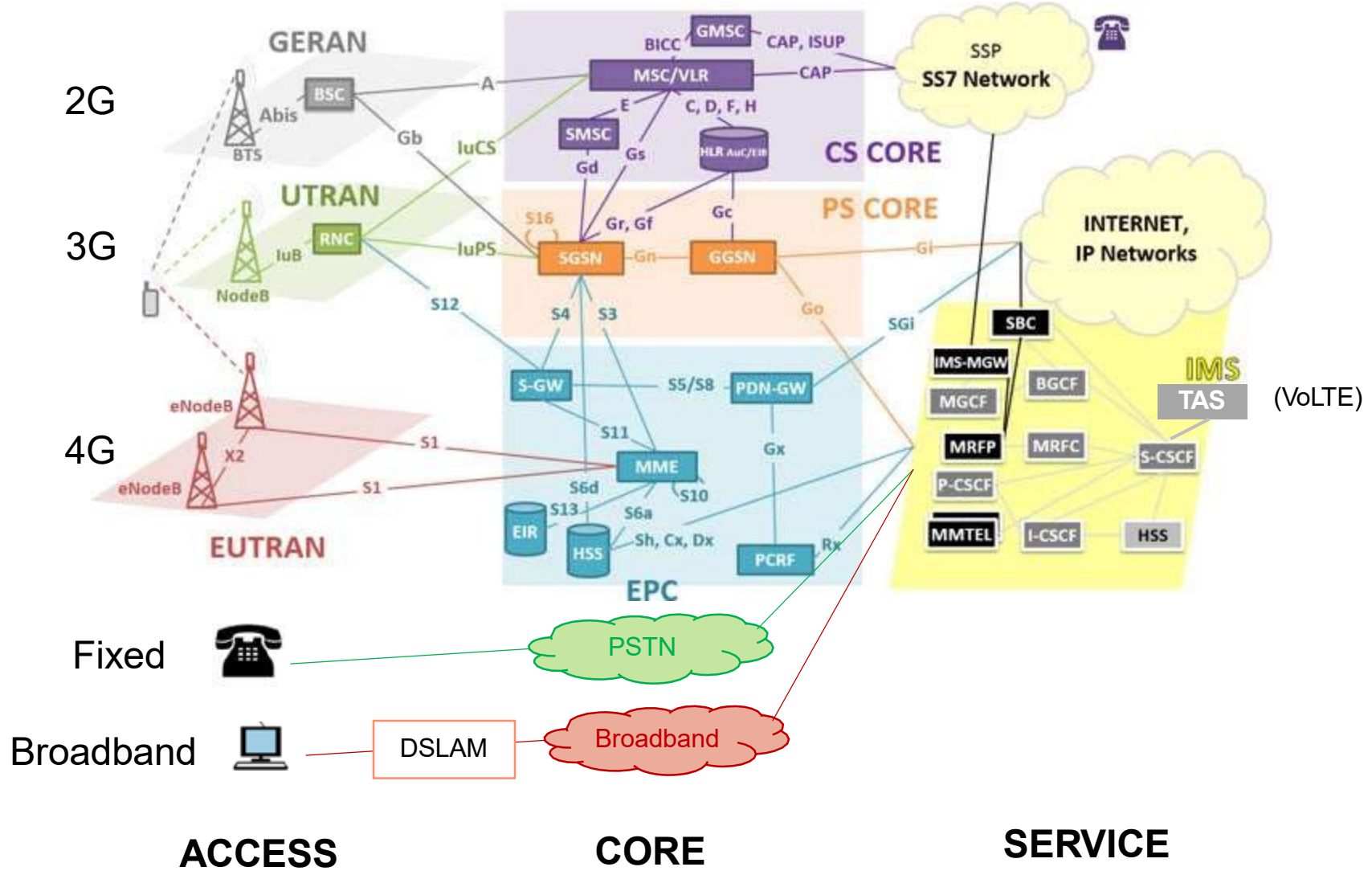
5G Use Cases



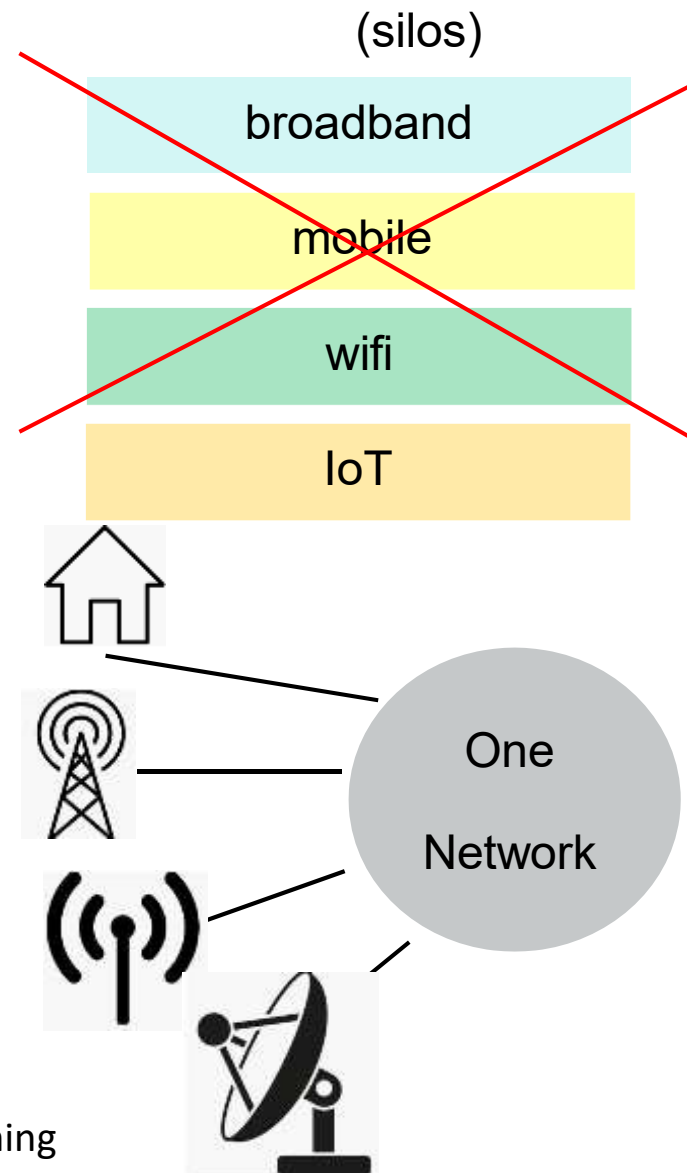
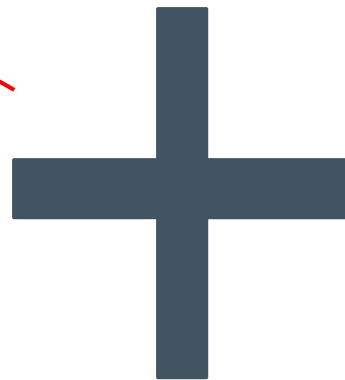
Source: 5G Americas

5G Tech

Current - Multiple Silo networks

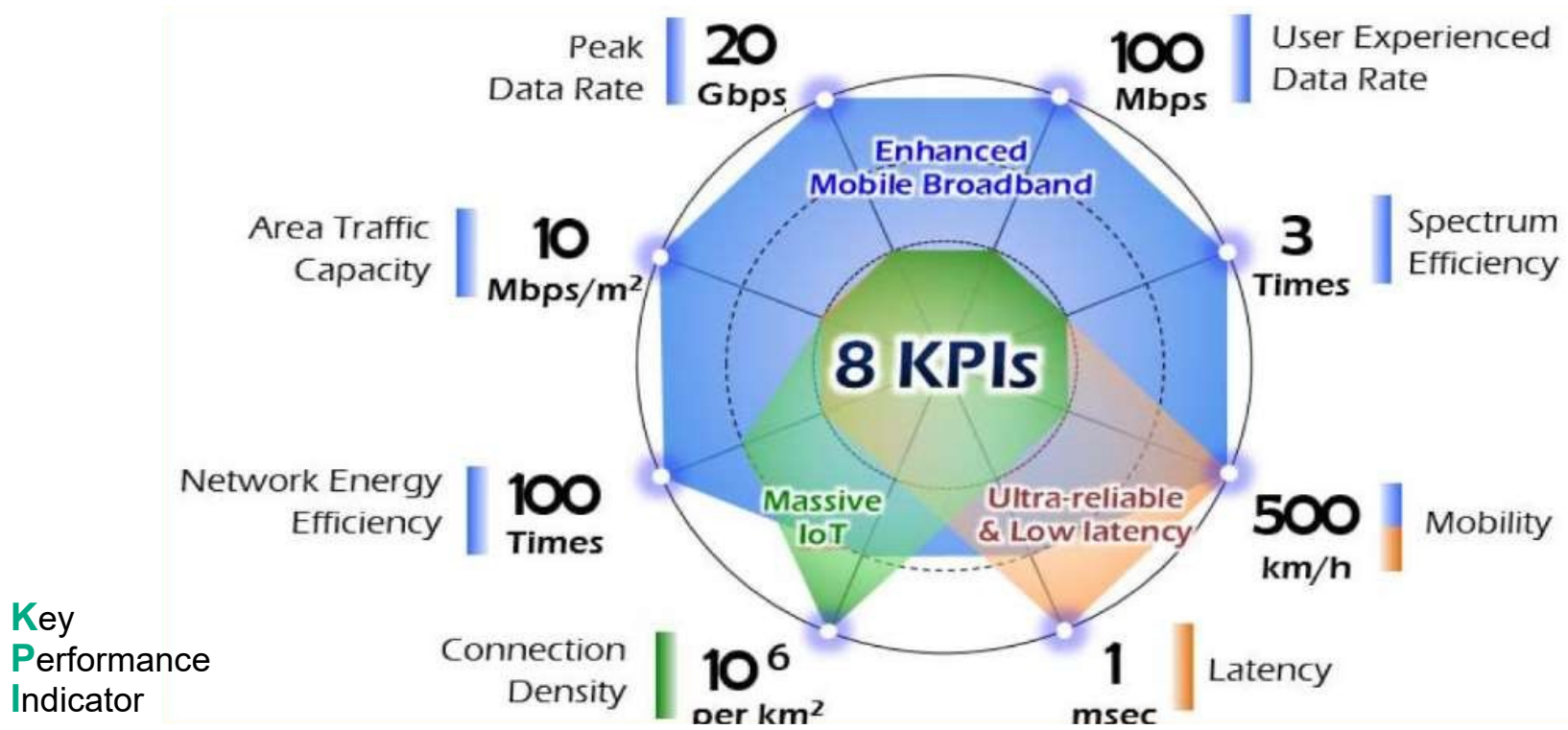


5G: new Antennas, new network Architecture



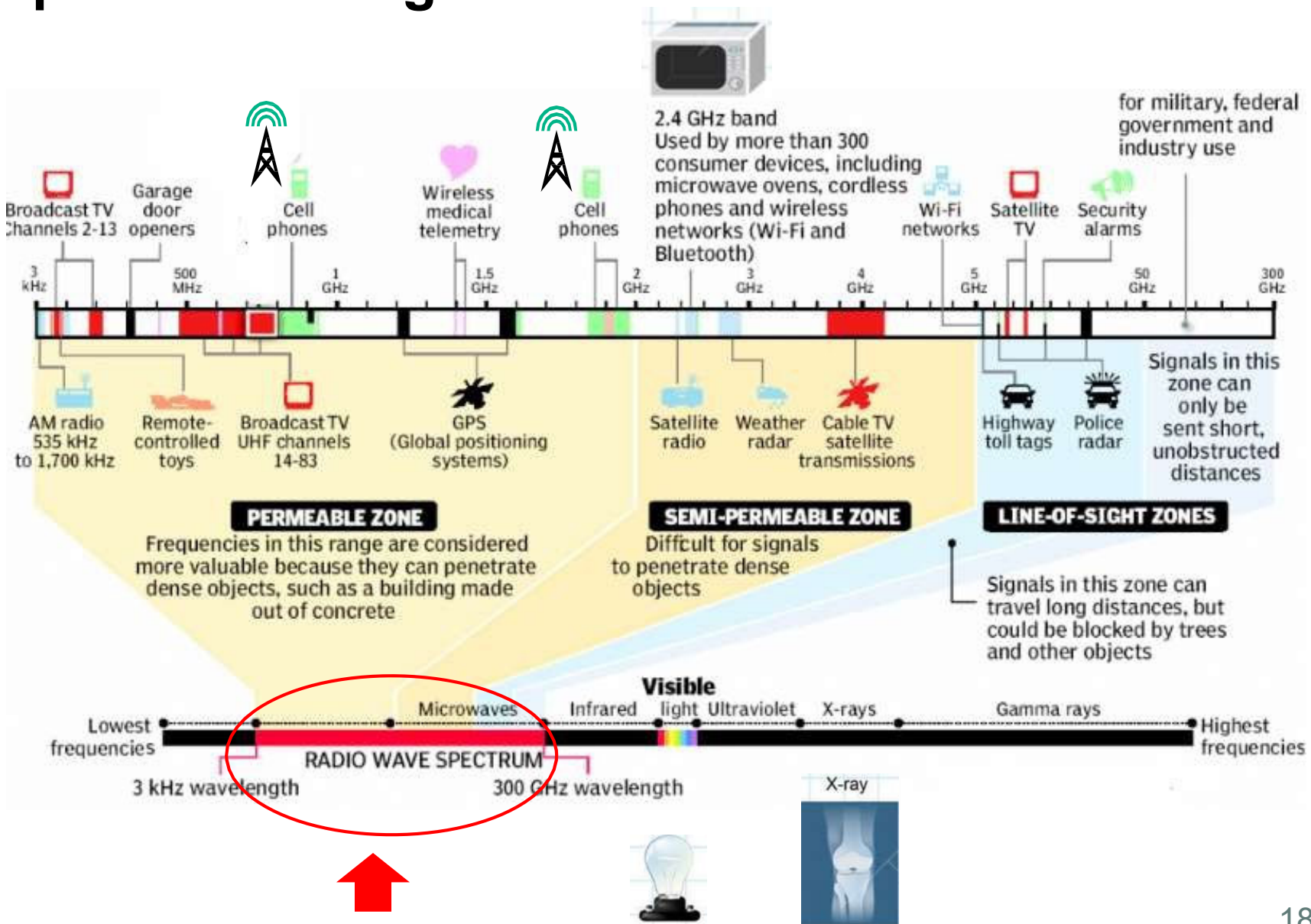
Cloud-native 5G Core that connects everyone and everything

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

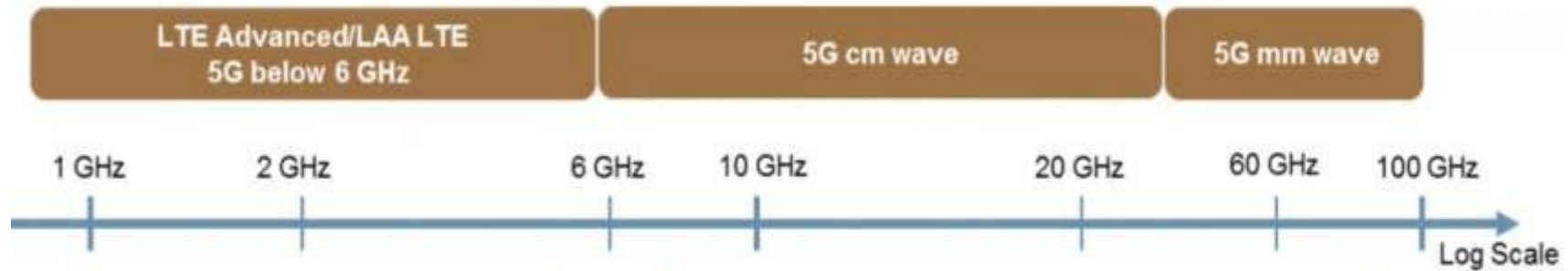


Source: 5GPPP

Spectrum background – Focus on Radio Wave



5G Spectrum ... New Spectrum



Band designation	Frequency range	Explanation of meaning of letters
HF	0.003 to 0.03 GHz	High Frequency ^[3]
VHF	0.03 to 0.3 GHz	Very High Frequency ^[3]
UHF	0.3 to 1 GHz	Ultra High Frequency ^[3]
L	1 to 2 GHz	Long wave
S	2 to 4 GHz	Short wave
C	4 to 8 GHz	Compromise between S and X
X	8 to 12 GHz	Used in WW II for fire control, X for cross (as in crosshair). Exotic. ^[3]
K _u	12 to 18 GHz	Kurz-under
K	18 to 27 GHz	Kurz (German for "short")
K _a	27 to 40 GHz	Kurz-above
V	40 to 75 GHz	
W	75 to 110 GHz	W follows V in the alphabet ^[citation needed]
mm or G	110 to 300 GHz ^[note 1]	Millimeter ^[7]

Meeting ITU Dec 2019

Antennas ... directional, more efficient

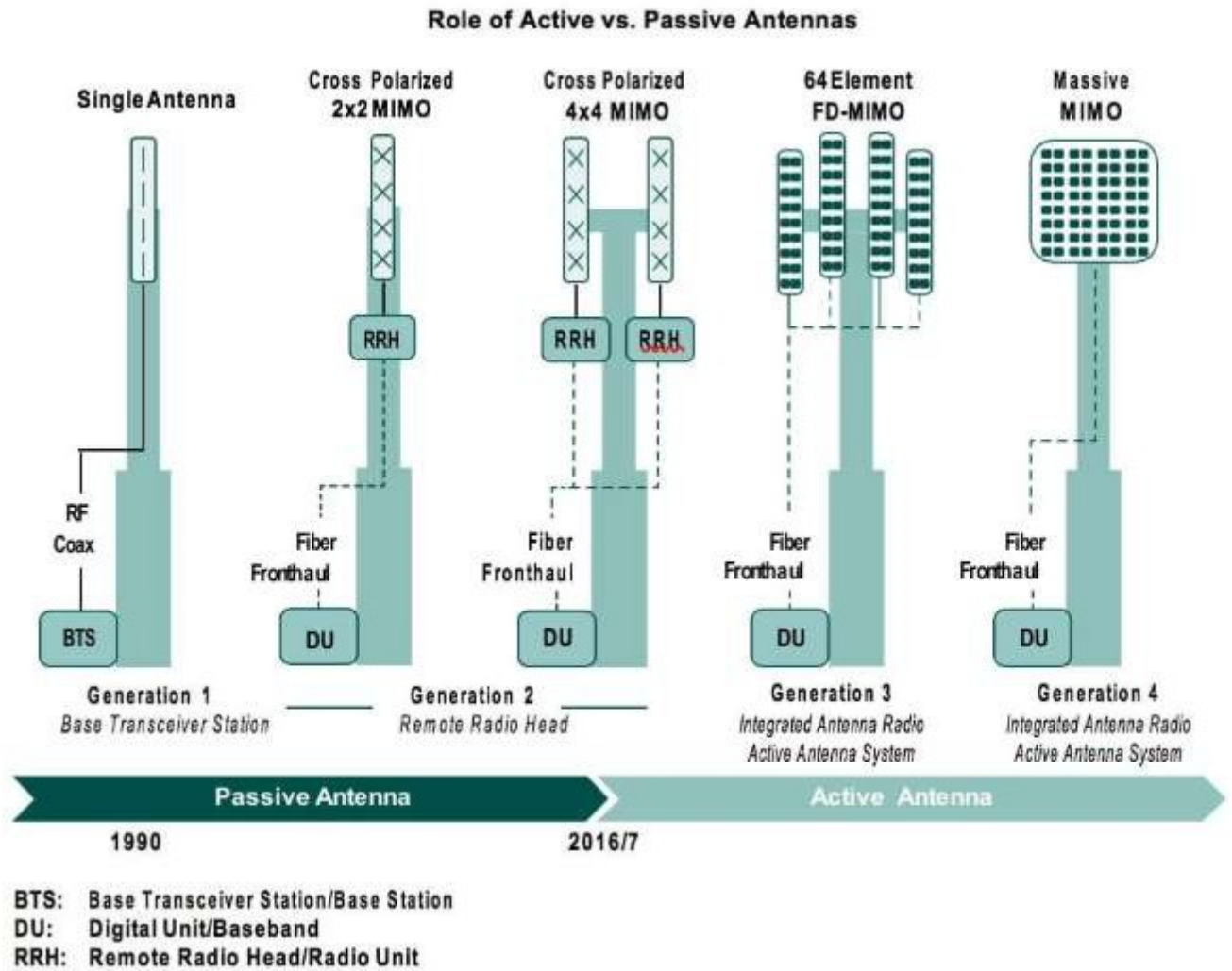
Antenne 4G



Antenne 5G

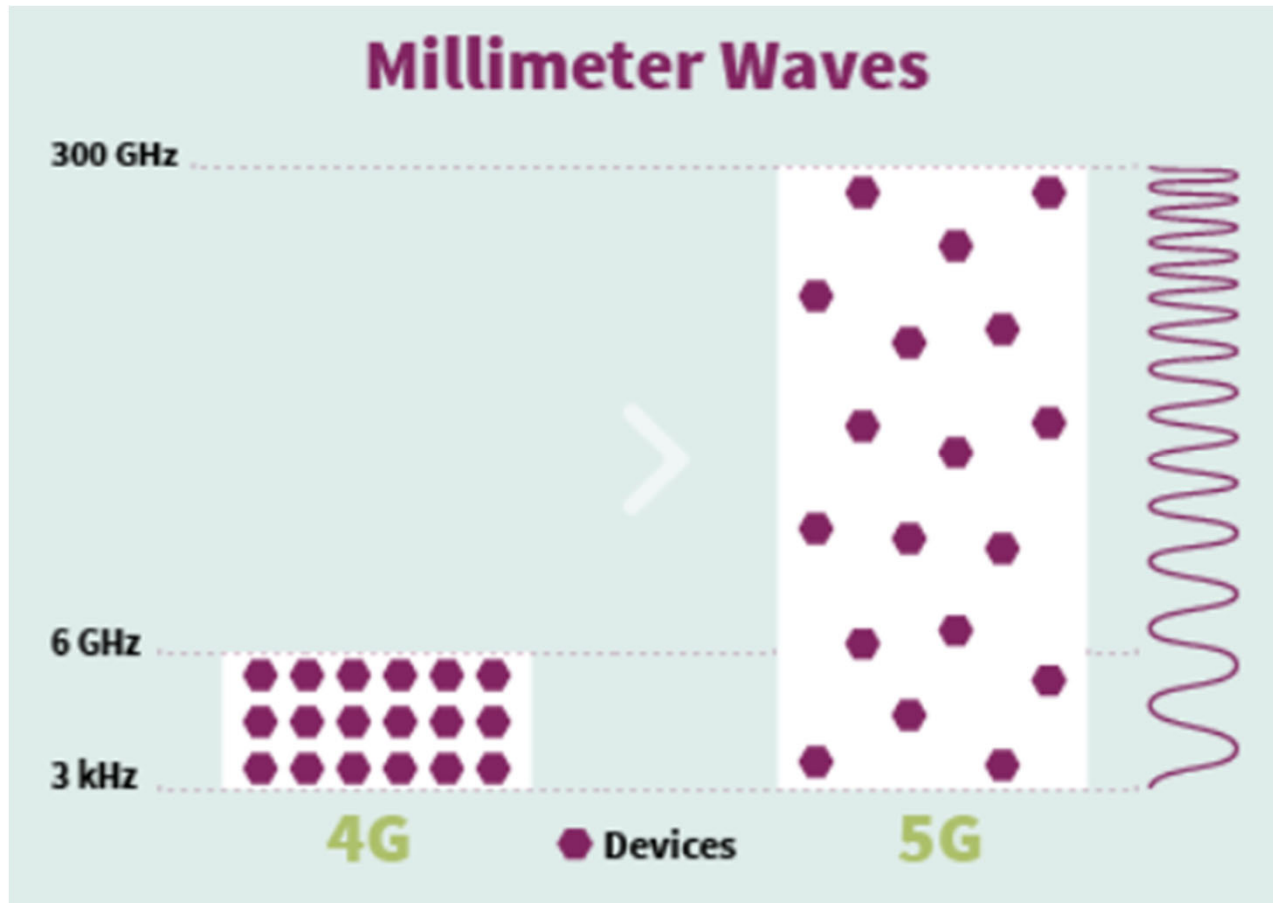


Antenna evolution



Source: RCR Wireless

Millimeter Waves



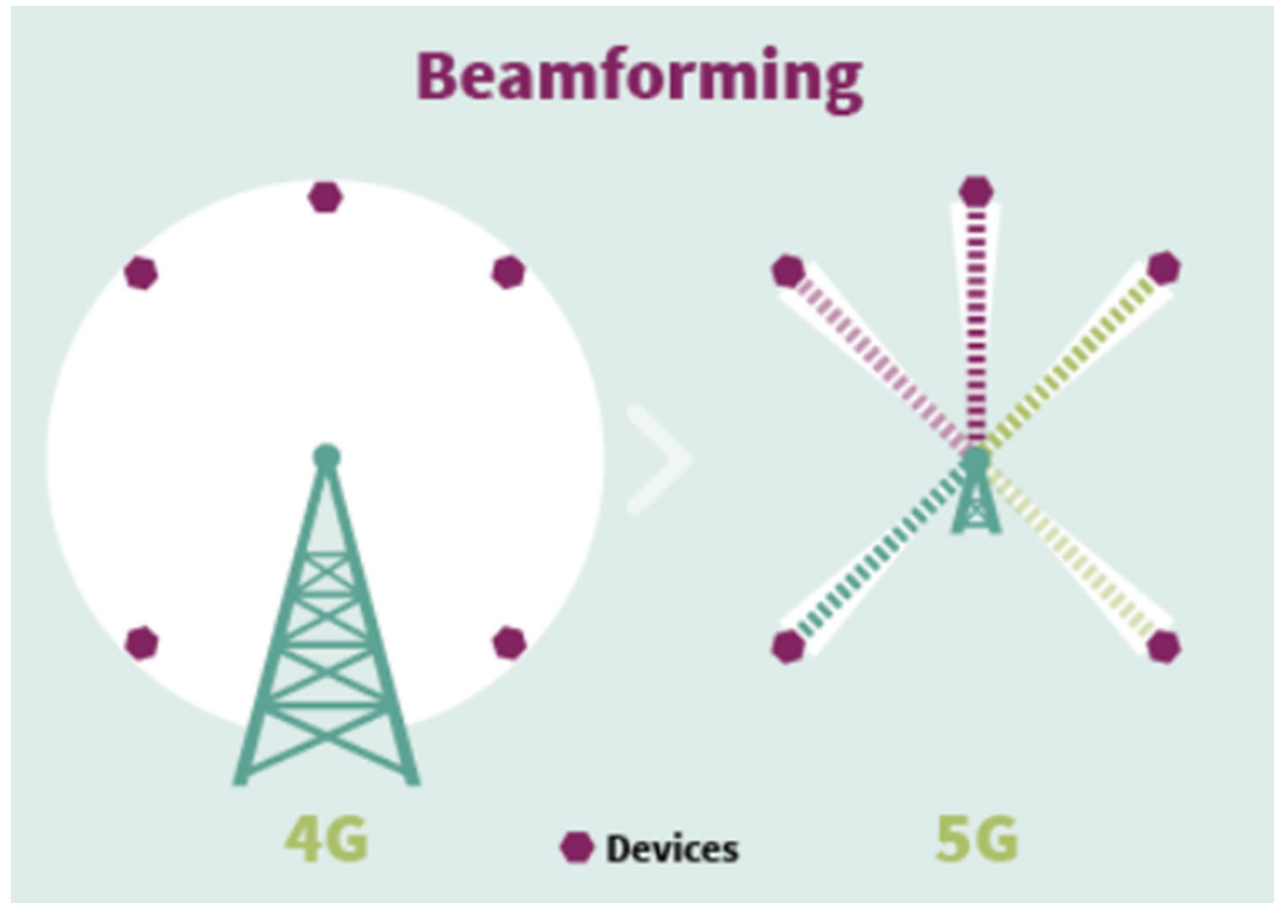
Source: Infinion

Massive MIMO



Source: Infinion

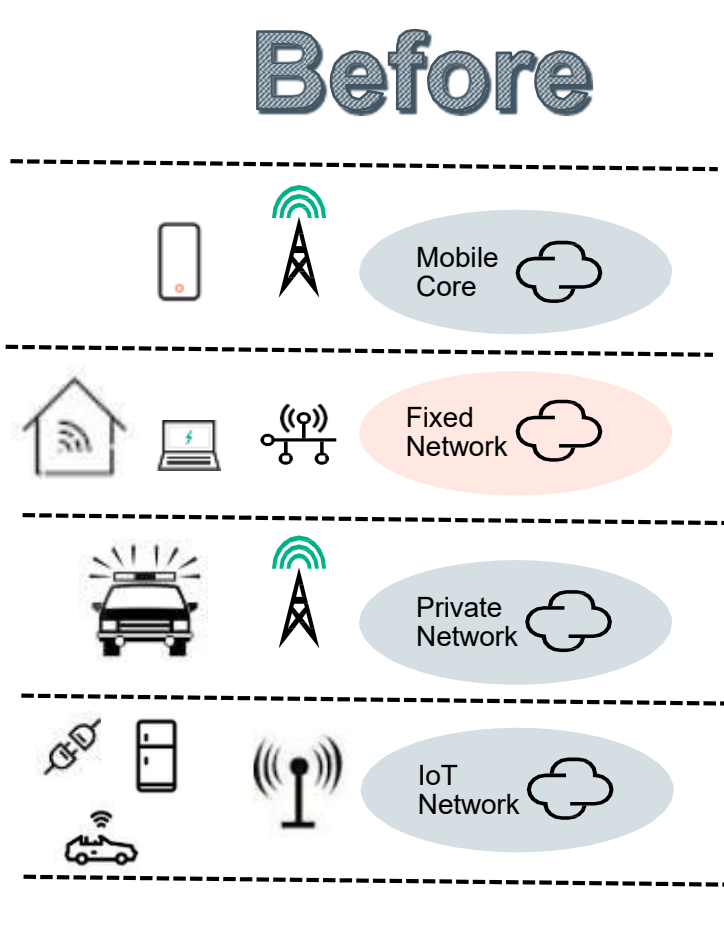
Beamforming



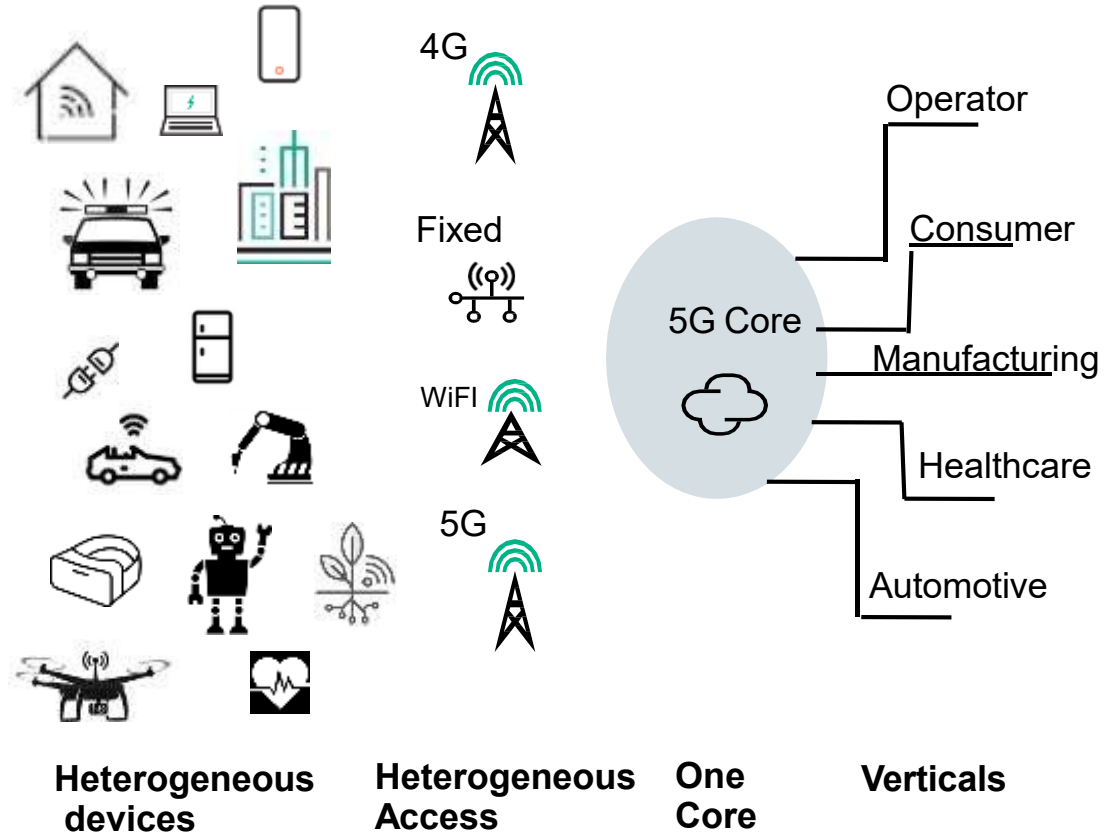
Source: Infinion

From Silos to a Common Core for All

Before



After



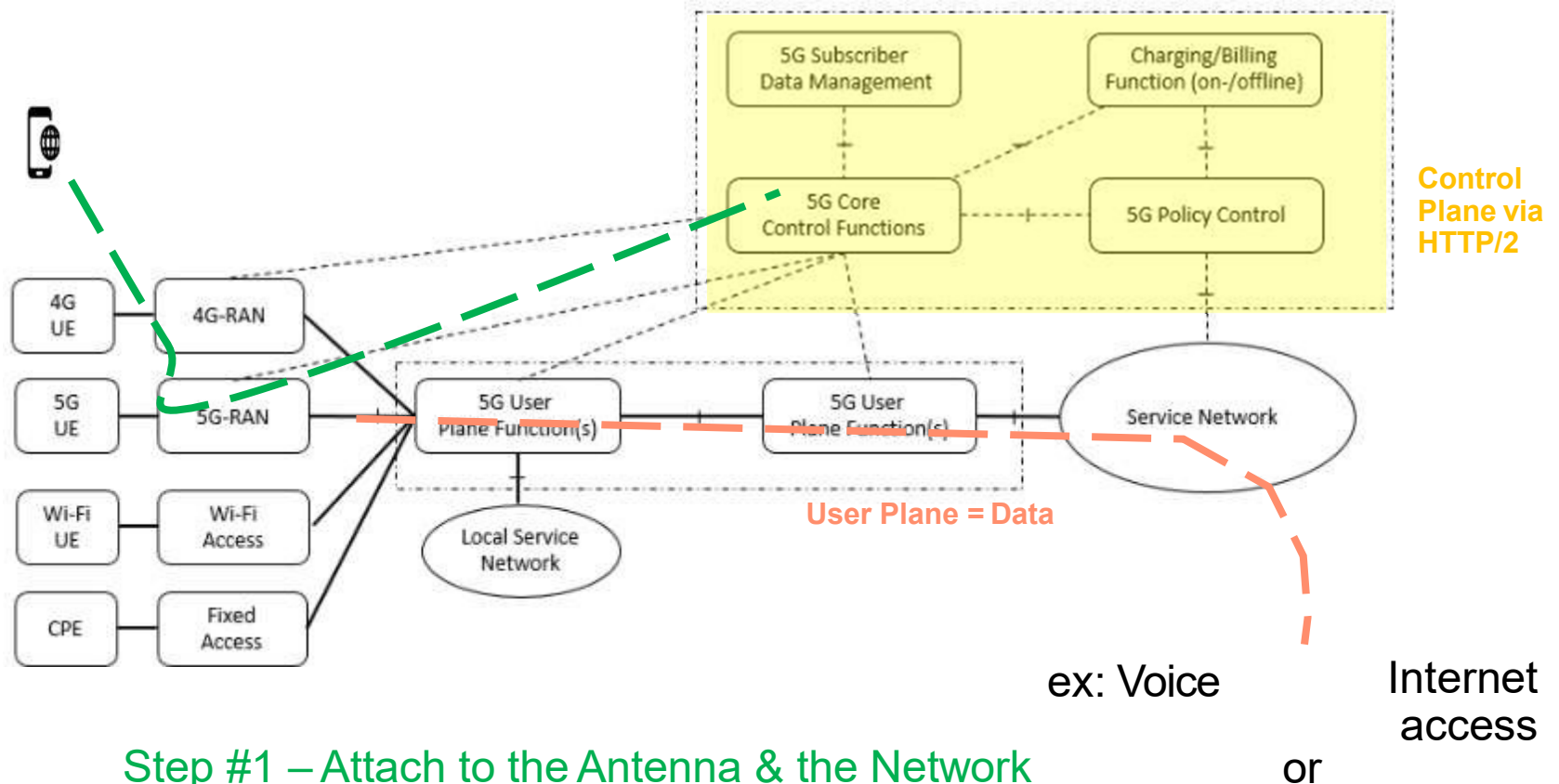
Data security thanks in part to semiconductor solutions

Increased connectivity means that the need for data security is also greater. Smart homes, connected cars and Industry 4.0 require protection against unauthorized access as well as secure data and processes.... protecting the future 5G cellular structure from the rising number of security threats.

5G network Architecture

Heterogeneous Access

Common Core



Step #1 – Attach to the Antenna & the Network
 Ask for authorization to use the Network
 = “Control Plane”

Step #2 – Communicate (Voice, Data, Video) => ex: VoLTE, Internet
 = “User Plane”

5G Slicing

5G Network Slicing

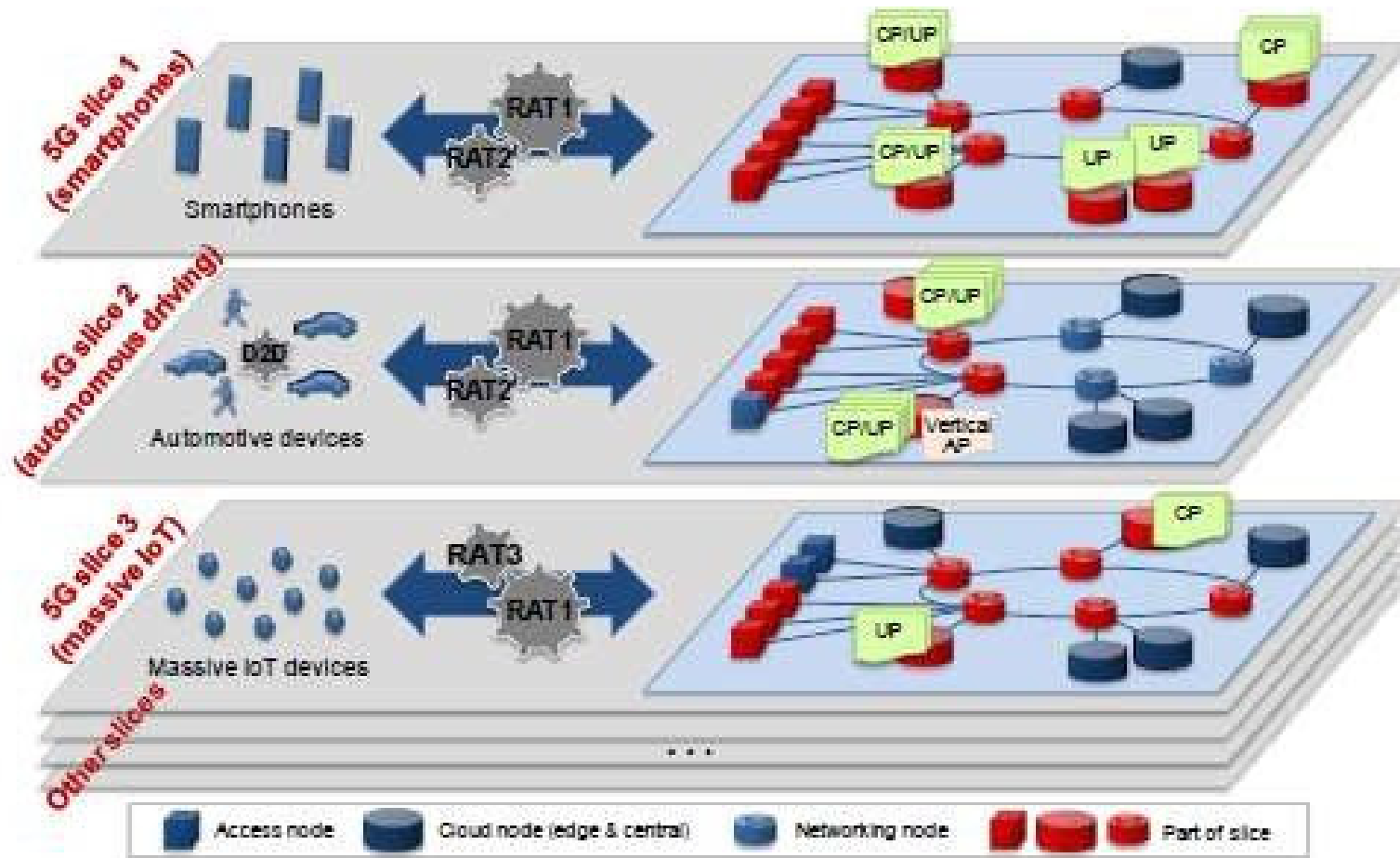
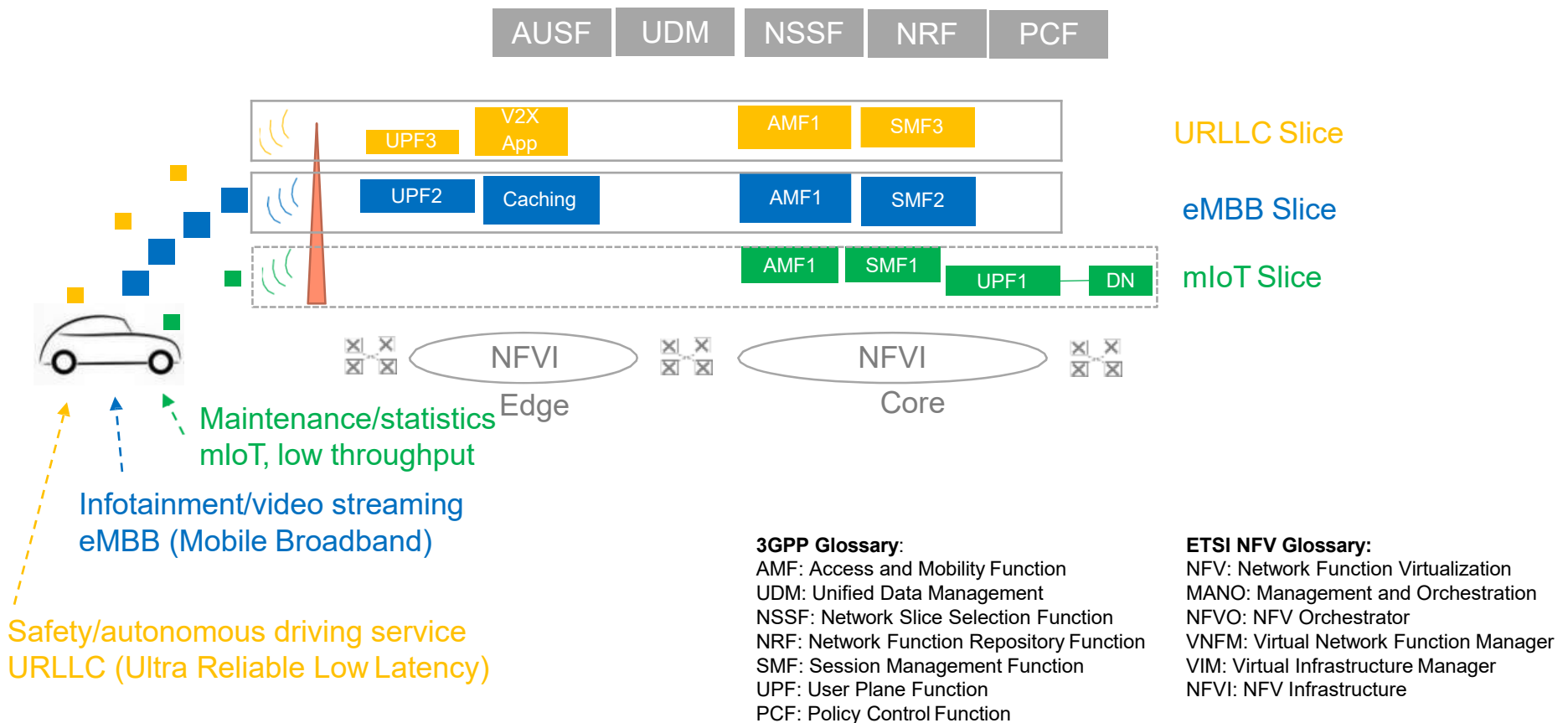


Figure 9: 5G network slices implemented on the same infrastructure

V2X Slice example

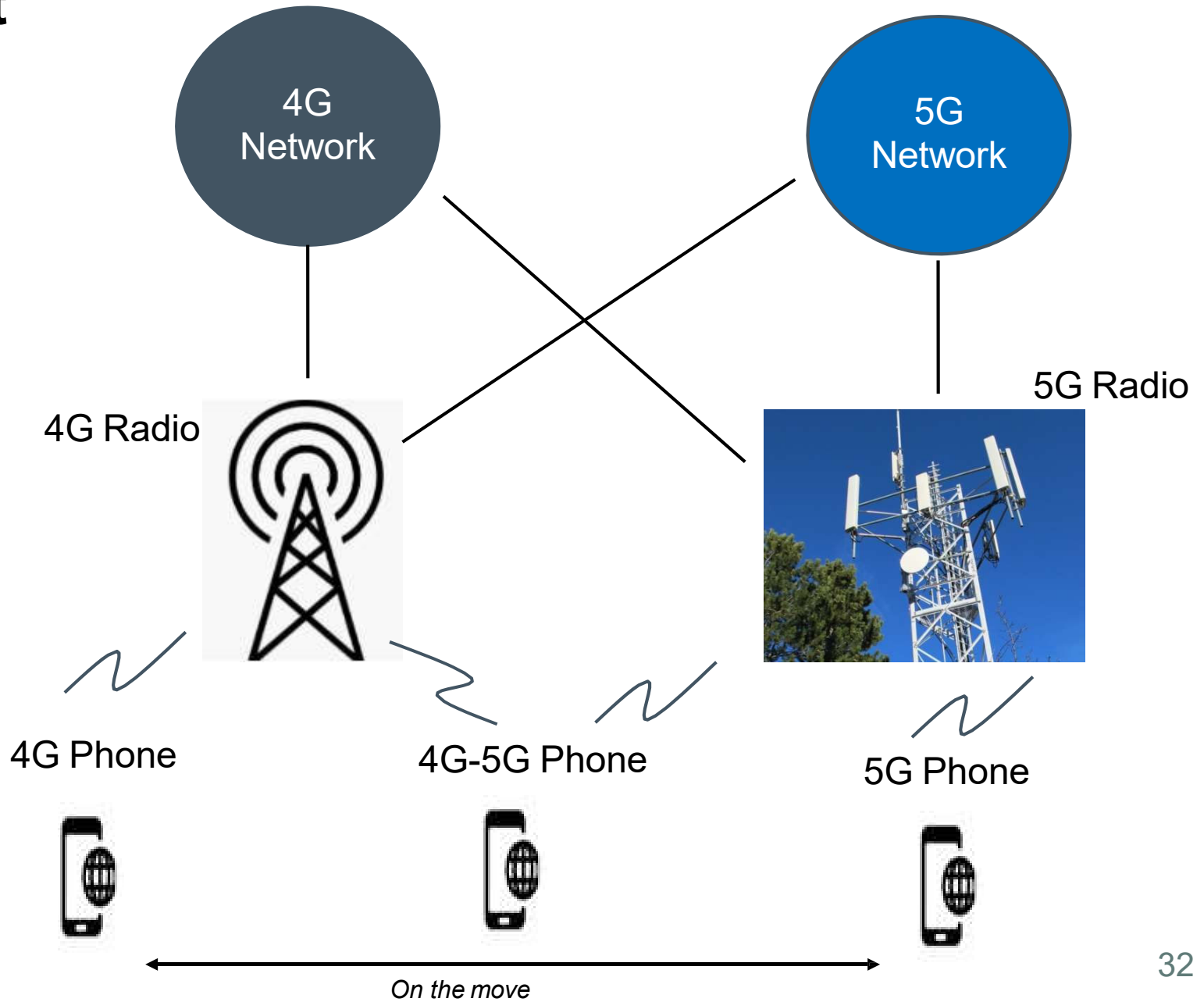
1 car, 1 SIM Card, but 3 slices:

- One for car sensors = IoT
- One for entertainment in the back seat = eMBB
- One for autonomous driving, highly reliable, low latency to prevent collision = uRRLC



Deployment Model

target



5G Today – T-Mobile

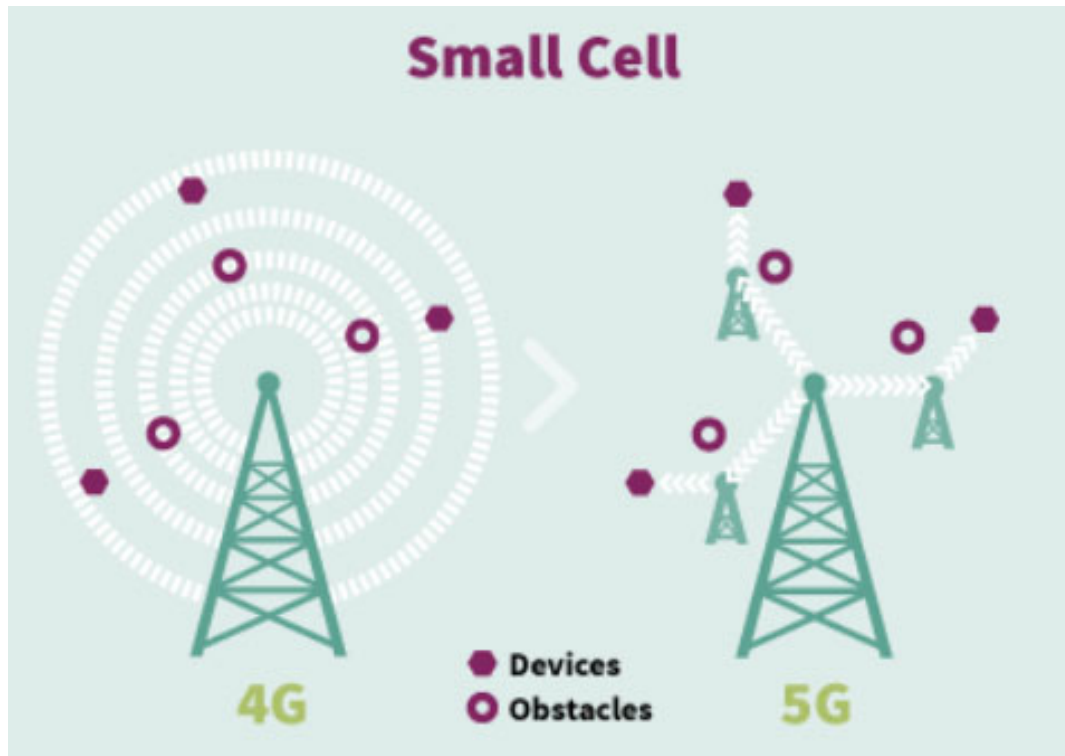
T-Mobile is offering 5G using sub-6GHz bands that cover wider areas. It is also planning on launching mmWave spots in select urban locations in the near future.



T-Mobile is currently offering five 5G phones: the Samsung [Galaxy S20](#) 5G, the Samsung [Galaxy S20+](#) 5G, the [Samsung Galaxy S20 Ultra](#) 5G, the [OnePlus 8](#) 5G and the [LGV60 ThinQ](#) 5G.

5G Configurations and Projects

Small Cell

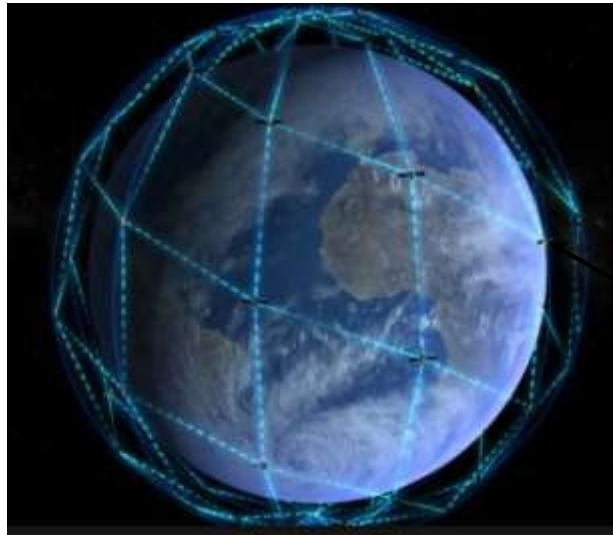


Source: Infinion

Lots of satellite Constellation that could evolve to 5G



Iridium Next Satellite Constellation



70+ satellites
Altitude: 780km

66 active satellites, with another nine in-orbit spares and six on-ground spares

Service Live since 2018

Last satellite launch (by SpaceX – Falcon9) in January 2019

Direct communication to Iridium satellite phone



The constellation provides:

- L-band data speeds of up to 128 kbit/s to mobile terminals,
- up to 1.5 Mbit/s to Iridium Pilot marine terminals,
- high-speed K_a-band service of up to 8 Mbit/s to fixed/portable terminals.

InDirect communication Via Terminals



=> 5G 'failover' Roadmap with Thales Mission Link terminal

WIFI

3G – 4G

5G

Starlink – Elon Musk 12,000 Satellites

In November 2018 SpaceX received FCC approval to deploy 7,518 broadband satellites, in addition to the 4,425 satellites that were approved in March 2018 => $7,518 + 4,425 = 11,943$

Theoretically, Starlink will be able to send message twice as fast as optic fibers, since signal speeds are slower when transmitted through glass than through space.

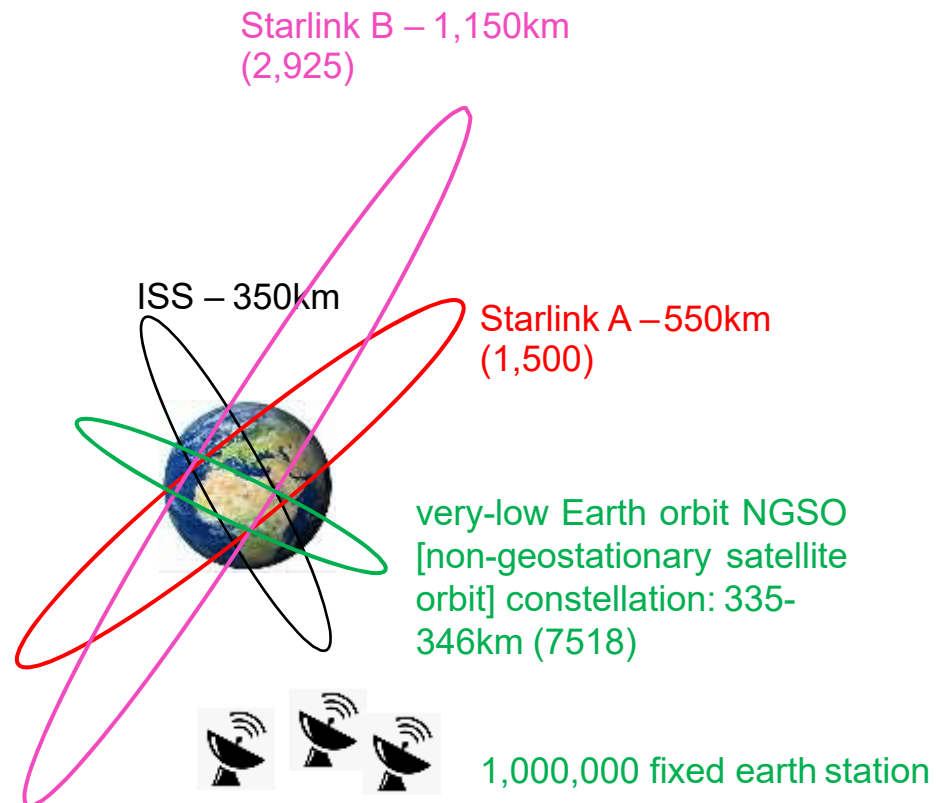
INVESTING IN SPACE

SpaceX says Starlink internet has 'extraordinary demand,' with nearly 700,000 interested in service

PUBLISHED SAT, AUG 1 2020 3:00 PM EDT

Michael Sheetz @THESHEETZTWEETZ

SHARE f t in e



Updates and sign up for beta: <https://www.starlink.com/>

Questions and Contact

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Resouces:

GSMA: https://www.gsma.com/futurenetworks/ip_services/understanding-5g/

LightReading: <https://www.lightreading.com/5g.asp>

Integrated access and backhaul – a new type of wireless backhaul in 5G:

<https://www.ericsson.com/en/reports-and-papers/ericsson-technology-review/articles/introducing-integrated-access-and-backhaul?gclid=EAIaIQobChMIK-0vIKJ6wIViITCh1arweuEAAYAiAAEgIOXfD BwE&gclsrc=aw.ds>

5G bandwidth and wavelength: <https://www.verizon.com/about/news/5g-bandwidth-wavelength/>

What is edge computing? The benefits of mobile edge computing and 5G:

<https://www.verizon.com/about/news/what-is-edge-computing>

5G Telecommunications Science Safety: <https://mdsafetech.org/5g-telecommunications-science/>

5G Spectrum and Frequencies: Everything You Need to Know: <https://www.lifewire.com/5g-spectrum-frequencies-4579825>