

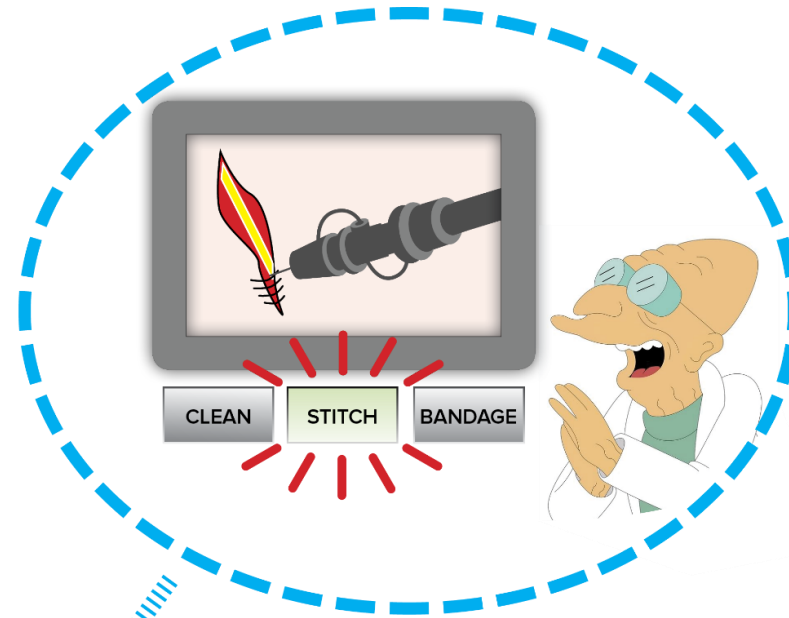
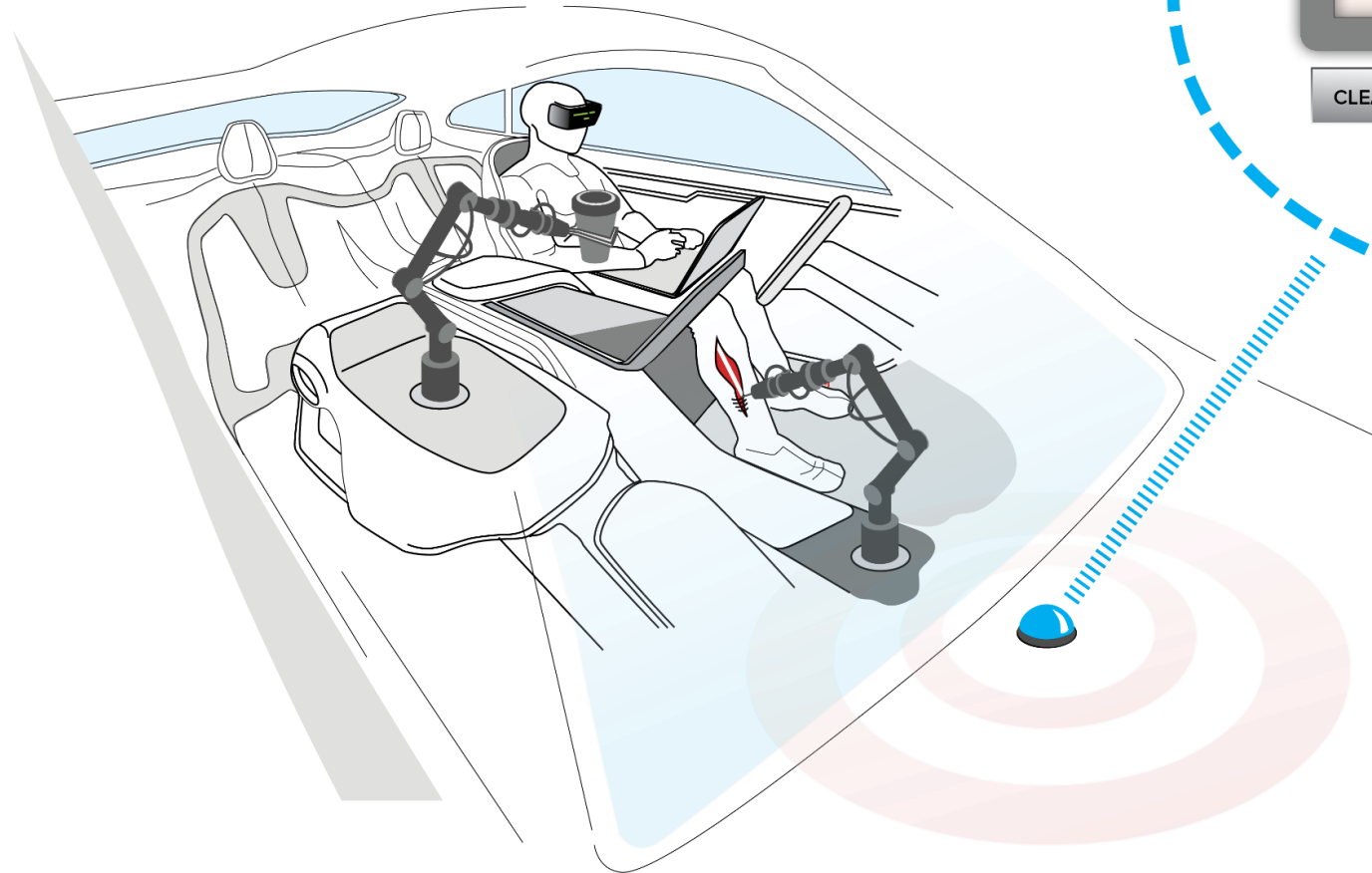
Gimme 5!

5G – What's it all about?

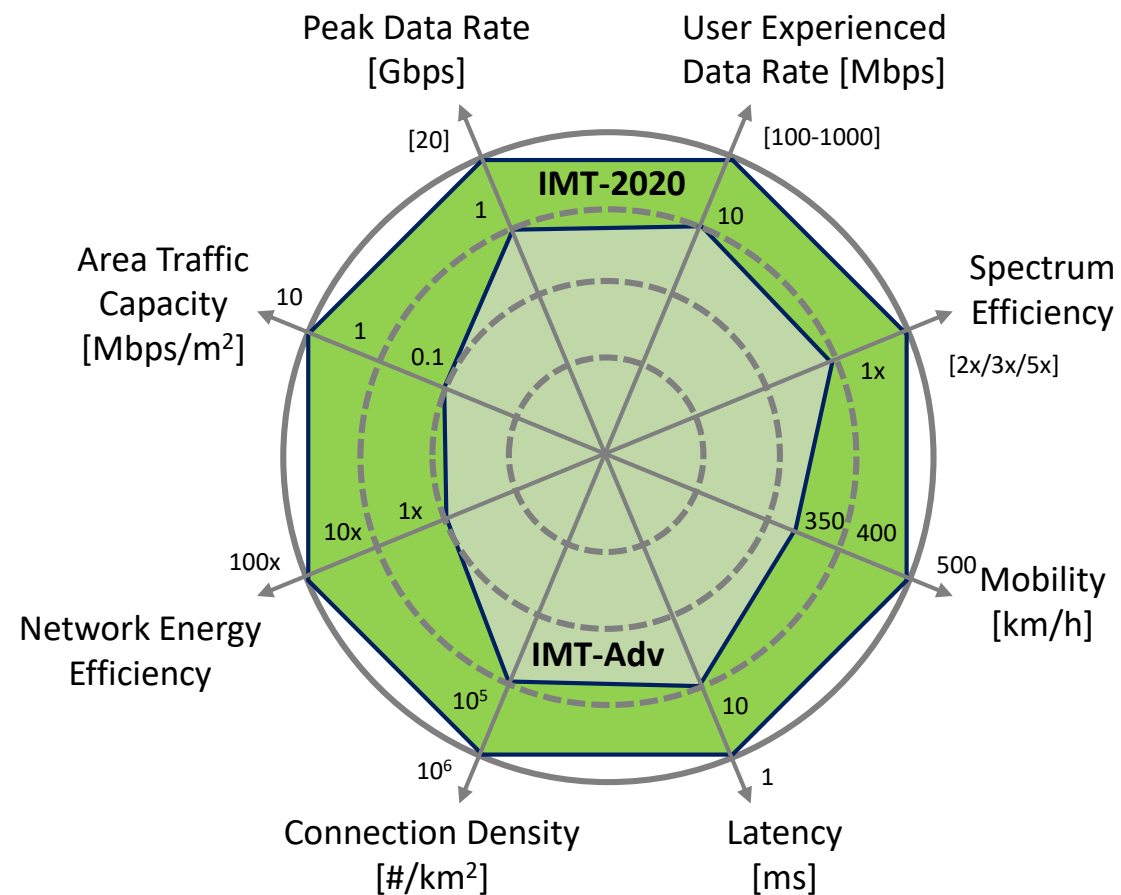
Anand Ram @ ITSF2017



5G – The Hype



5G – The Vision

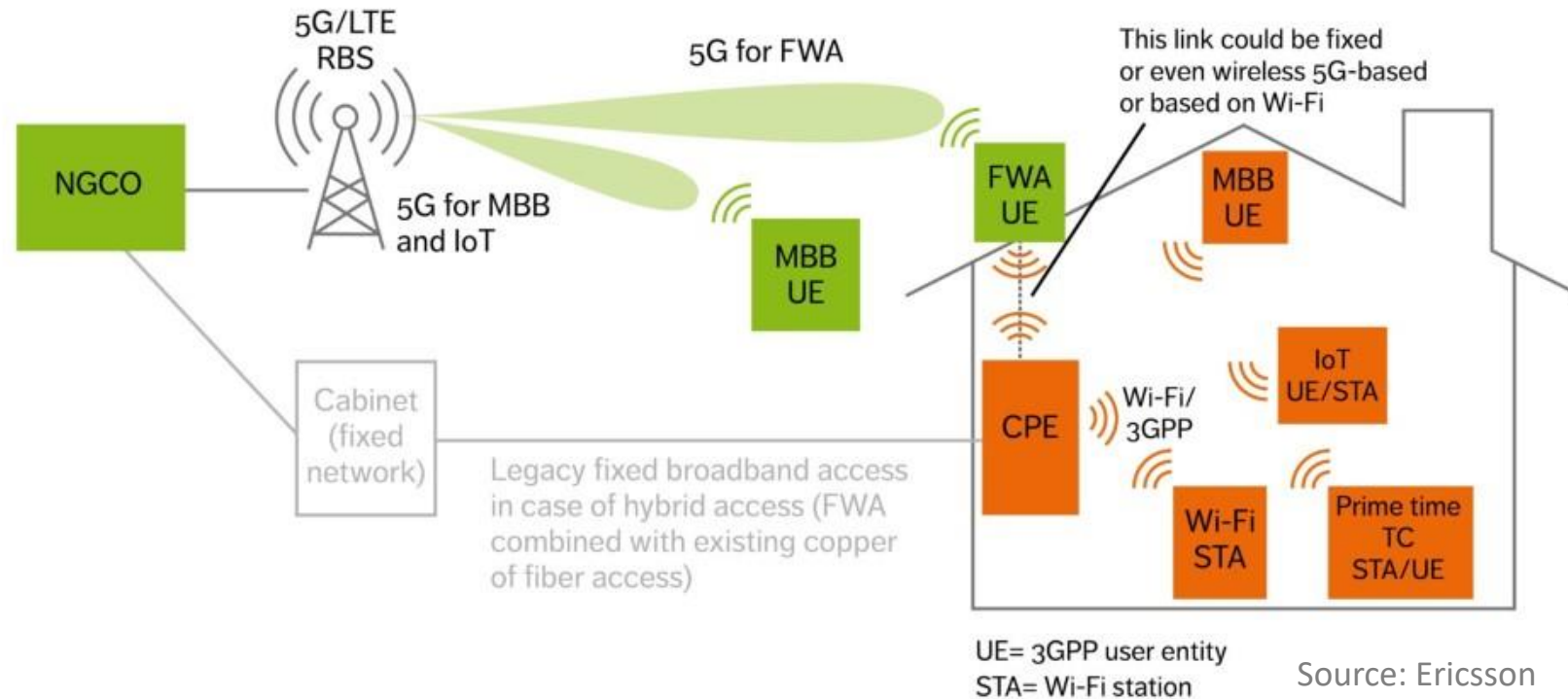


"4G has changed lifestyles. 5G will re-shape societies"

Mr. Li Yue, CEO – China Mobile

- IMT-Advanced (LTE, 4G)
- IMT-2020 (5G), relative to IMT-Advanced

5G – The Reality



- Shared infrastructure – Mobile, Home, Enterprise → Savings
- Backhaul/Fronthaul Capacity will need to grow rapidly

Breaking News! – 5G Has Landed*



Light Reading
5G
A NEW GENERATION
OF COMMUNICATIONS

HOME NEWS & VIEWS FEATURED STORIES AUTHORS MESSAGES VIDEO AUDIO WEBINARS RESEARCH LR EVENTS

TECHNOLOGY COMPONENTS GIGABIT MOBILE 5G IoT CABLE OPTICAL ETHERNET/IP DATA CENTER S

HOT TOPICS AUTOMATION WHITE BOX SERVICES SECURITY UBB 2020 ENTERPRISE CLOUD WOMEN IN COMMS

3GPP Plans Early Mobile 5G Spec for December 2017



NEWS ANALYSIS
DAN JONES,
Mobile Editor
9/8/2016

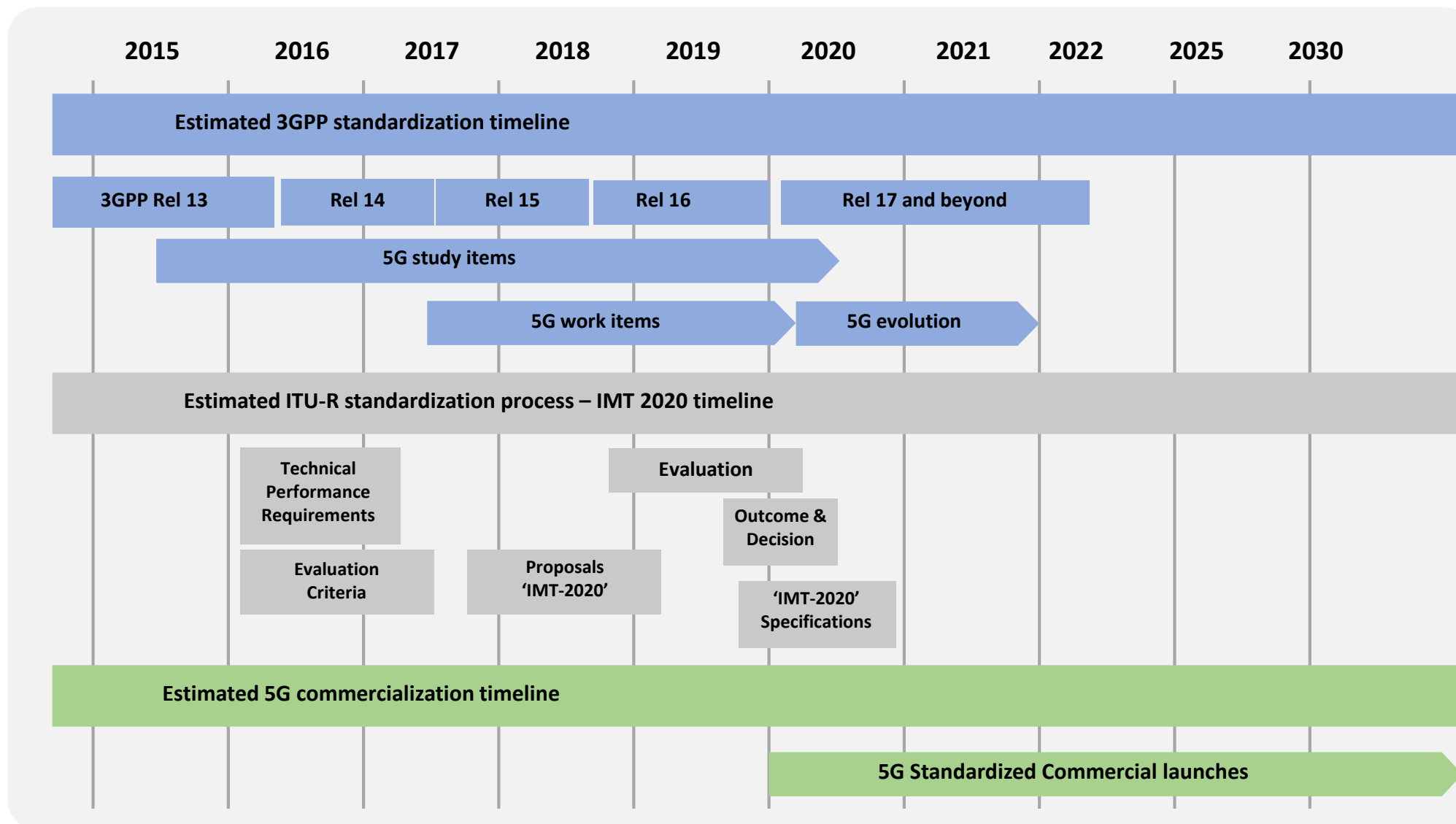
COMMENT (14)

LAS VEGAS -- CTIA Super Mobility Week 2016 -- An initial version of the 5G specification for mobile applications could be agreed upon on by the end of 2017 but that doesn't mean the over-arching spec is agreed upon yet.

The 3rd Generation Partnership Project (3GPP) 's NSA-NR (Non-Standalone-New Radio) specification is now due to be baked in December 2017. "NSA-NR is intended for mobile devices," Qualcomm Inc. (Nasdaq: QCOM)'s SVP of engineering, Durga Malladi, told me on the show floor Wednesday evening.

The non-standalone part of NSA-NR refers to the fact that a 5G radio is twinned with LTE as the "anchor network" managing the connection. In other words, 5G is the fast radio super highway, while LTE functions as the stop and go lights controlling the traffic and making sure calls get on and off the highway. (See Is

****Next month***



The New Radio (NR)

5G NR Objectives

Peak Data Rate	20Gbps DL; 10Gbps UL
Peak Spectral Efficiency	30bps/Hz – 15bps/Hz
Control Plane Latency	10ms
User Plane Latency	URLLC: 0.5ms UL and DL
Mobility Interruption Time	0ms
Inter-system Mobility	With other IMT systems
Reliability	URLLC: P=10-5 in 1ms
Coverage	mMTC 164dB
Extreme Coverage	100-400km voice/low data
UE Battery Life	mMTC 15 years
Connection Density	mMTC 1M device/km ²
Mobility	500 km/h

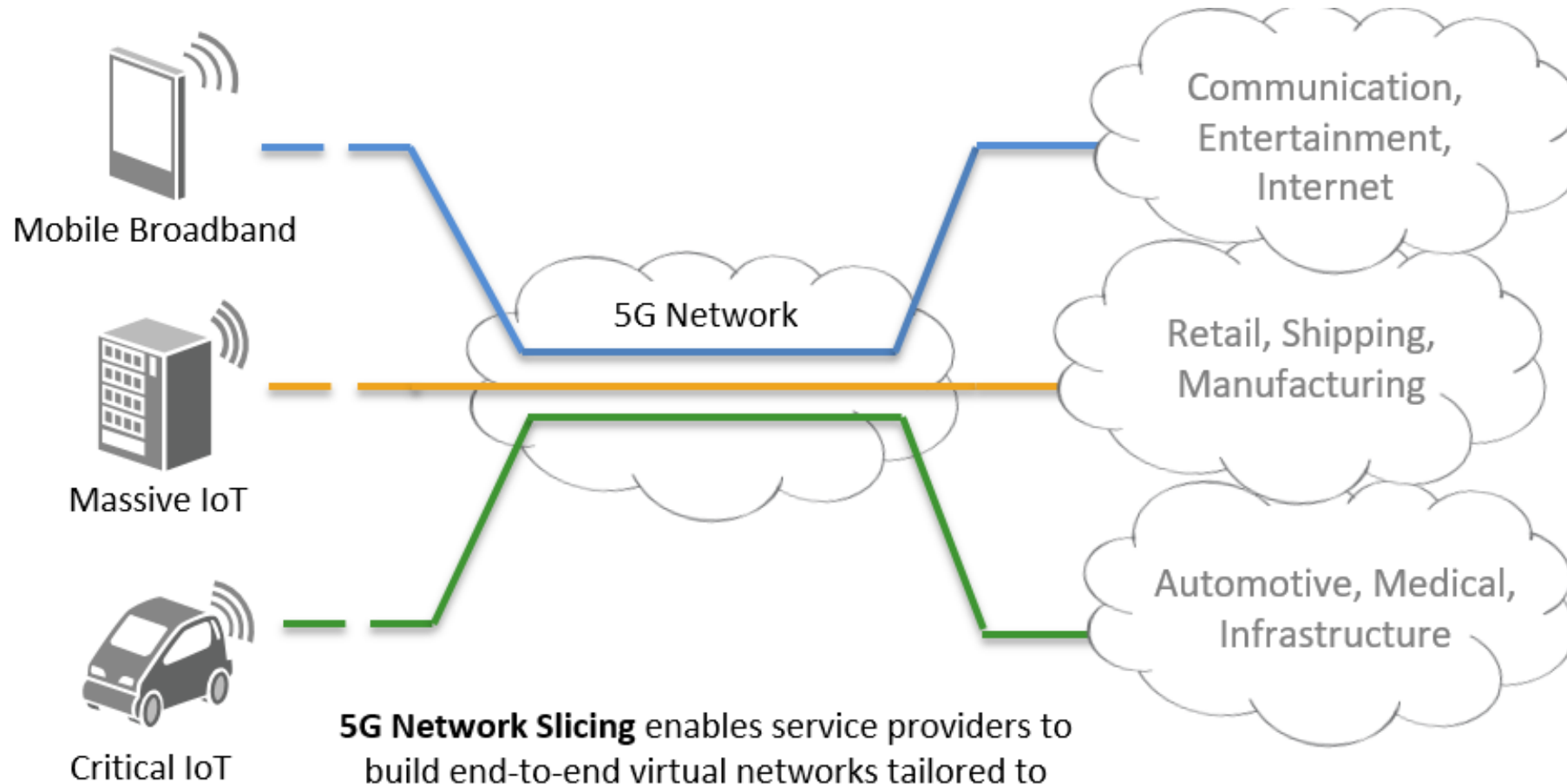
5G NR

- Spectrum
 - Sub-6GHz
 - mmWave (>24GHz)
- Massive MIMO (>8x8)
 - 128-element MIMO field trials in 2017
- New waveforms, multiple-access techniques
 - e.g. SC-FDE and RSMA for IoT
- Scalable and flexible Time Transmission Interval (TTI)
- Adaptive beam-forming and beam-tracking



The Next-Gen Core (NGCN)

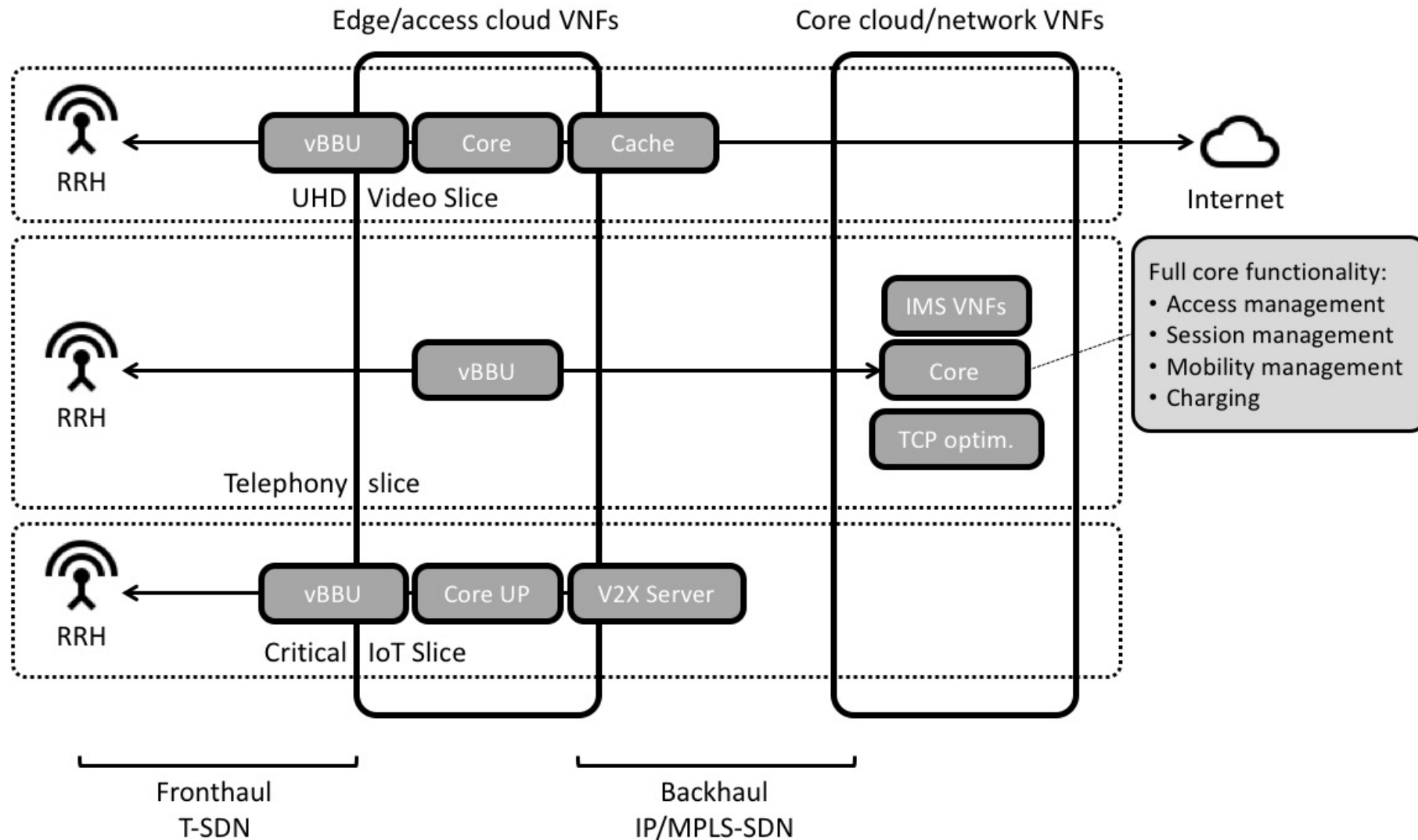
Network Slicing



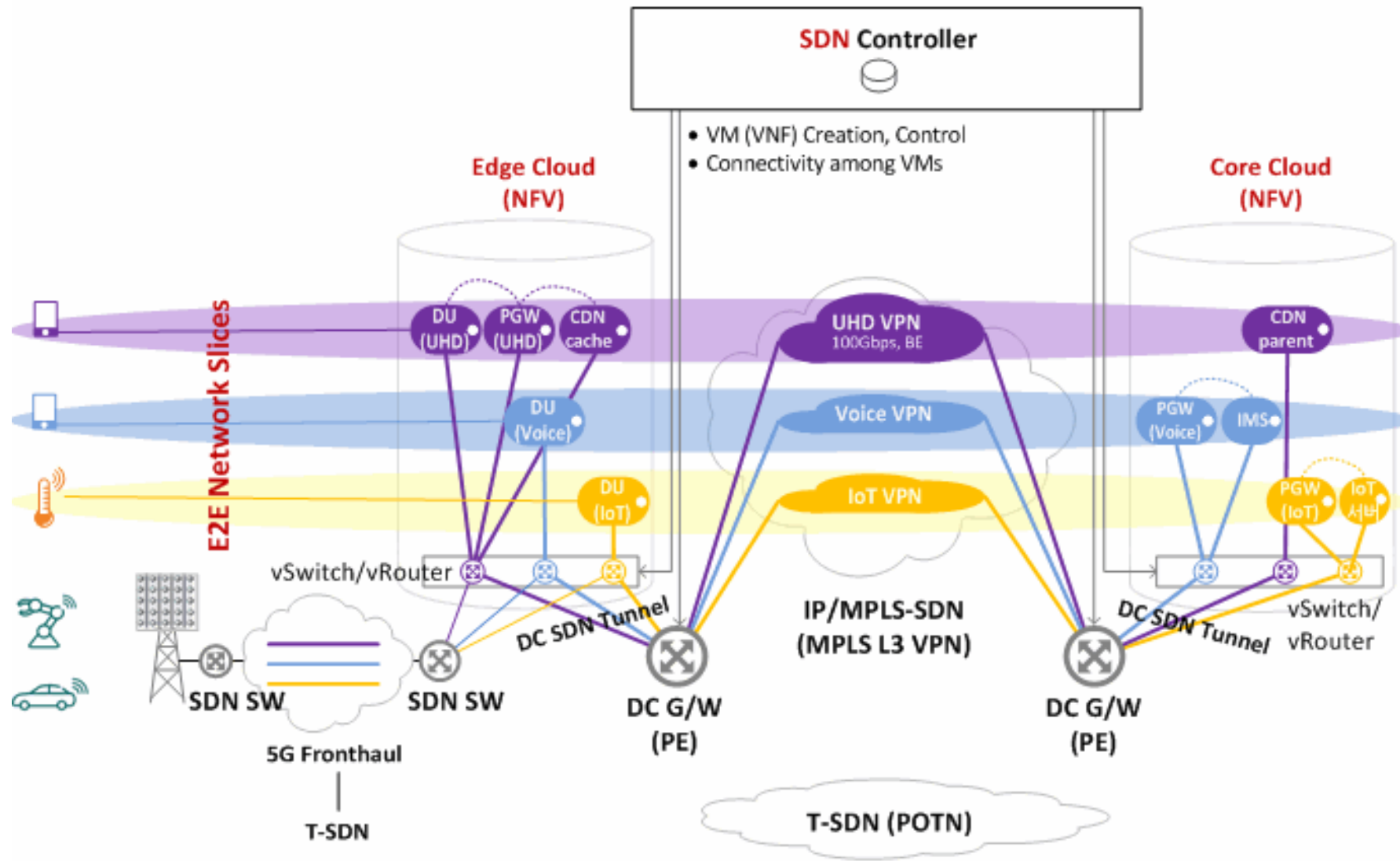
5G Network Slicing enables service providers to build end-to-end virtual networks tailored to application requirements.

Source: www.vanillaplus.com

Network Slicing



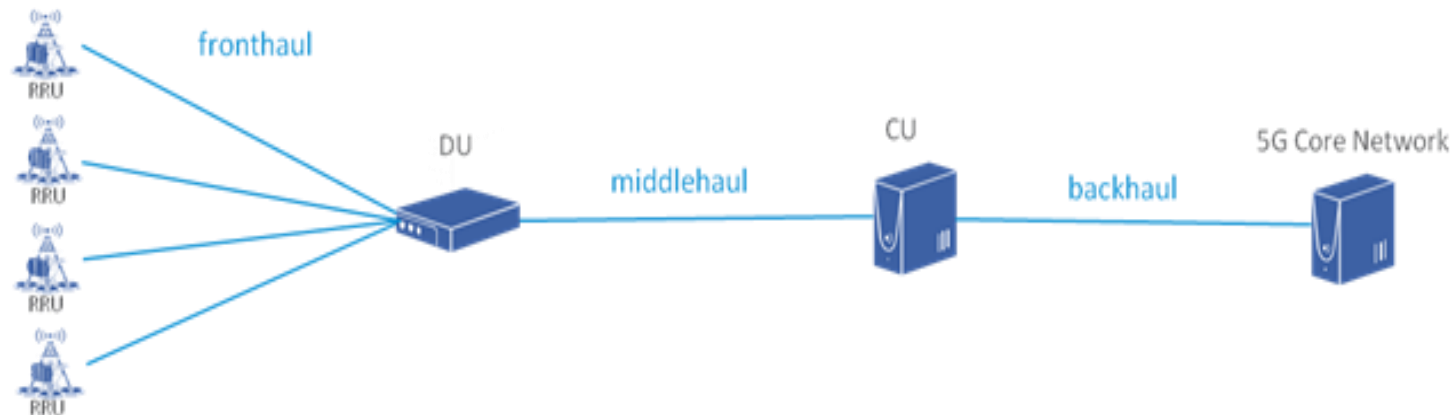
Network Slicing



Fronthaul / Backhaul / x-haul

5G: More Bandwidth, Better Efficiency

- Carrying a radio signal over a digital link is inefficient; better to carry the actual data before modulating onto a radio signal
 - With 5G, it was at least 25Gb/s to each RRU
 - 3GPP started looking at different functional splits to improve the efficiency of the fronthaul network
 - Proposed split into three parts, fronthaul, middlehaul and backhaul:



Network Technology Options

- Operators want a consistent, unified network for backhaul, middlehaul and fronthaul
- Even better if it supports the network slicing concept
- Options:
 - **Ethernet** – this was the original proposal for NGFI (IEEE 1914)
 - Flat network structure, not optimised for slicing
 - **FlexE** – originally developed by OIF for datacentres
 - Based on standard Ethernet physical layer
 - Provides a flexible way of matching interface speeds to link speeds
 - Facilitates network slicing
 - **FlexO** – developed by ITU
 - Similar to FlexE, but for OTN
 - Uses DWDM to achieve shared network efficiency
- Not clear which technology will “win” at this time



Insight and Innovation

calnexsol.com

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