Calnex

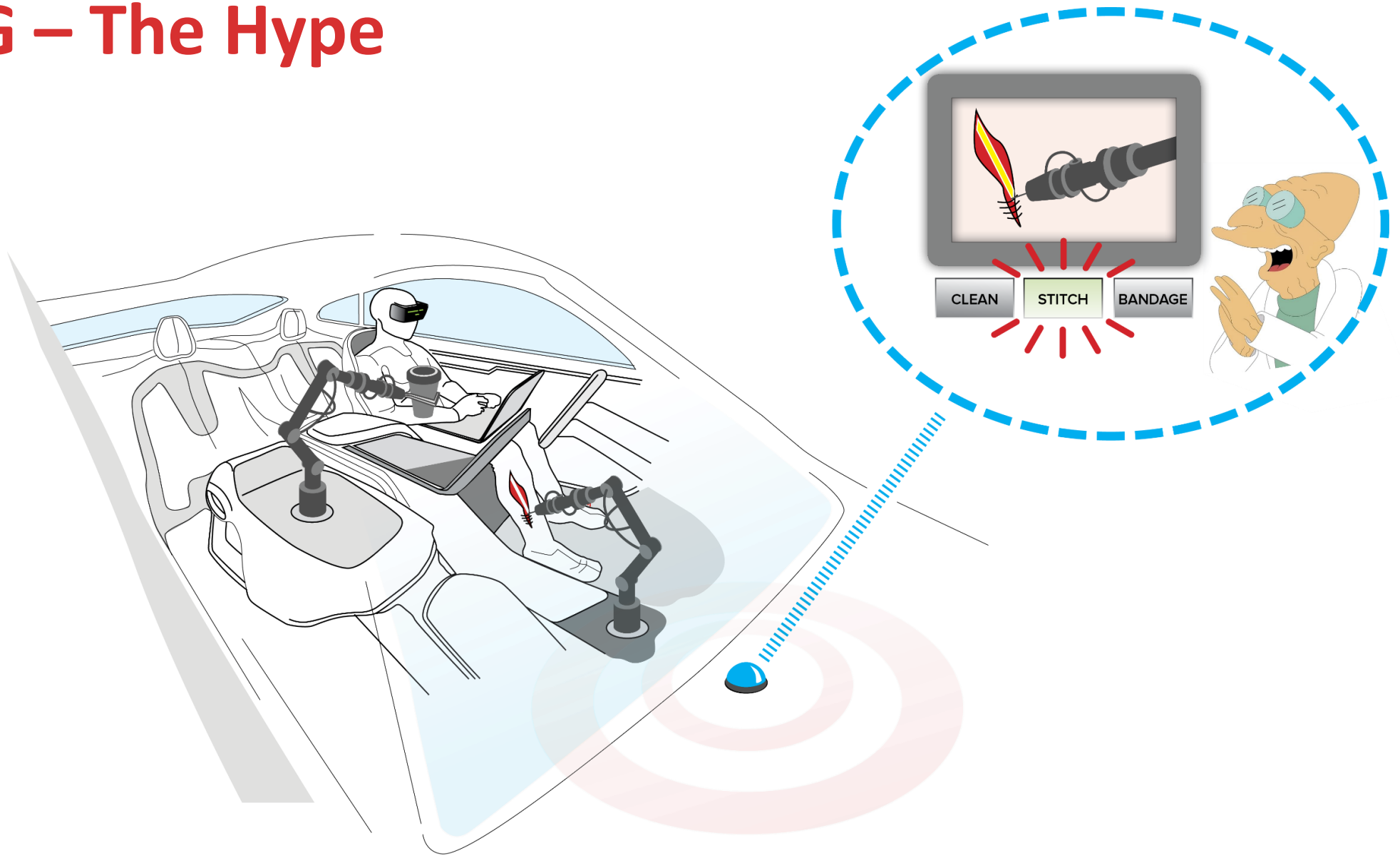
Gimme 5!

5G – What's it all about?

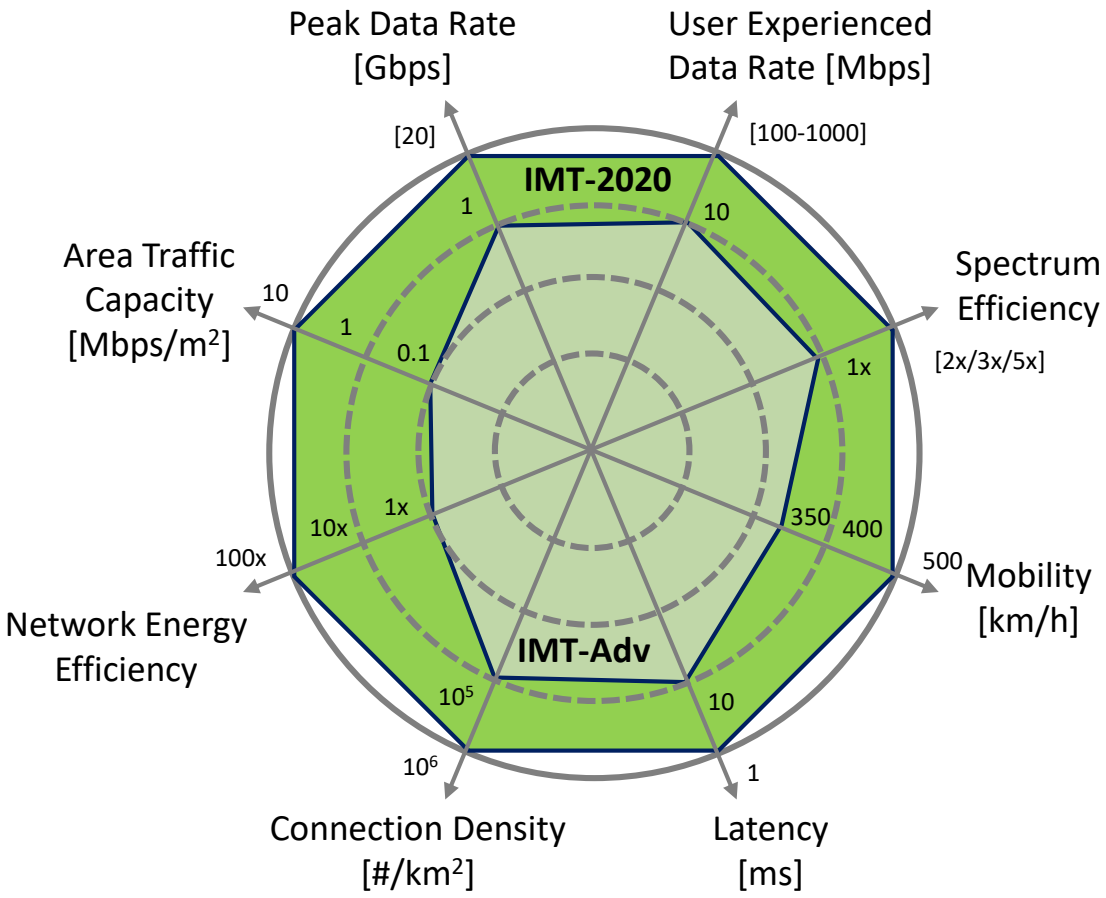
Anand Ram @ ITSF2017




5G – The Hype



5G – The Vision



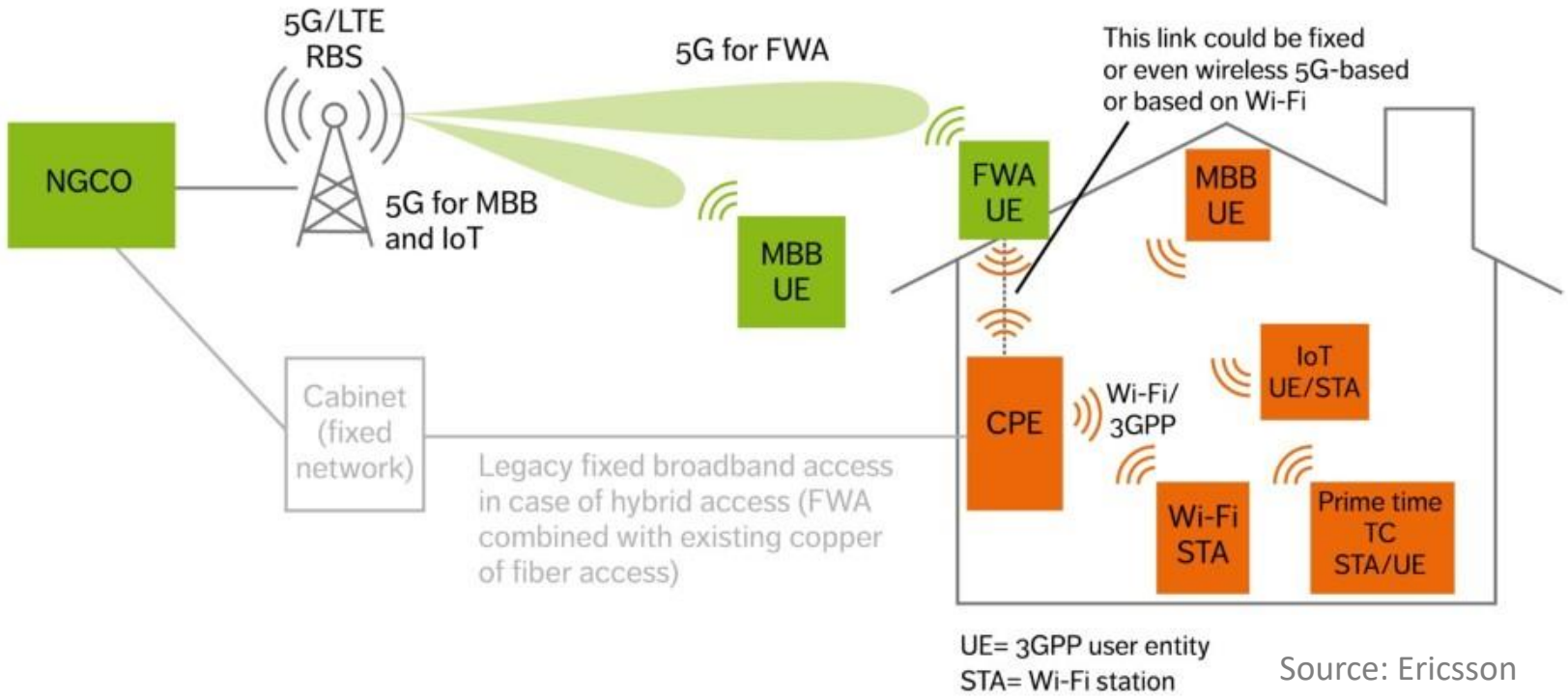
"4G has changed lifestyles. 5G will re-shape societies"

Mr. Li Yue, CEO – China Mobile

IMT-Advanced (LTE, 4G)

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

5G – The Reality



Source: Ericsson

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

Breaking News! – 5G Has Landed*

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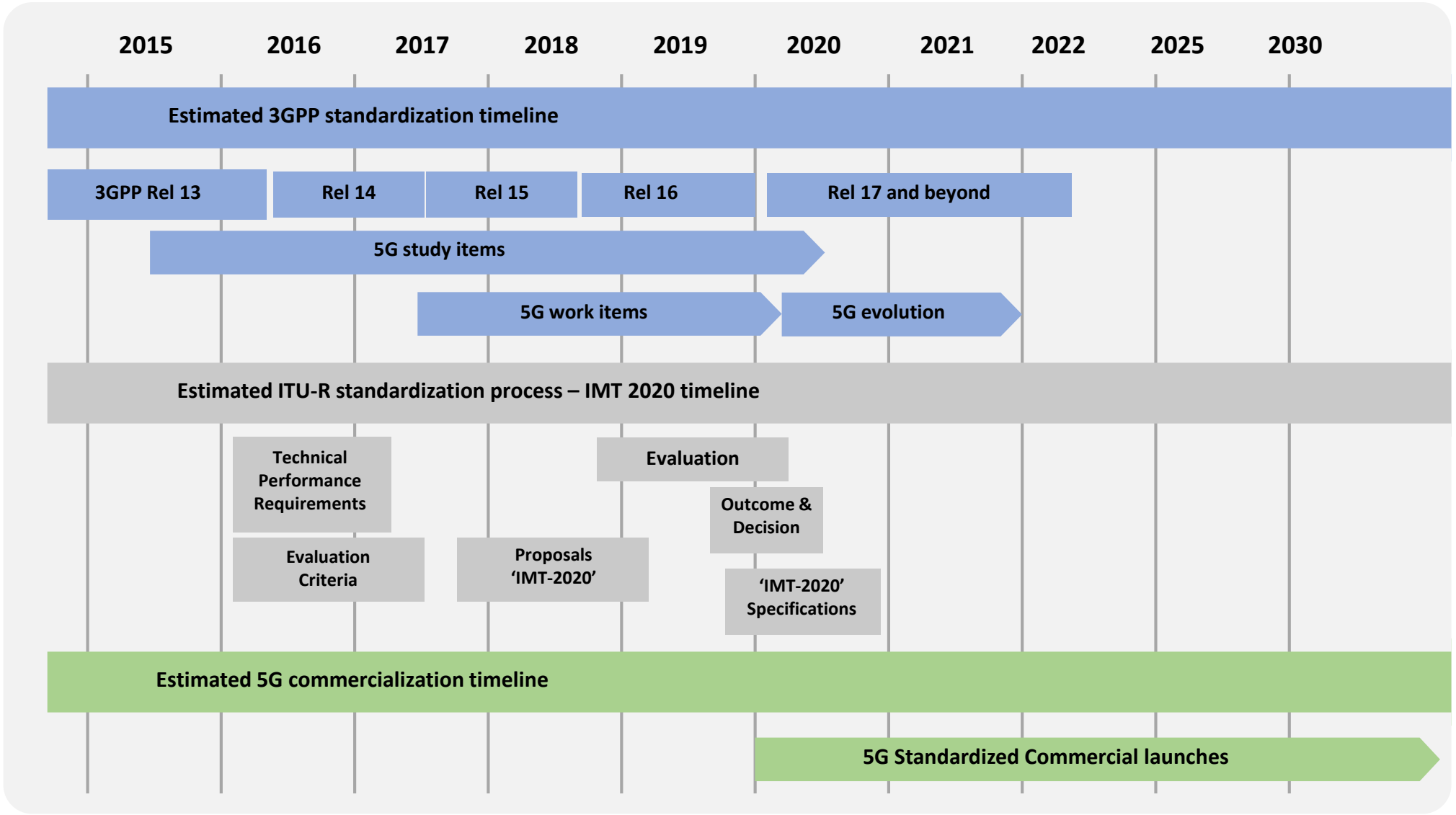
Next month



Source: 4G Americas

The New Radio (NR)

5GNR Objectives

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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/km2
Mobility	500 km/h

5G NR

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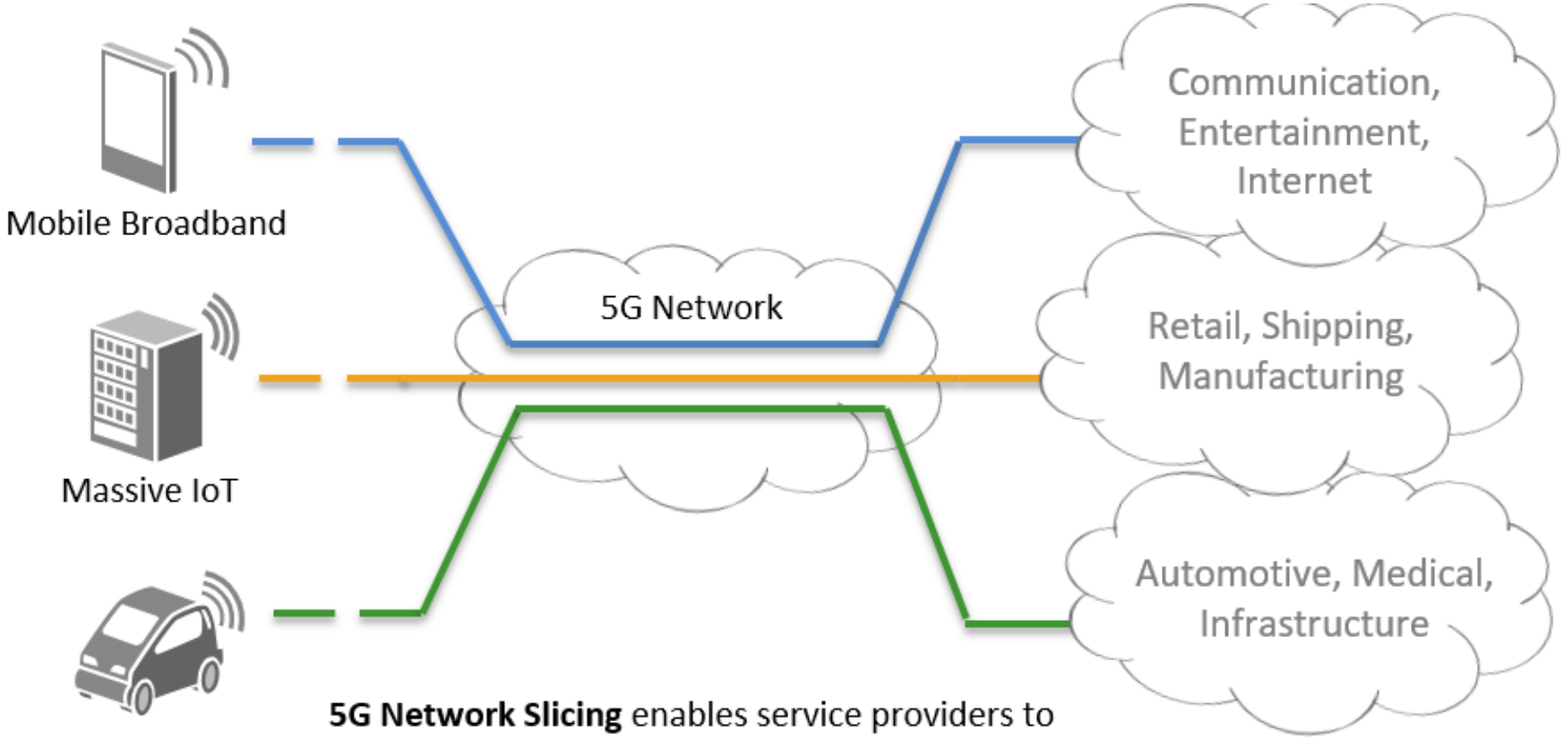
- Spectrum
  - Sub-6GHz
  - mmWave (>24GHz)
- Massive MIMO (>8x8)
  - 128-element MIMO field trials in 2017
- New waveforms, multiple-access techniques
  - e.g. SC-FDE and RSMA for IoT
- Scalable and flexible Time Transmission Interval (TTI)
- Adaptive beam-forming and beam-tracking

The Next-Gen Core (NGCN)

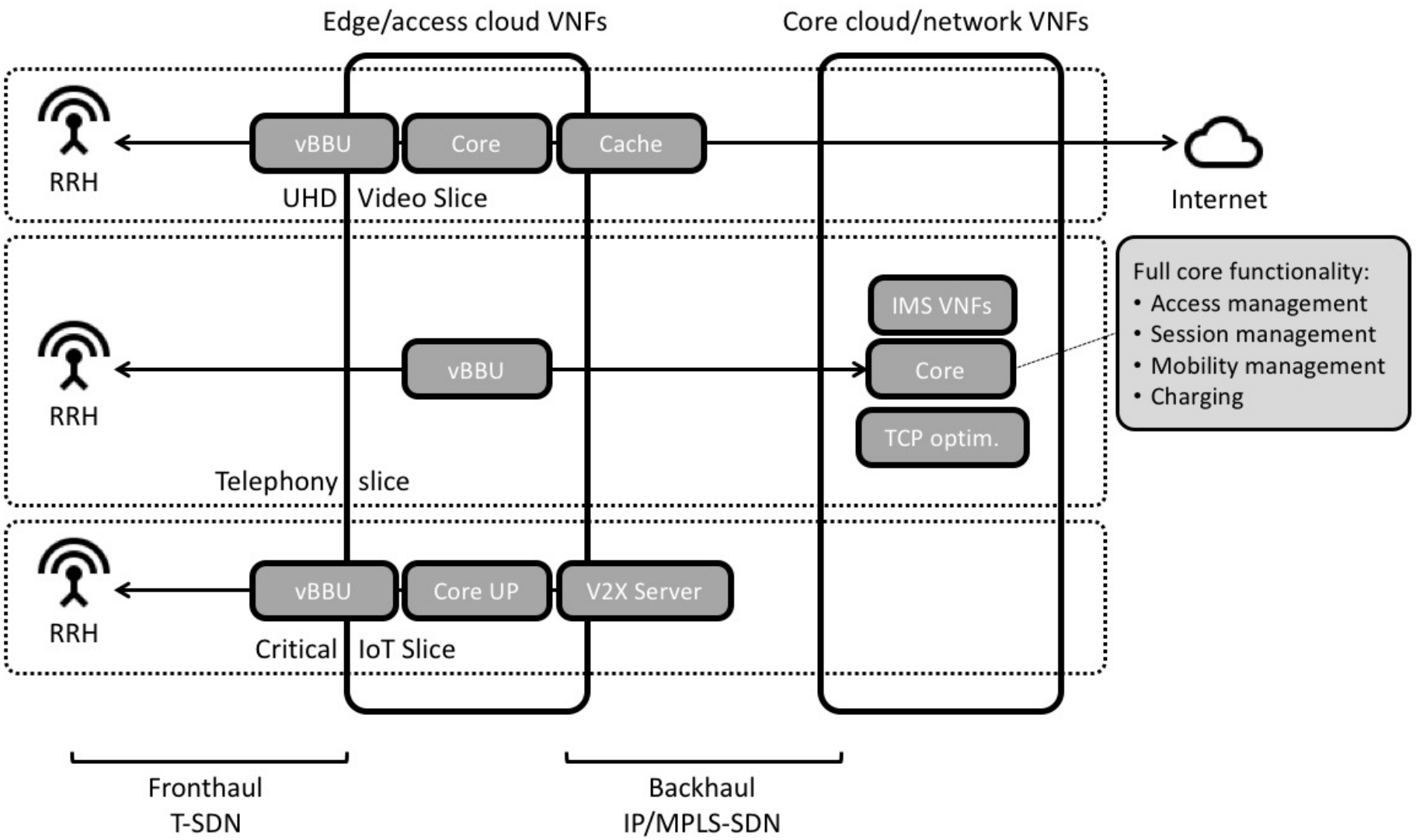
Network Slicing



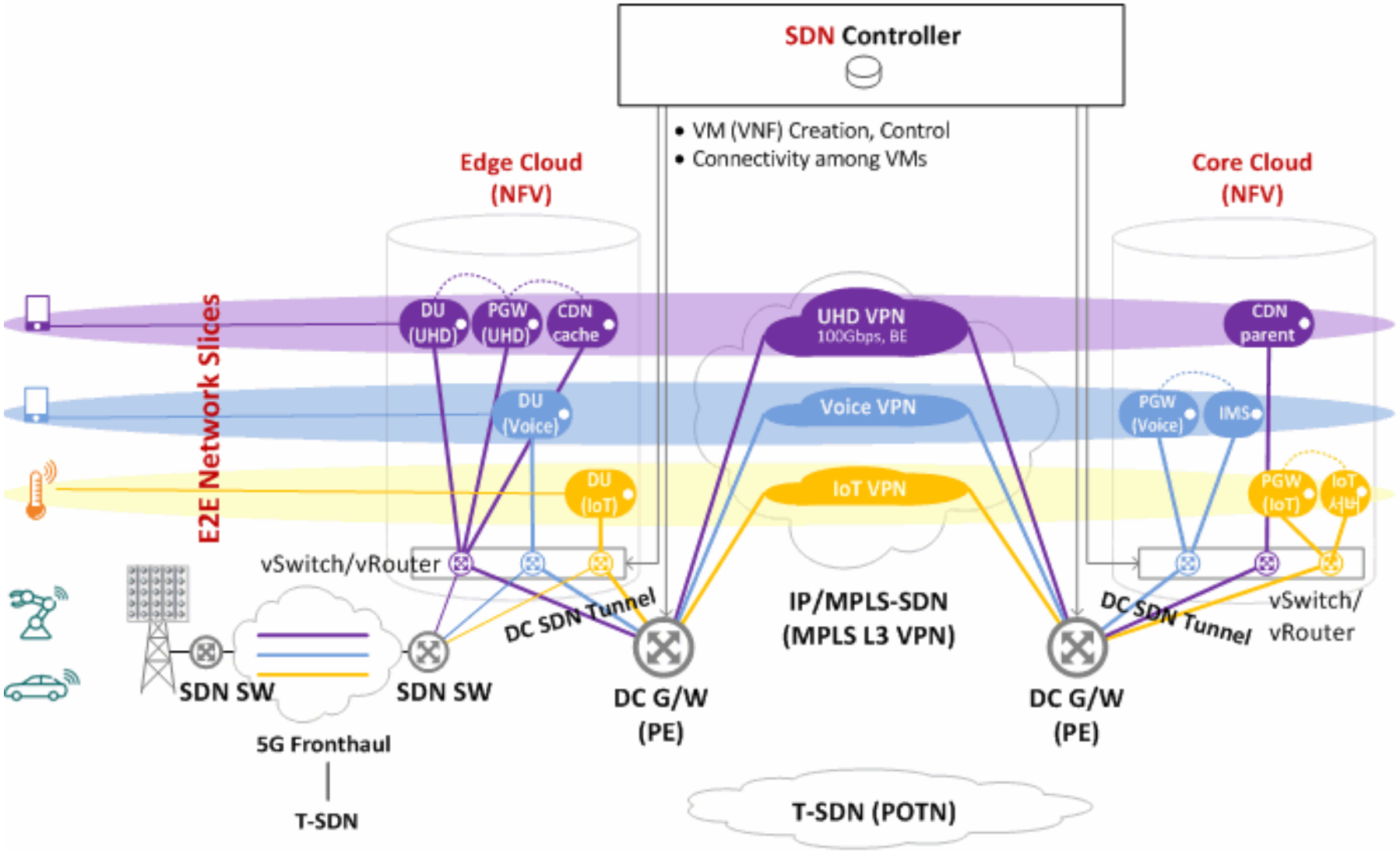
5G Network Slicing enables service providers to build end-to-end virtual networks tailored to application requirements.

Source: www.vanillaplus.com

Network Slicing



Network Slicing



Fronthaul/Backhaul/x-haul

5G: More Bandwidth, Better Efficiency

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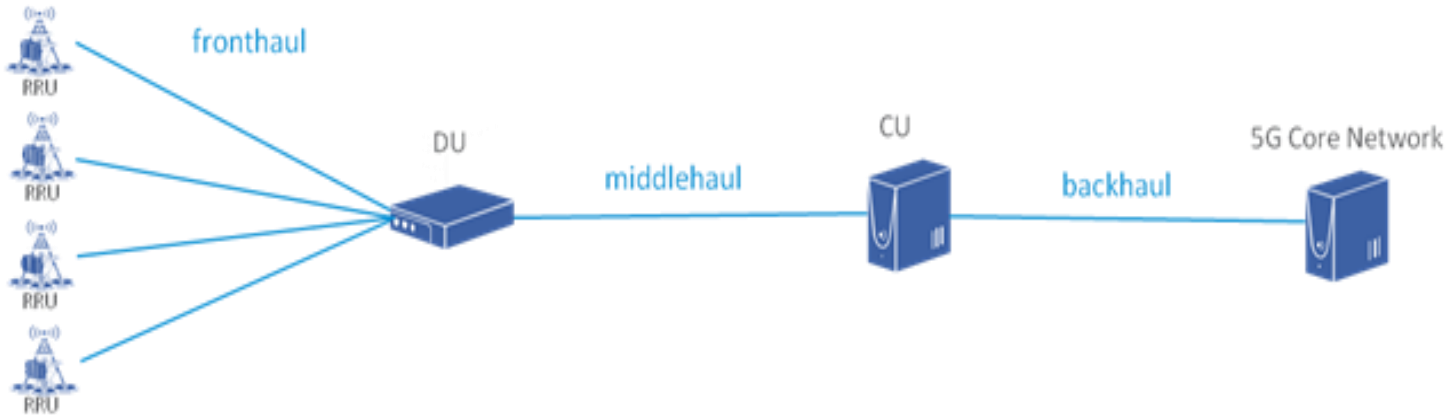
- Carrying a radio signal over a digital link is inefficient; better to carry the actual data before modulating onto a radio signal
  - With 5G, it was at least 25Gb/s to each RRU
  - 3GPP started looking at different functional splits to improve the efficiency of the fronthaul network
  - Proposed split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



Network Technology Options

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- 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

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