



CREATING THE LIVING NETWORK™

5G Vision



5G: The Most Diverse in Any Generation!

4G purposed mainly for VIDEO...

IMT-2020

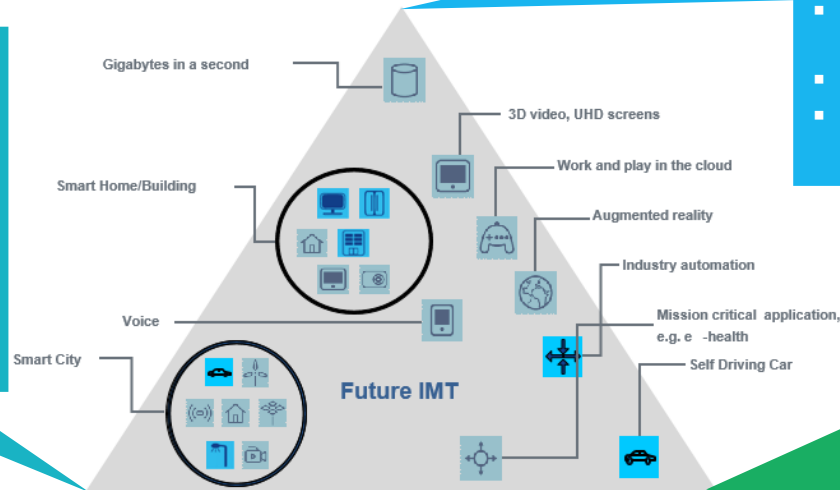
5G purposed for eMBB, mMTC, and URLLC

Enhanced Mobile Broadband (eMBB)

- Peak data rates: 20 Gbps (DL) and 10 Gbps (UL)
- Peak spectral efficiency: 30bps/Hz (DL) and 15bps/Hz (UL)
- 4 ms user plane latency
- Indoor/hotspot and enhanced wide-area coverage

Massive Machine Type Communications (mMTC)

- Low data rates (1 to 100 kbps)
- High device density (up to 1,000,000/km²)
- Latency: seconds to hours
- Low power: up to 15 years battery life

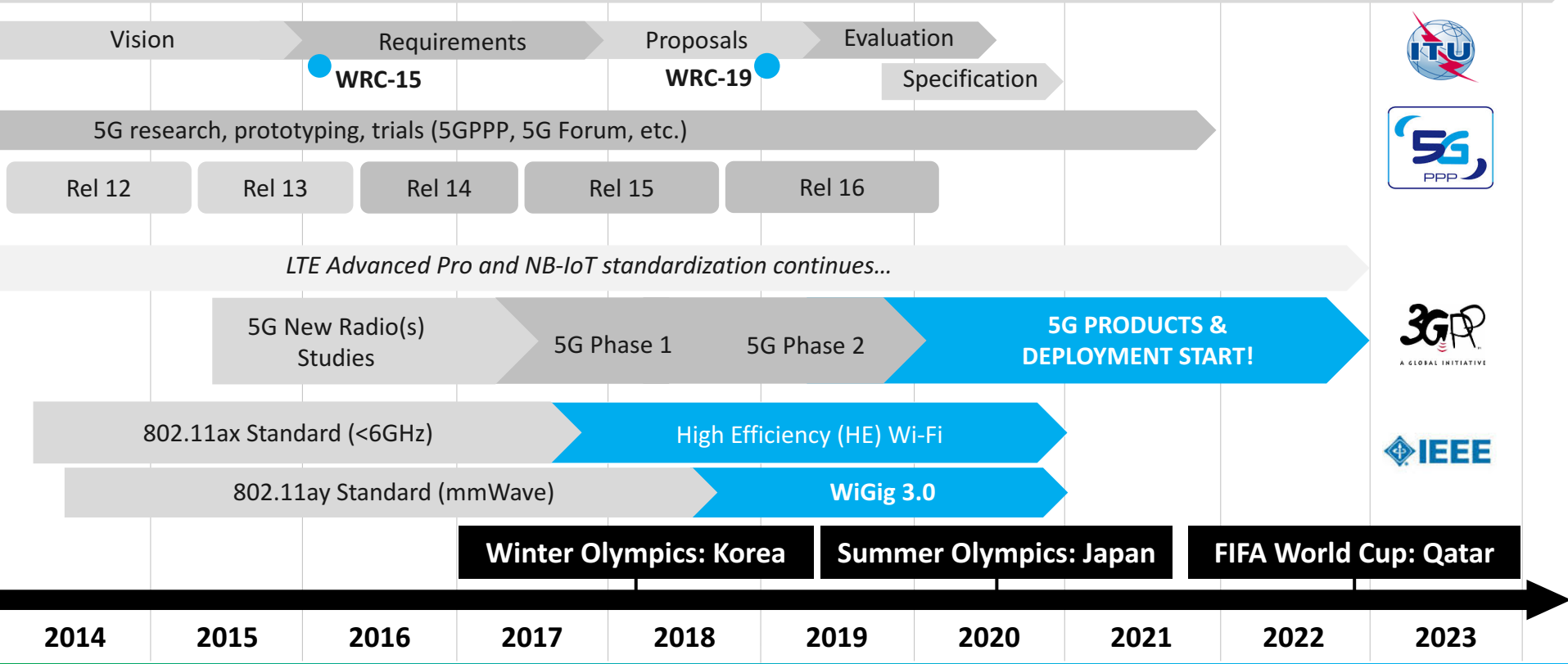


Ultra-Reliable and Low Latency Communications (URLLC)

- Low to medium data rates (50 kbps to 10 Mbps)
- 0.5 ms user plane latency
- 99.999% reliability and availability within 1 ms
- High mobility

5G Roadmap: With Key International Event Drivers

InterDigital Vision 2020, Creating the Living Network, 5G...



InterDigital's 5G Focus Areas

**CREATING THE
LIVING NETWORK™**

Radio Access Network

- 5G LTE (includes NB-IoT)
- 5G NR (New Radio)
- Wi-Fi
- Fixed Wireless Access
- Millimeter Wave
- Spectrum Sharing (LAA, CBRS, etc.)

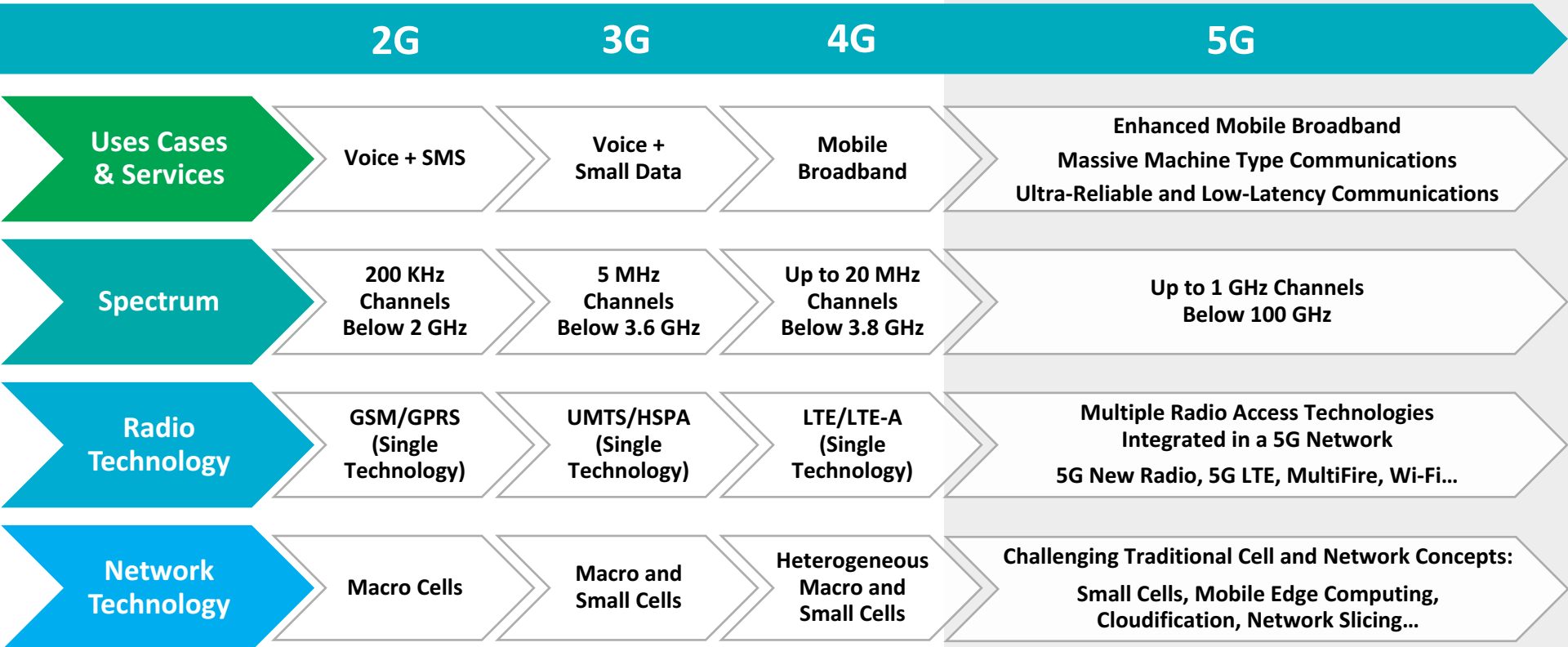
Network Infrastructure

- 5G Core Network
- Fronthaul, Backhaul and Crosshaul
- Information Centric Networking (ICN)
- Mobile Edge Computing
- Cloud RAN
- Small Cells / Densification

Services and Applications

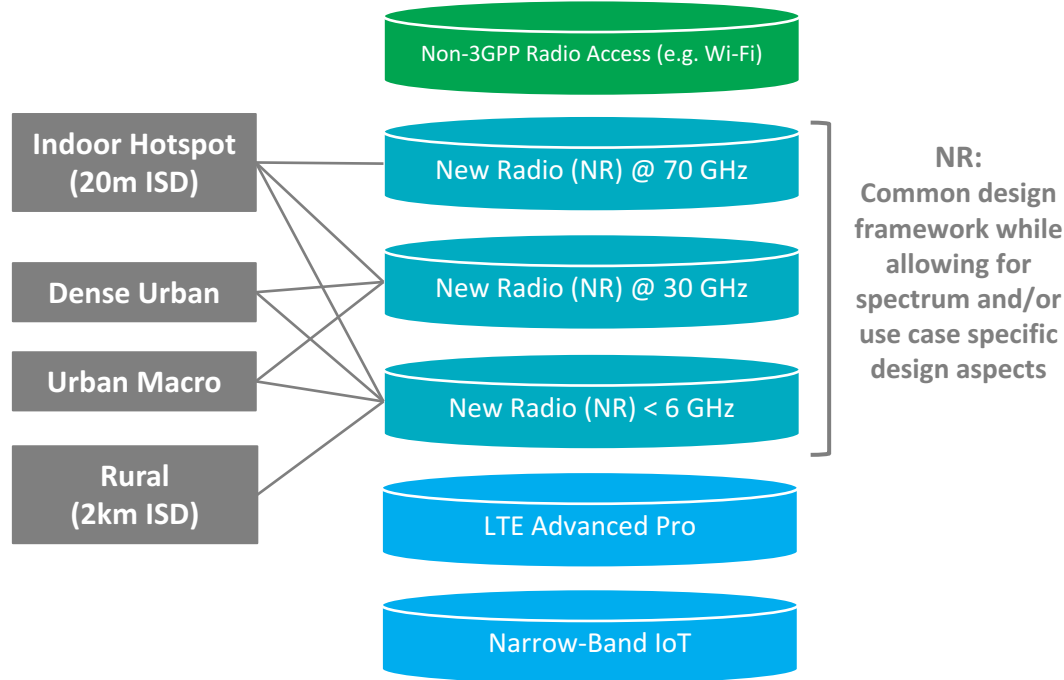
- Video (360, VR, etc.)
- Security
- Sensors
- IoT Analytics
- Autonomous Vehicles
- Edge Applications

How Different Will 5G Be?



5G: A Multi-Layer Radio Network

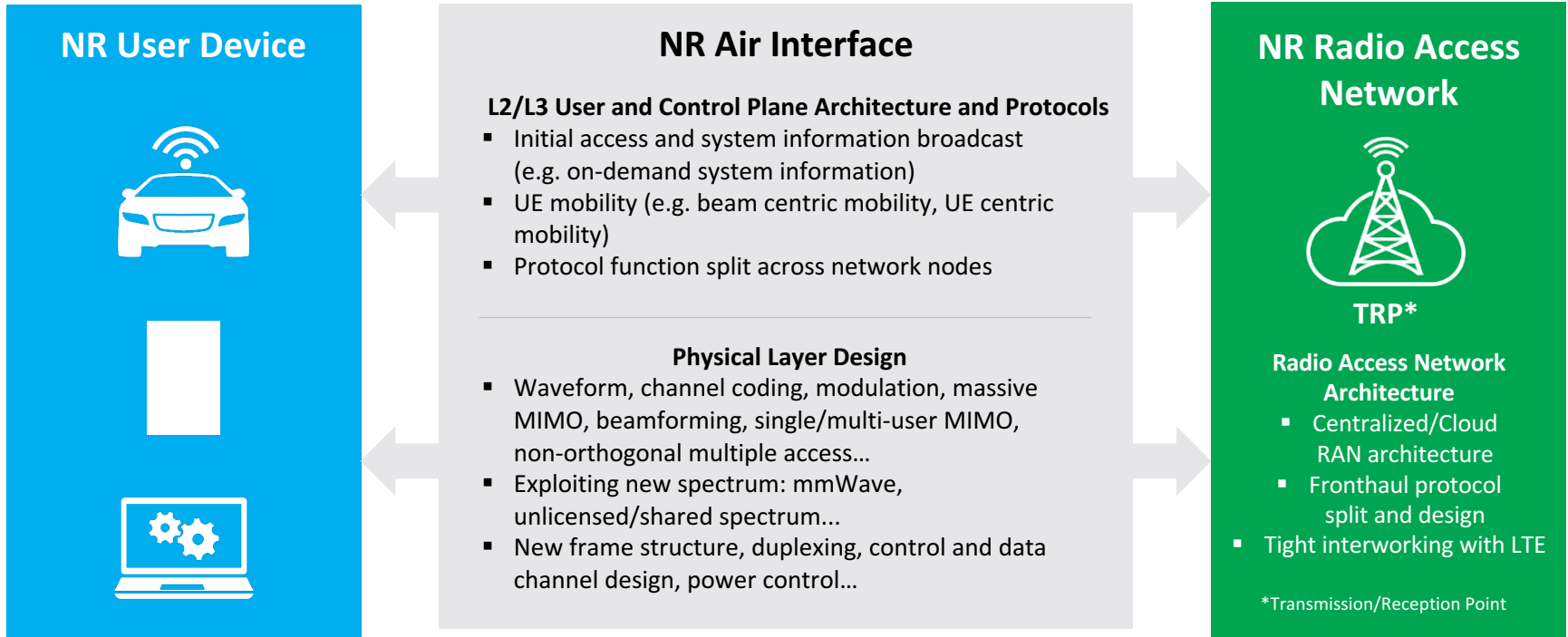
5G will be designed with native support for connectivity across multiple radio layers



- New Radio (NR): new, non-backwards compatible air interface
- Radio layers could be deployed as “standalone” or using multi-connectivity framework
- Radio layers can be deployed based on individual operator roll out plans for 5G networks (i.e. 2025+) envisioned to include all radio layers working together
- LTE and NB-IoT expected to evolve as a components within 5G networks

5G New Radio (NR): Whole New System Design

3GPP designing new non-backwards compatible air interface and radio network architecture for 5G

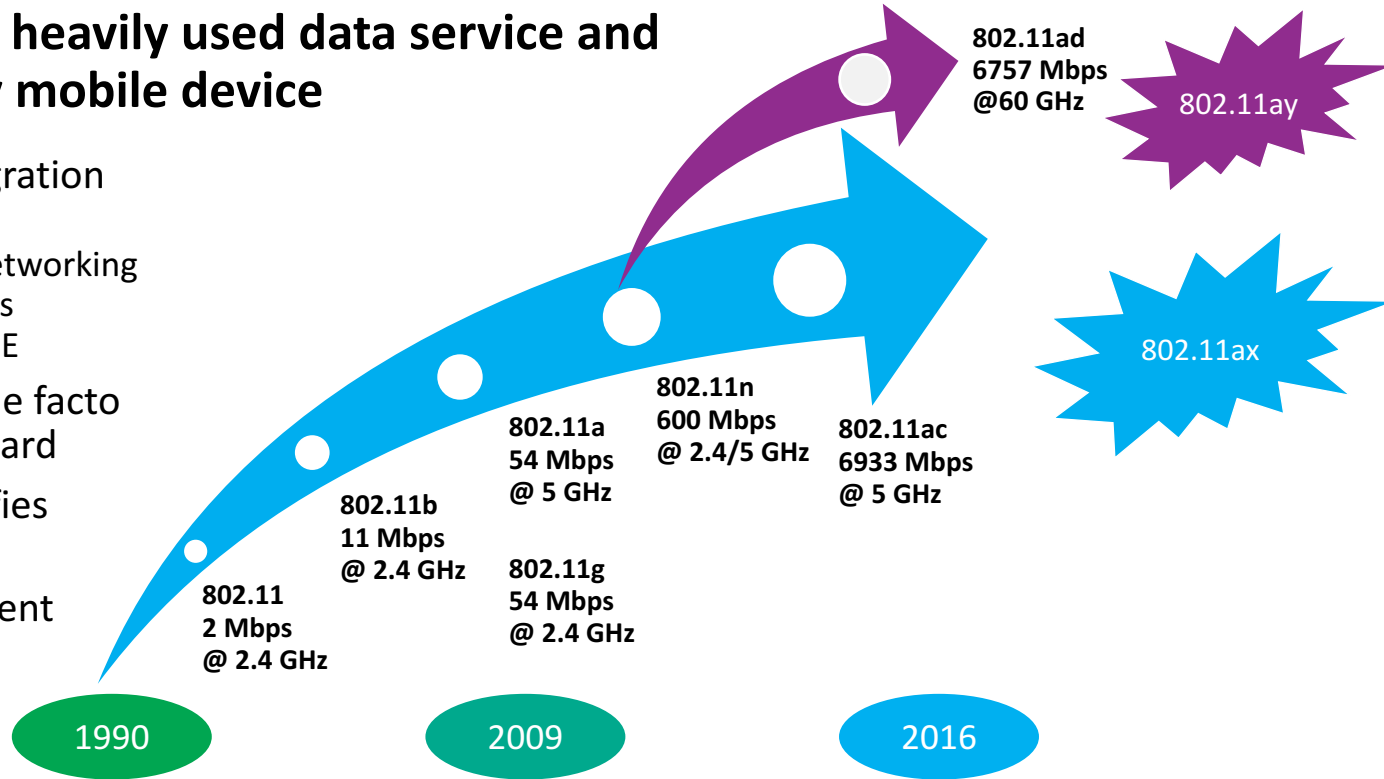


Wi-Fi is a key part of 5G



Wi-Fi is the most heavily used data service and is in nearly every mobile device

- Expect tighter integration in the 5G era
 - Heterogeneous networking via 3GPP standards
 - 5G activities in IEEE
- IEEE 802.11 is the de facto Wireless LAN Standard
- Wi-Fi Alliance certifies devices
- Network management system needed for good performance



5G Network Infrastructure Evolution

5G will be about deeper virtualization, broader usage of SDN

First wave of virtualization

and the second

the third & not last

Circuit Switching

...giving us 800#,
voicemail, Caller
ID and GSM!

**Emergence of
Intelligent Networking
(SS#7/AIN)**

STEP1 : Separate service
logic from switching
Infrastructure

**Break up of Bell
system in USA**

1982

Mid '80s

...the era of
Convergence

**Emergence of Soft
Switch Technology
(MGCP, MEGACO, SIP)**

STEP2 : Separate control
and data planes
(Commodity Hardware)

Mid '90s+

All IP

The Internet Protocol "Rubicon"

**Emergence of NFV and
SDN Technology**

NFV : Separate service logic
from HW Platform

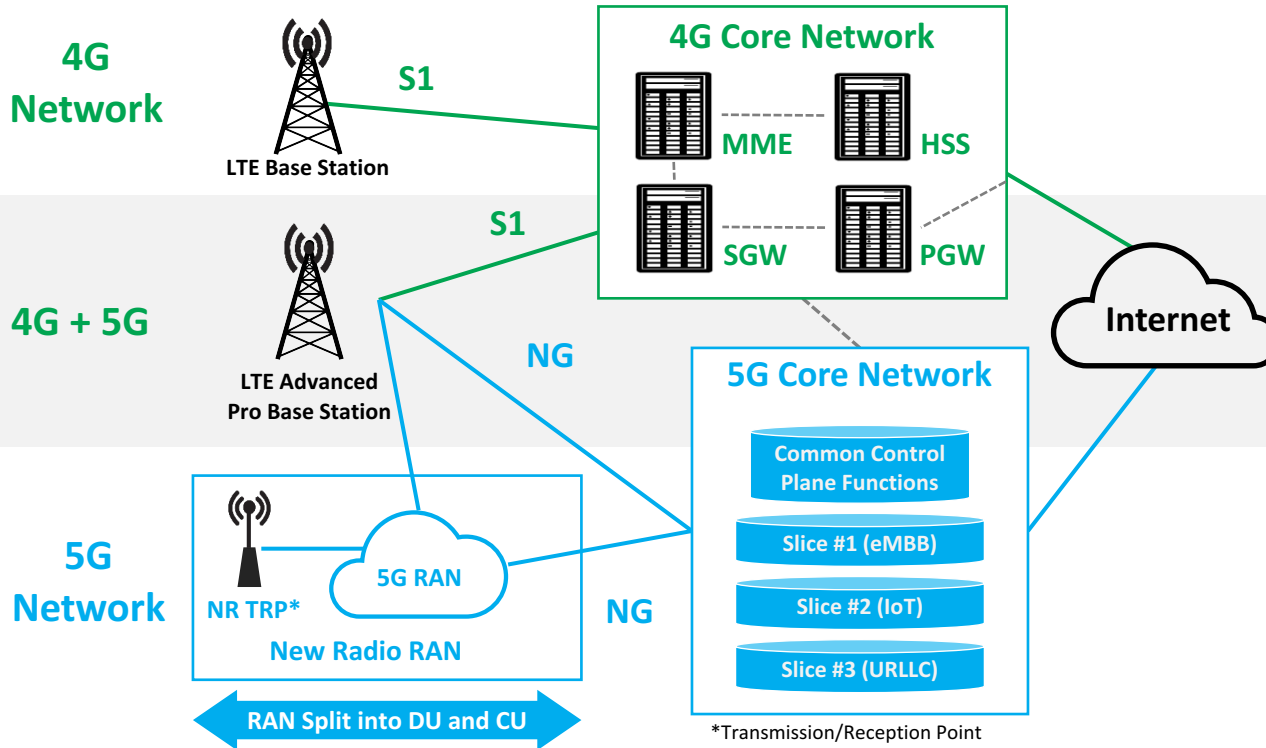
SDN : Separate control
and data planes

NFV=Network Function Virtualization,
SDN=Software Defined Networking

Mid/Late '00s+

5G Core Network: Gluing 4G, 4G Evolution & 5G

5G system should allow for independent evolution and flexible deployment of RAN and Core Network



Network Function Virtualization

- Allows flexibility to locate functions when and where you need them, on general purpose hardware

Network Slicing

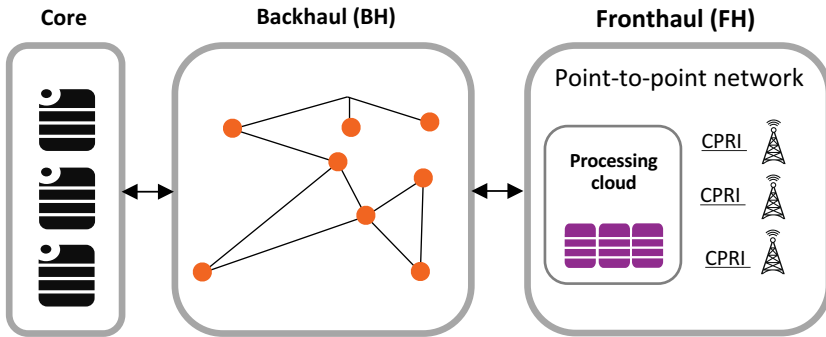
- Segmentation of resources to form a different logical CN per service (e.g., IoT, eMBB)
- Allows dynamic scaling of resources based on service type needs

Service Capability Exposure

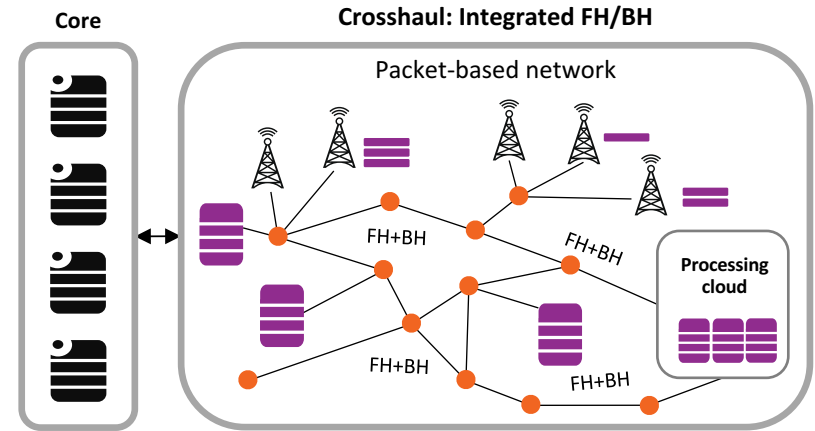
- Allowing 3rd party service/application providers access to information and service customization

Integrated 5G transport networks - Crosshaul

- Today's C-RAN mobile transport network will not scale to support additional spectrum and antennas
- Separated fronthaul and backhaul management adds complexity and cost
- C-RAN functional splits are fixed and static

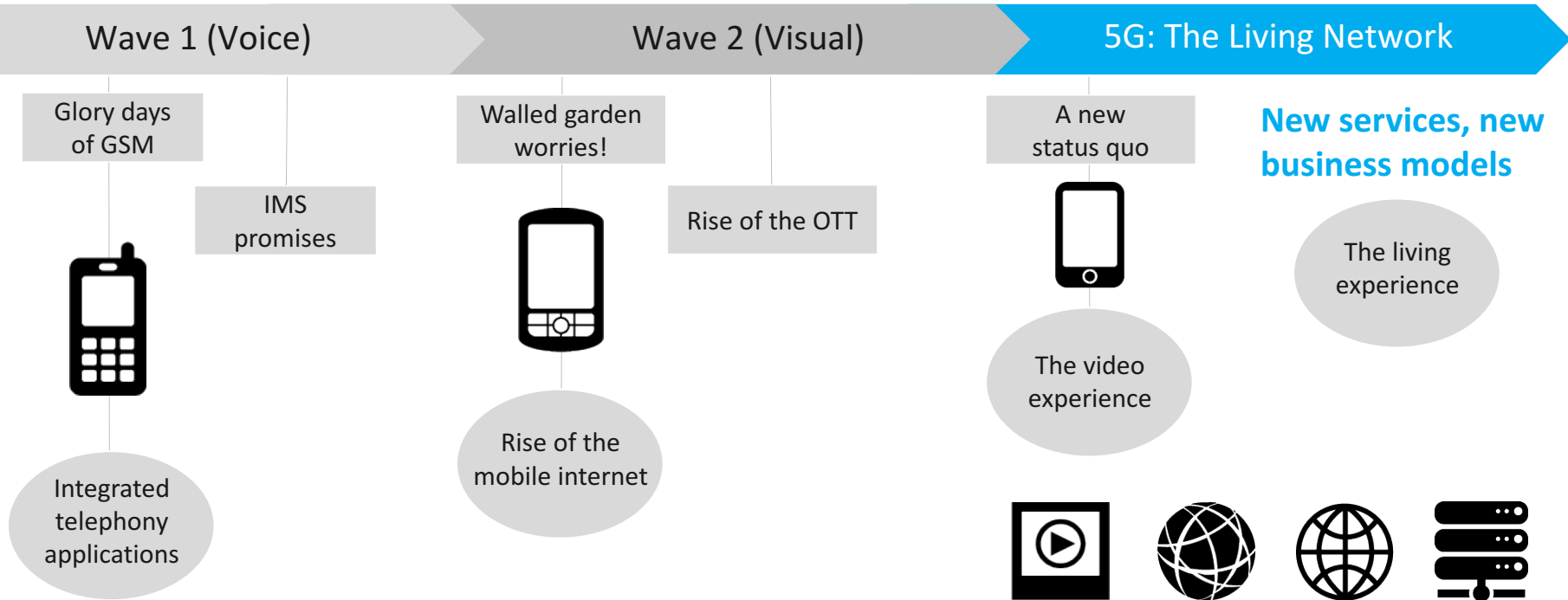


- An integrated fronthaul/backhaul (Crosshaul) will support diverse 5G traffic types
- Unified management built on SDN frameworks
- Wireless and wired transport for dense network edge connections, with path diversity for high reliability



Service Evolution to the Living Network

5G systems will deliver next level of experience and enable new business models



Emerging 5G Services and Applications



Immersive video experiences that create a personalized virtual reality experience based on localized content



Autonomous vehicles that leverage one-hop-away edge computing service, and ultra-reliable radio network solutions



IoT devices that are massively interconnected to change the way we collect information and interact with things