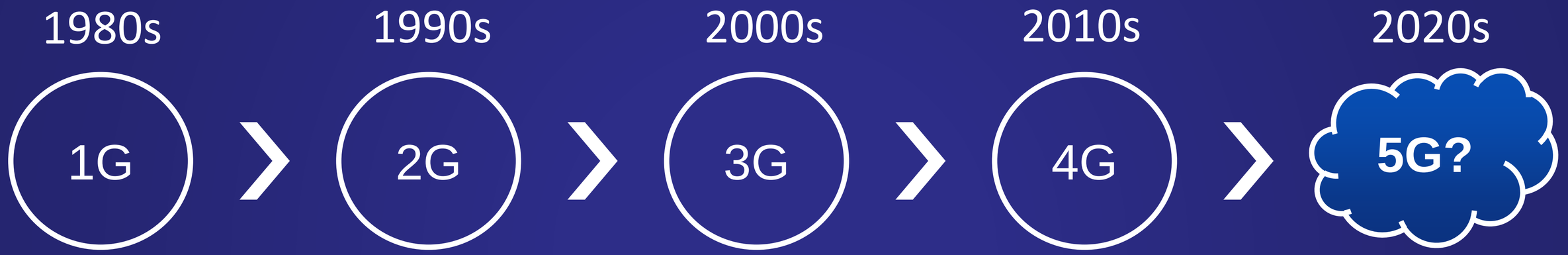
5G Concept

IMT-2020 (5G) Promotion Group

2015-02-11

5G has been a global R&D focus



- **FDMA**
- **Analog voice**

- **TDMA**
- **Digital voice**
- **Low-data-rate services**

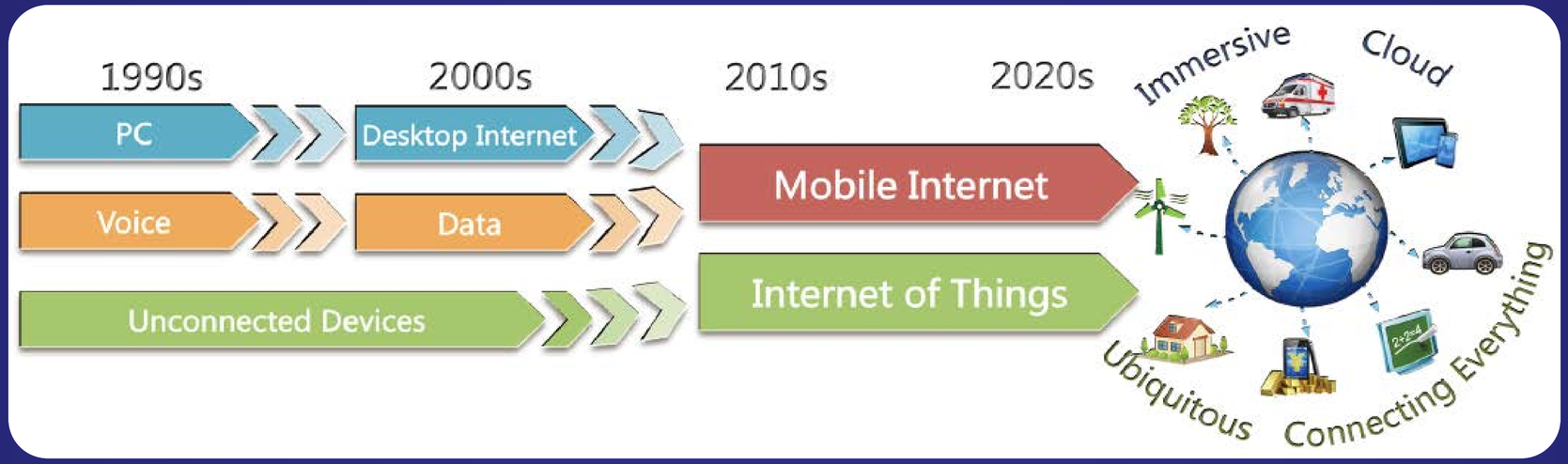
- **CDMA**
- **2 ~ Tens of Mbps (peak data rate)**
- **Multimedia**

- **OFDMA**
- **100M ~ 1Gbps (peak data rate)**
- **MBB**

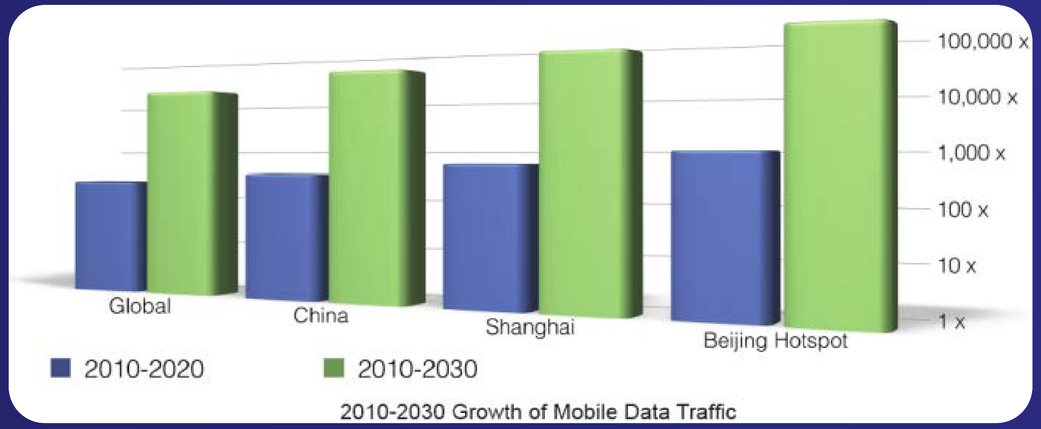
5G Concept?

5G standardization is expected to be launched in early 2016

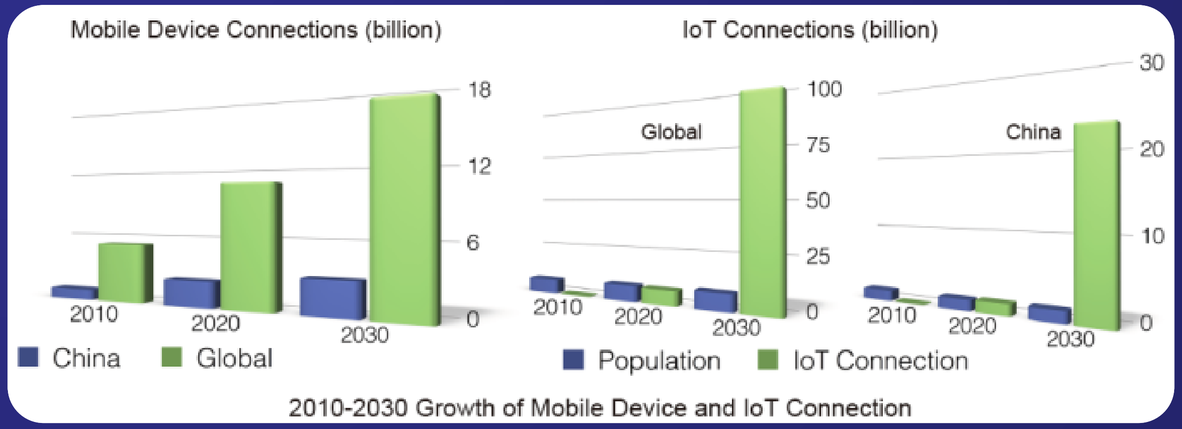
5G Main drivers: Mobile Internet and IoT



Mobile Data Traffic: Thousands of times growth



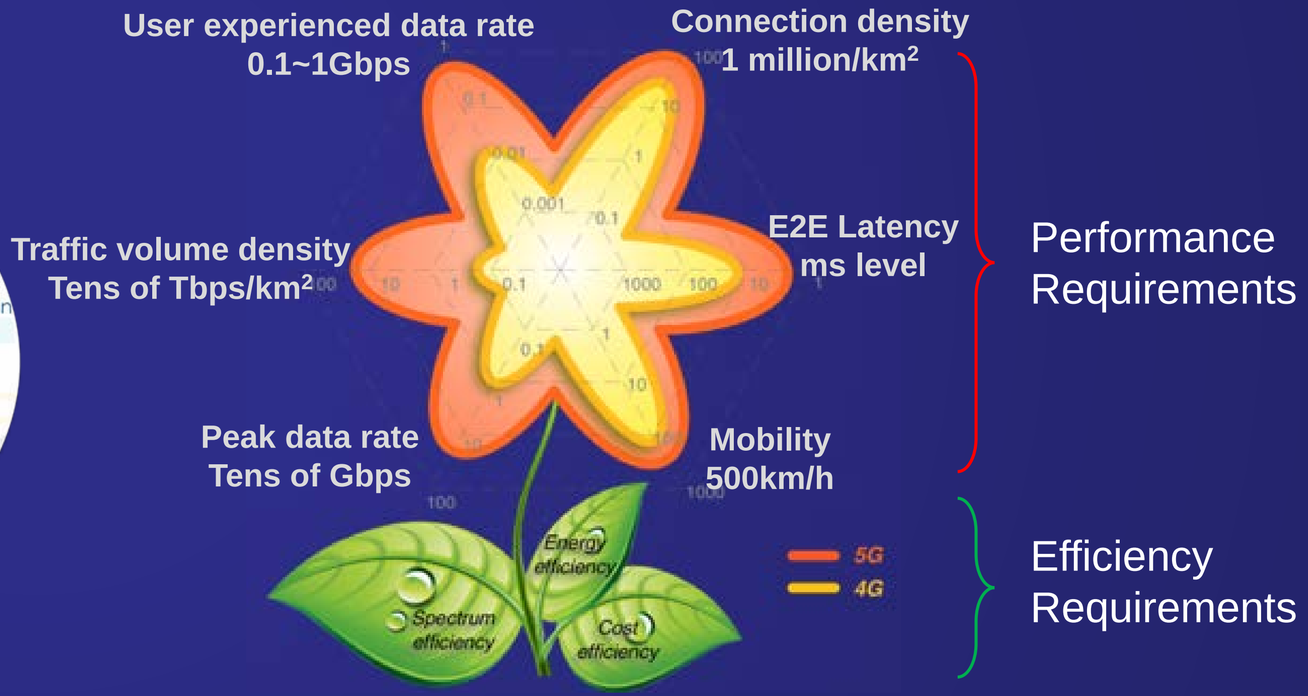
Mobile Internet & IoT Connections: Up to 100 billion



5G Vision and Requirements

5G Vision

5G Key Capabilities



"Information a finger away, everything in touch"
"信息随心至，万物触手及"

User experienced data rate is widely recognized as the most important KPI

5G Technical Scenarios and Challenges

Mainly for Mobile Internet

Seamless Wide-Area Coverage

- User experienced data rate: 100 Mbps

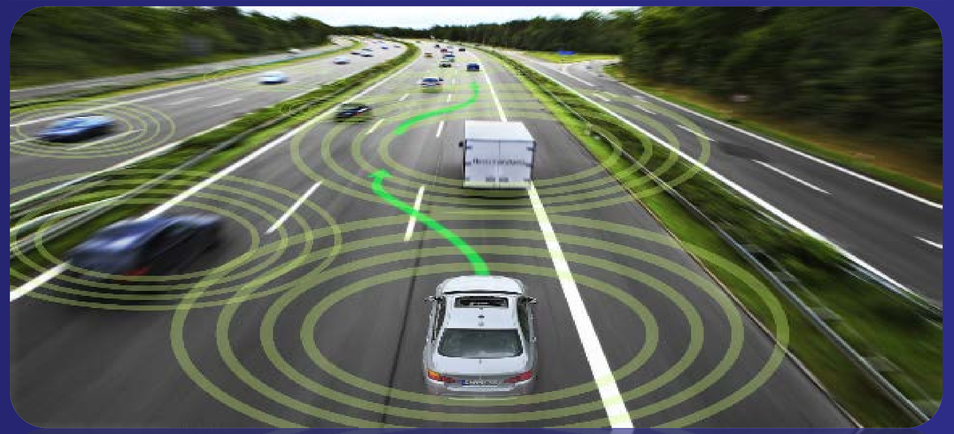
High-Capacity Hot-Spot

- User experienced data rate: 1 Gbps
- Peak data rate: Tens of Gbps
- Traffic volume density: Tens of Tbps/km^2

5G Technical Scenarios and Challenges

Mainly for IoT (new scenarios)

Low-Latency High-Reliability



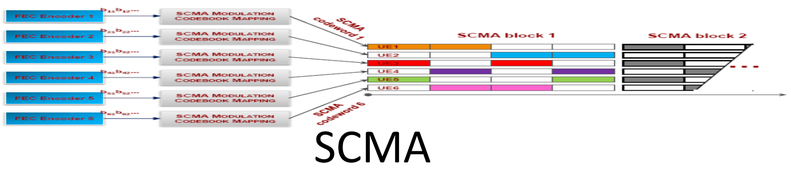
- Air interface latency: 1 ms
- End-to-end latency: ms level
- Reliability: nearly 100%

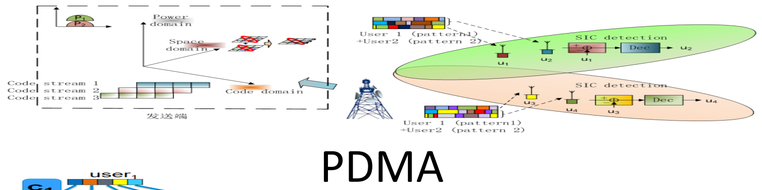
Low-Power Massive-Connections

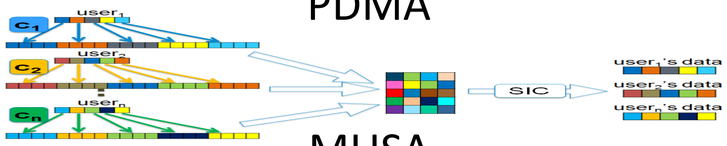
- Connection density: 10^6 / km^2
- Ultra-low power consumption
- Ultra-low cost

5G Key Wireless Technologies

Novel Multiple Access

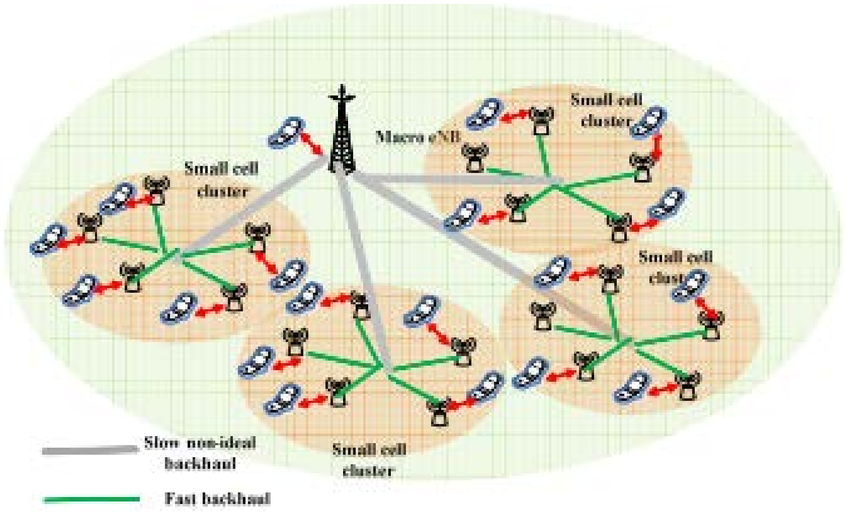






- Benefit to spectral efficiency, connection capability, and latency in various scenarios
- Candidate schemes: SCMA, PDMA, MUSA, NOMA, etc.

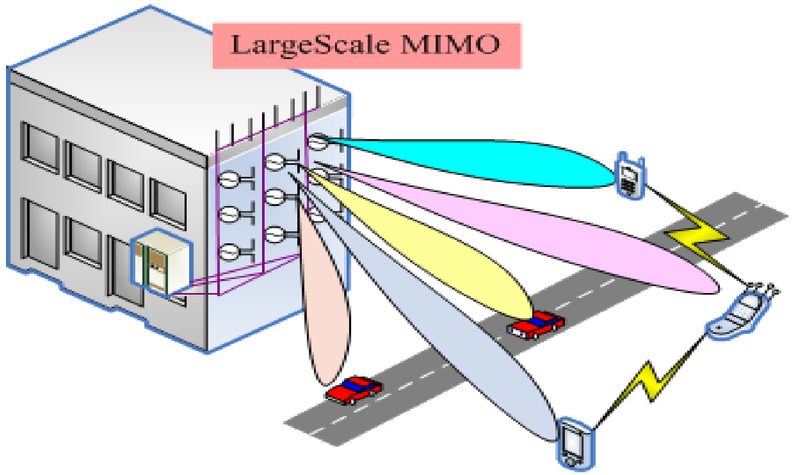
Ultra-Dense Networking



- Most important way to meet 1000x traffic growth.
- Research areas: interference suppression, virtual cell, joint access and backhaul, etc.

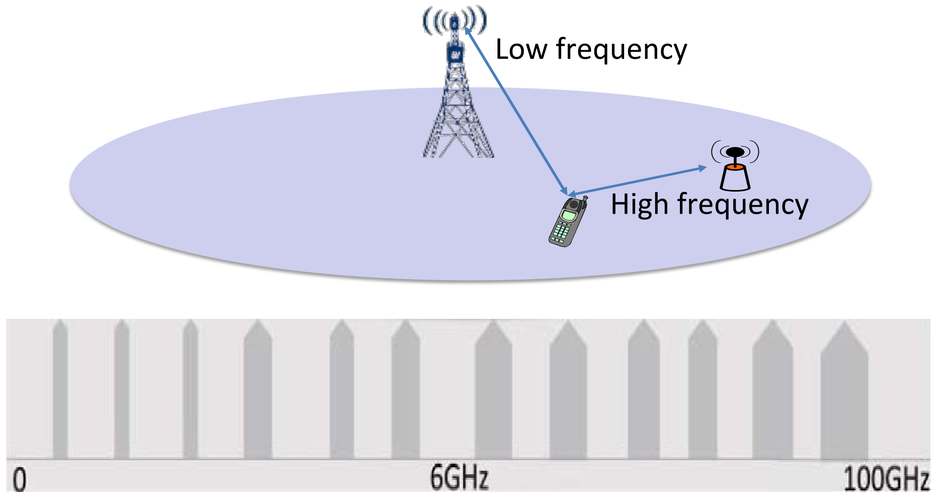
5G Key Wireless Technologies

Massive MIMO



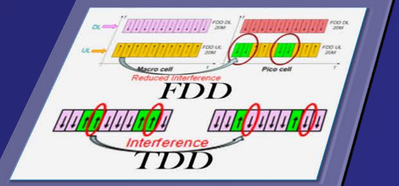
- Improve the spectral efficiency of multi-user systems by several folds
- Key issues: Channel estimation and feedback, reference signal design, antenna array design, and low-cost implementation

All-Spectrum Access

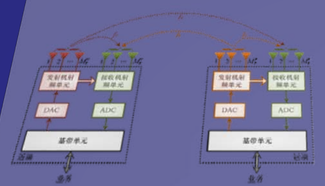


- High / low, paired / unpaired, licensed / unlicensed, contiguous / non-contiguous bands
- Key issues: Channel measurement and modeling, unified access for low and high frequency, RF components

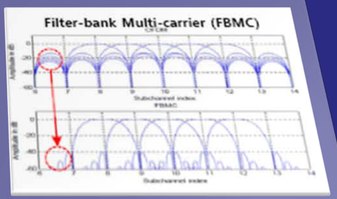
Other Potential Wireless Technologies



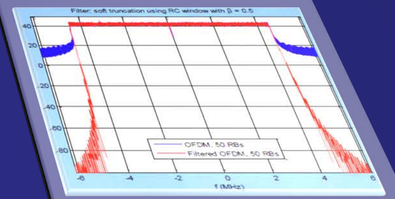
Flexible Duplex



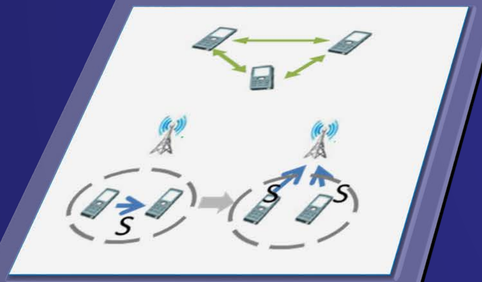
Full duplex



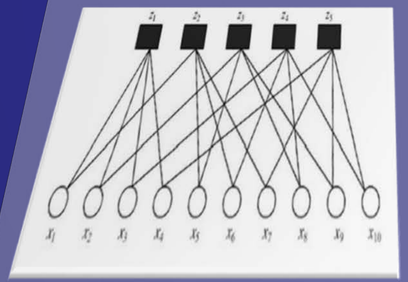
FBMC



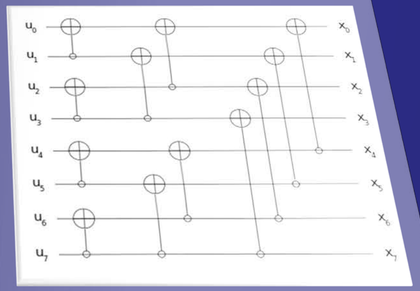
F-OFDM



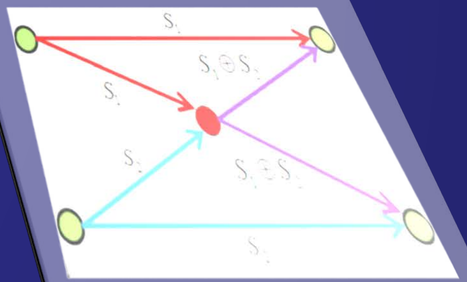
D2D



Q-ary LDPC



Polar codes

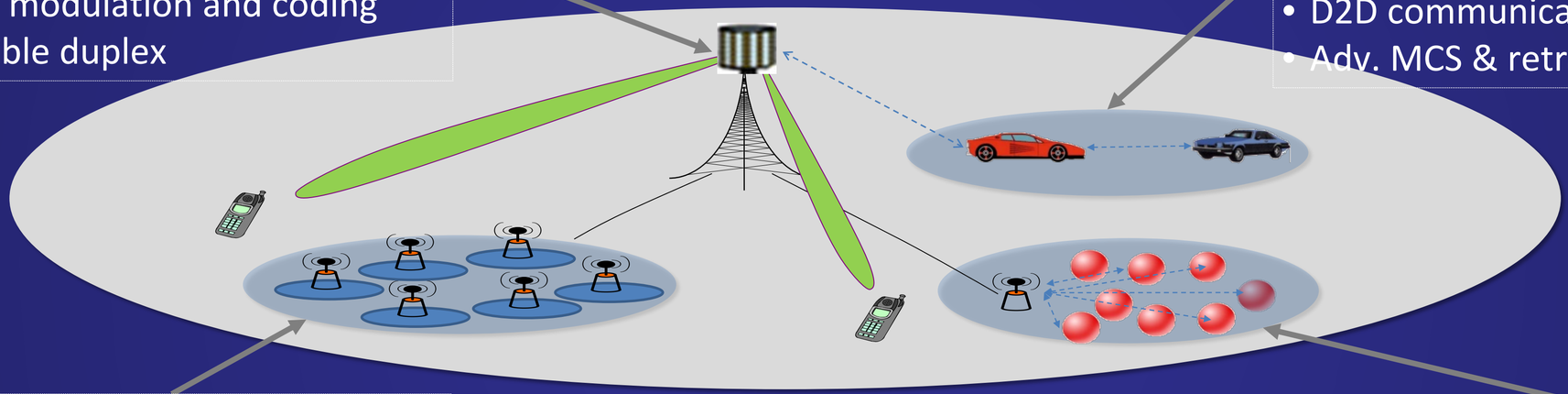


Network codes

Scenarios & Key Wireless Technologies

Seamless wide-area coverage
- Massive MIMO
- Novel multiple access
- Adv. modulation and coding
- Flexible duplex

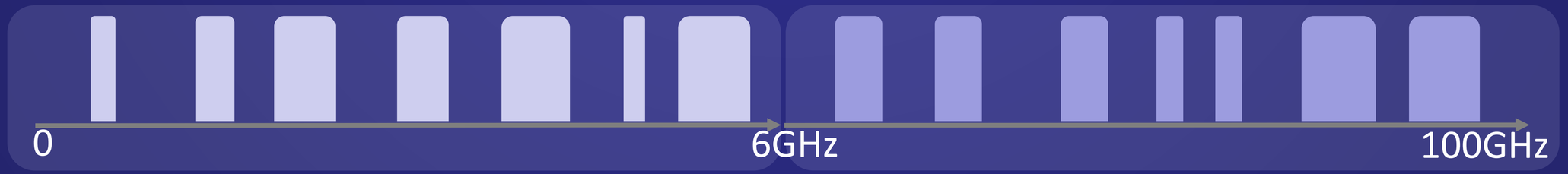
Low-latency high-reliability
- Short frame & optimized signaling
- Novel multiple access
- D2D communications
- Adv. MCS & retransmission



High-capacity hot-spot
- Ultra-dense networking
- Massive MIMO
- Novel multiple access
- Flexible/Full duplex

Low-power massive-connections
- Novel multiple access
- FBMC / F-OFDM
- D2D communications
- Adv. modulation and coding

All-Spectrum Access

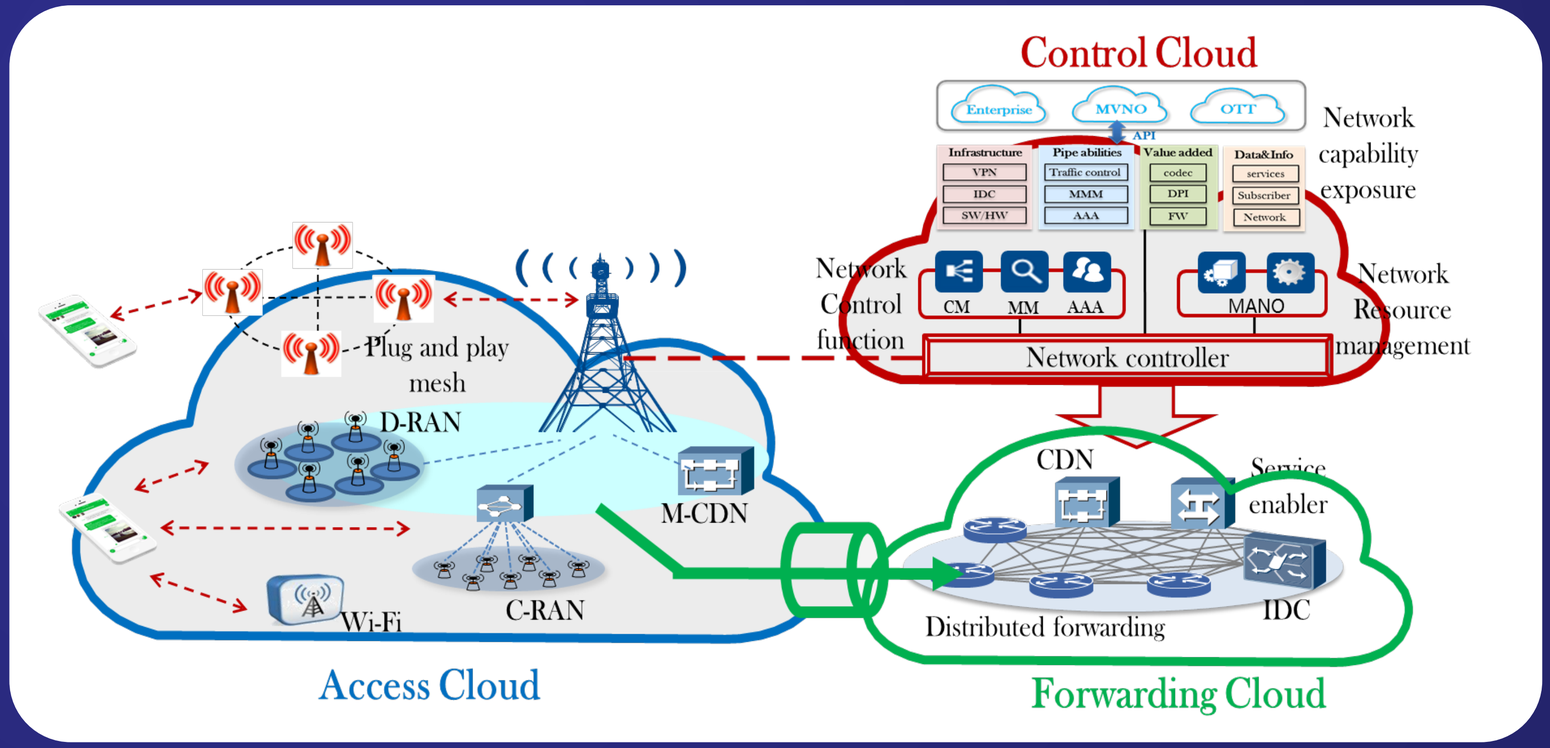


5G Network Architecture

Challenges

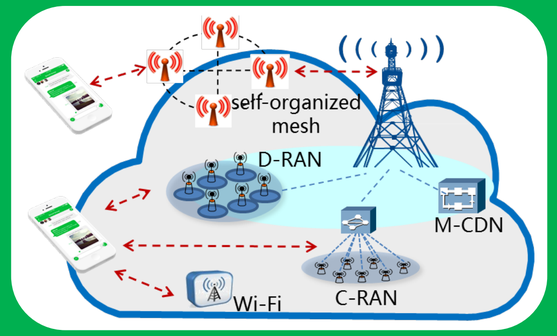
- ms-level E2E latency
- 1000x traffic growth
- Reliable & flexible QoS
- New scenarios & services
- Easier deployment, management & maintenance

“Three Clouds” Network Architecture



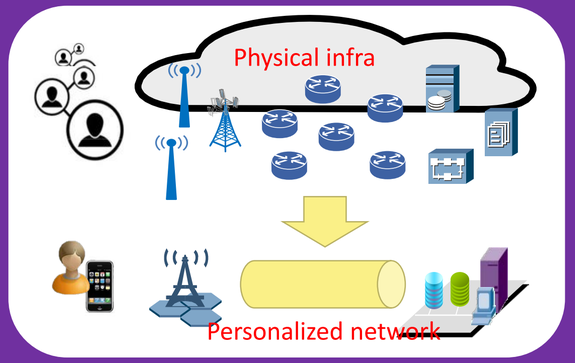
5G Key Network Technologies

New RAN Architecture



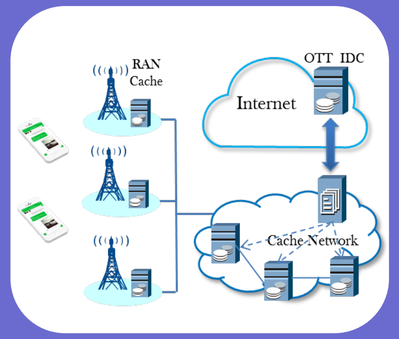
- C/U decouple
- Multi-RATs coordination
- Multi-architecture (C-RAN/D-RAN/Mesh)
- Plug-and-play

Customer-centric Network



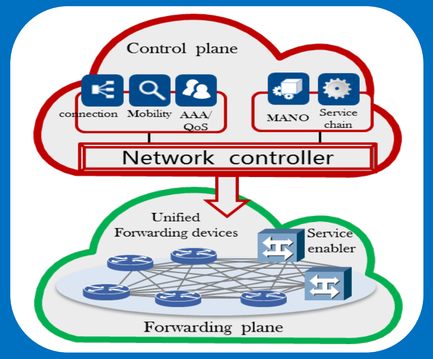
- Customer-centric Access
- Simplify multi-connection management mechanism
- Service provision optimization based on user preference

Mobile CDN



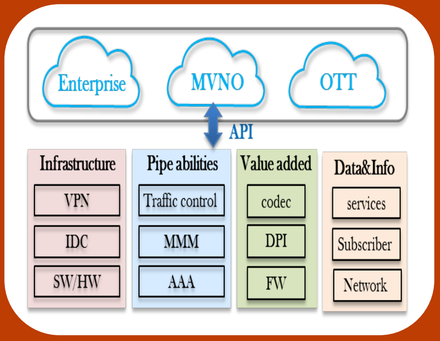
- 2 levels content offloading (RAN and CN)
- ms latency & high data rates
- Good experience

Resource Control and Service Steering



- Real-time traffic monitor
- Per-app resource reservation
- Intelligent value added service provision

Network Capabilities Exposure



- Adapting 3rd requirements to network capabilities
- Customized infrastructure
- Friendly API

5G Concept

5G Concept = “A Core KPI + A Group of Key Technologies”

The core KPI

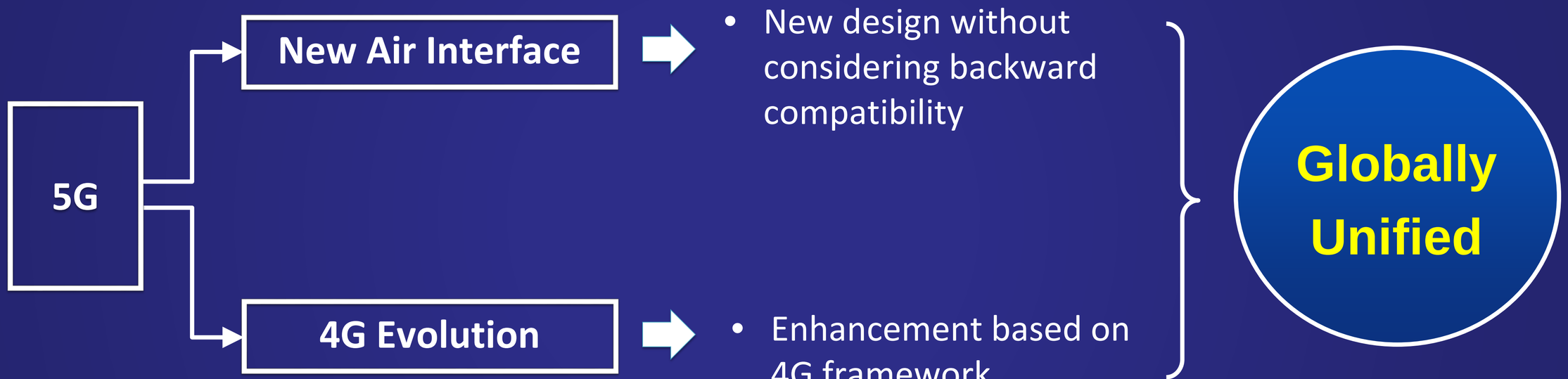
Gbps User Experienced Data Rate

- Traffic volume density
- Connection density
- E2E Latency
- Peak data rate
- Spectral efficiency
- Energy efficiency
- Mobility
- • • •

The group of key technologies

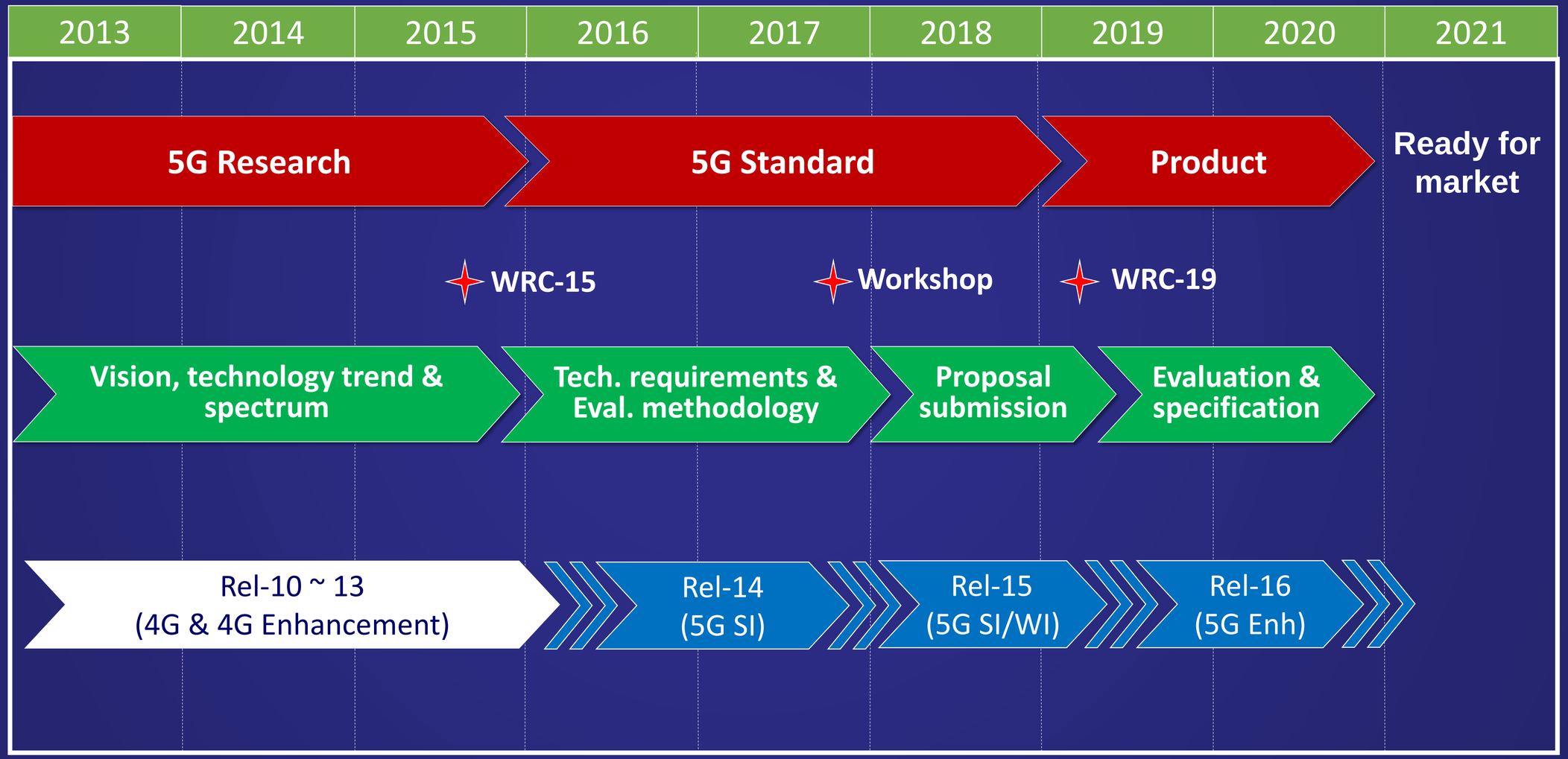
- **Novel Multiple Access**
- **Ultra-Dense Network**
- **Massive MIMO**
- **All-Spectrum Access**
- **New Network Architecture**

5G Technology Roadmap



Note: The next-generation WLAN (802.11ax) is considered as an important supplement to 5G.

5G Time Plan



Summary

5G Concept

- The core KPI
  - Gbps user experienced data rate
- Key technologies
  - Novel multiple access
  - Ultra-dense networking
  - Massive MIMO
  - All-spectrum access
  - New network architecture

5G Roadmap & Scenarios

- Technology roadmap
  - New air interface
  - 4G evolution
- Technical scenarios
  - Seamless wide-area coverage
  - High-capacity hot-spot
  - Low-power massive-connections
  - Low-latency high-reliability

THANK YOU!

IMT-2020 (5G) Promotion Group is willing to strengthen international collaboration to promote globally unified 5G standardization and industrialization.

www.imt-2020.cn