Jointly Paving the Way for 5G

5G Marketing

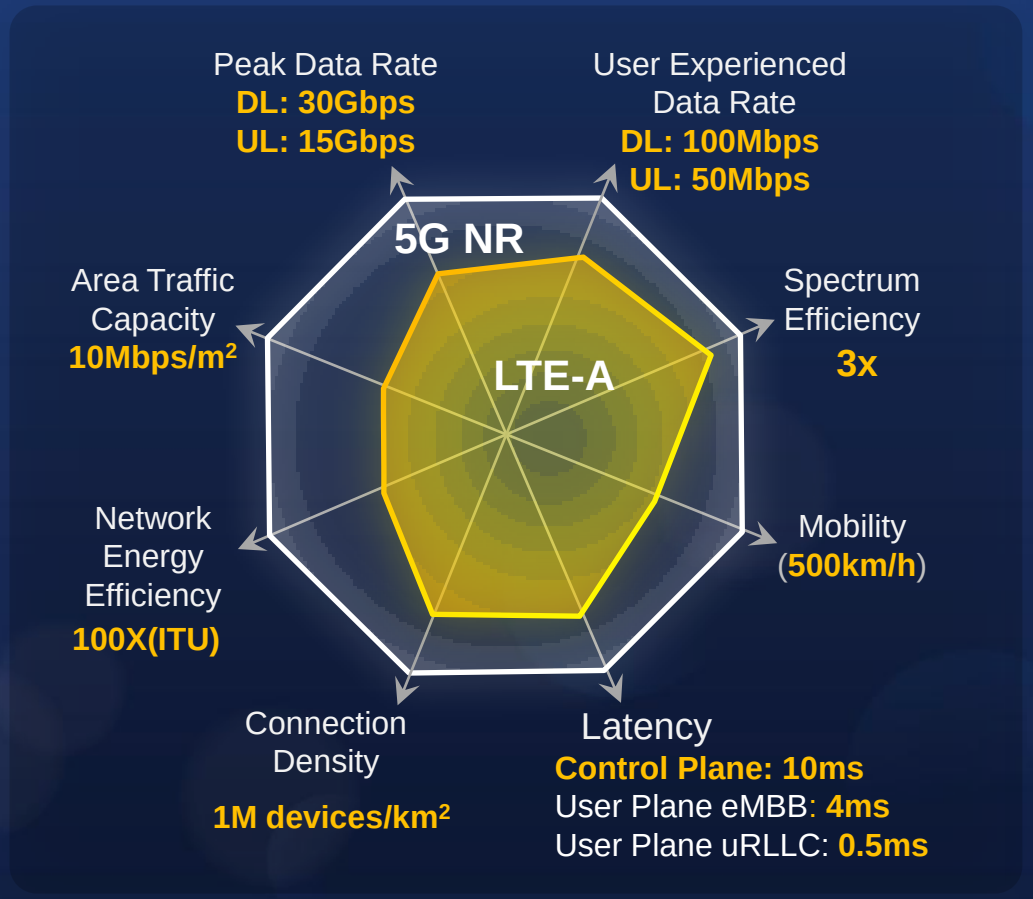
5G Industry Insight

5G Capability

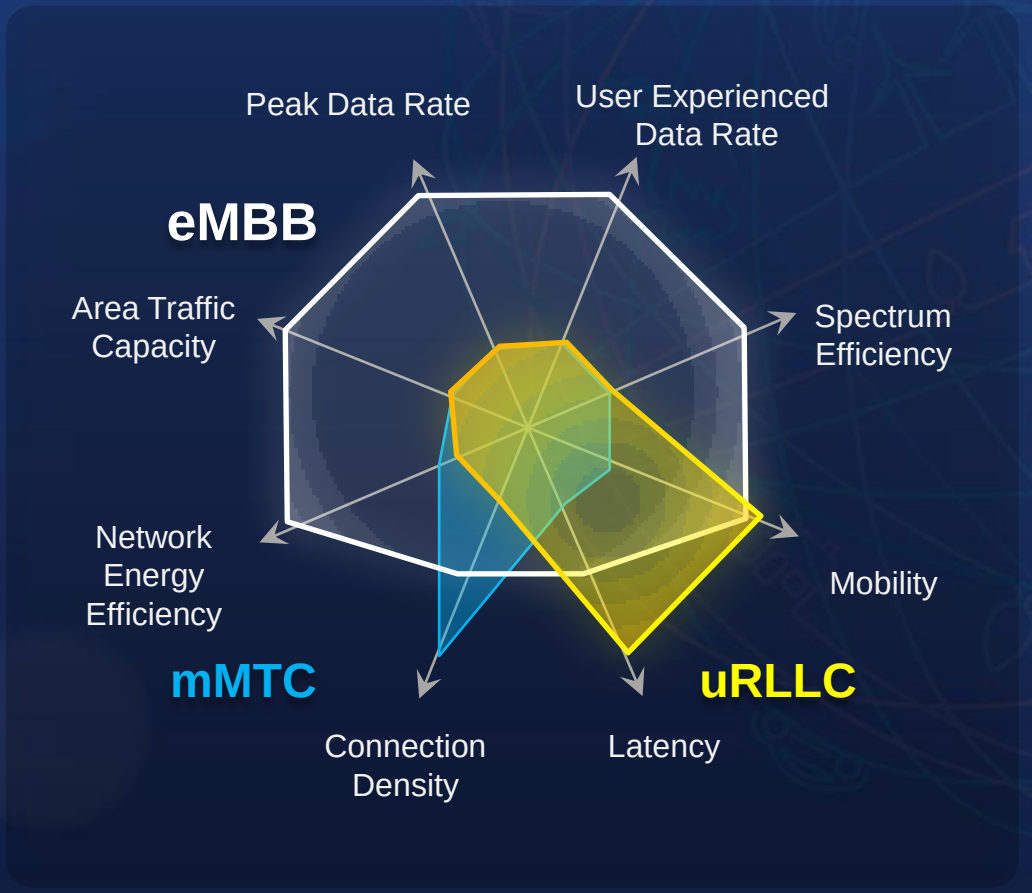
Use Cases

5G Capability Requirements Defined by 3GPP

3GPP Standardization Targets for 5G NR



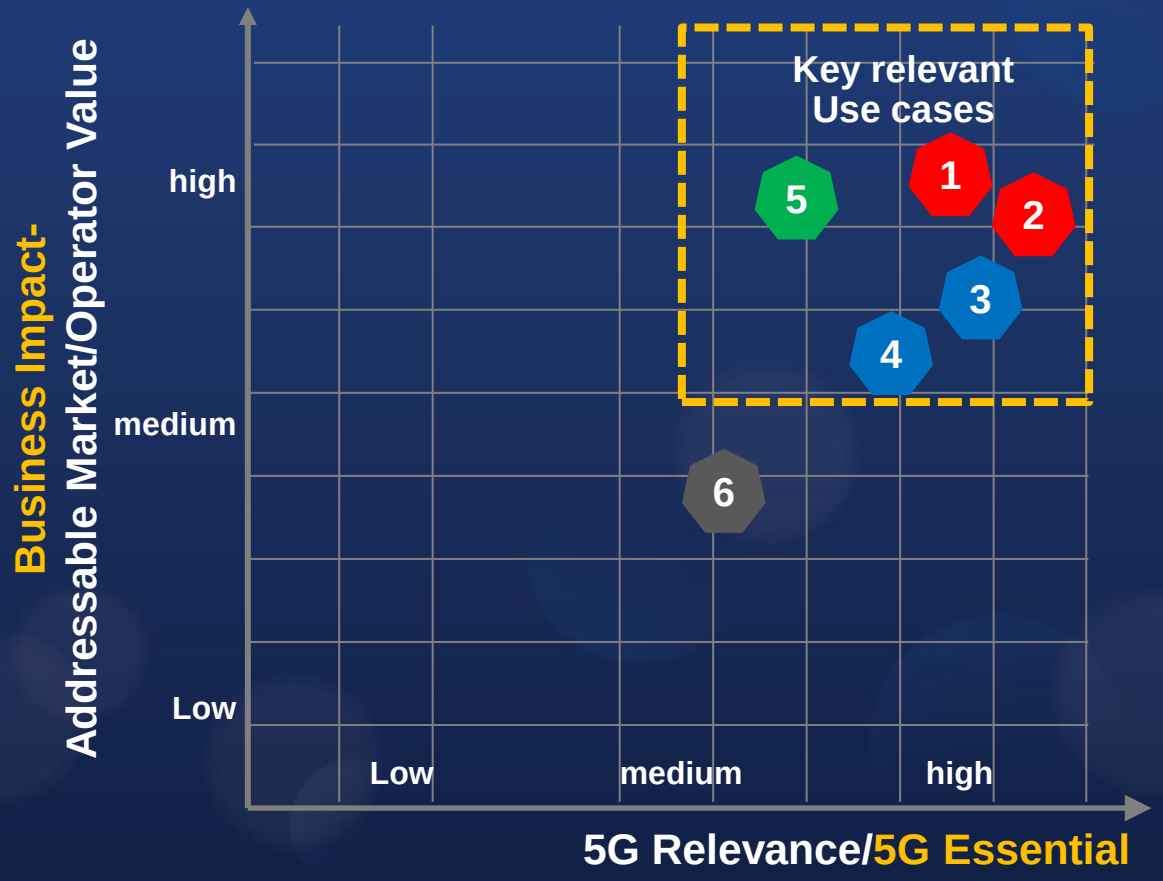
Requirements of Different Services



Source: 3GPP TR 38.913

5G Use Cases Evaluation & Prioritization

Use Case Evaluation

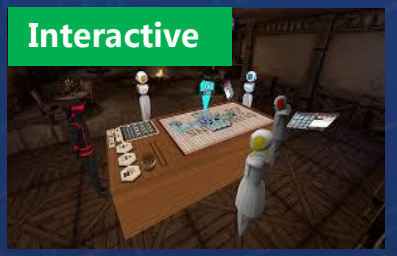


Use Case Example

1. UHD/3D/Holo… Video
2. AR/VR
3. Connected Vehicle
4. Smart Manufacturing
5. Fixed Wireless Access
6. Delivery Drone

Cloud based VR – Social VR

5G eMBB & uRLLC service exploration



Network Requirements

Latency < **5~9ms**

Throughput : **48Mbps~1.2Gbps**

Tele-operated Driving – Autonomous Car

5G uRLLC service joint innovation

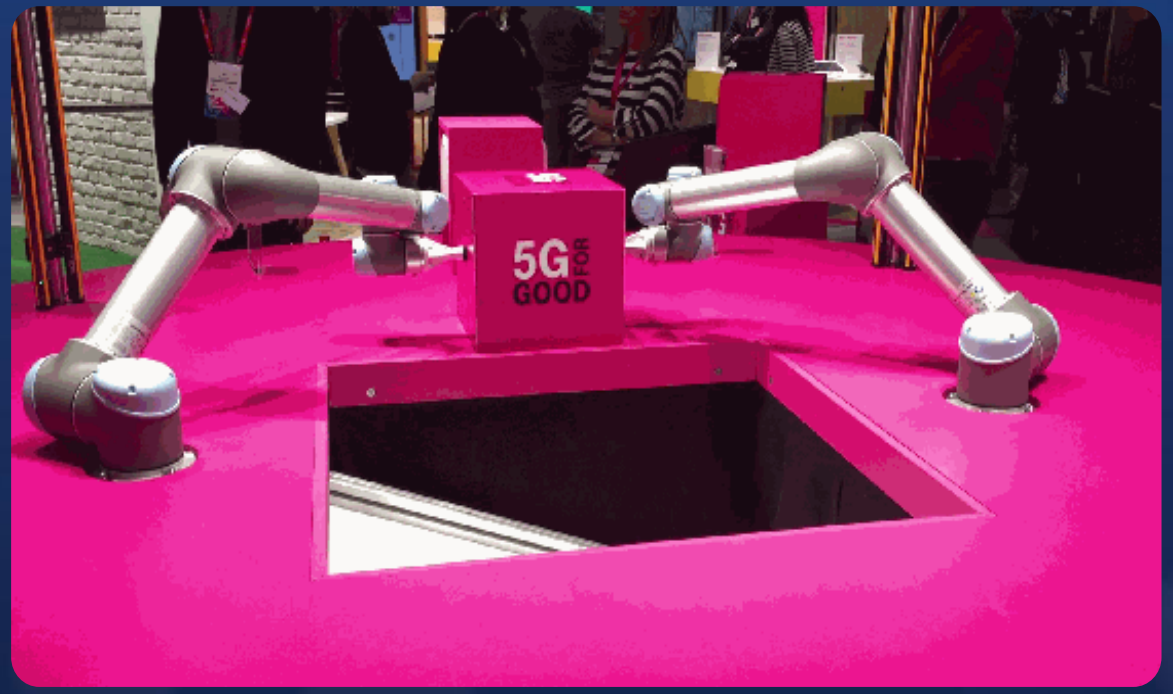
Network Requirements

Latency < **10ms**

Reliability: **99.999%**

Industry Robotic – Smart Factory

5G uRLLC & mMTC service joint innovation



Network Requirements

Latency < **5~100ms**

Throughput > **60Mbps**

Pave the Way for 5G

Spectrum & Site Ready

Network Architecture Ready

Target Network for 5G NR

mmWave

G30 G40 G70

C-Band

Sub-3GHz

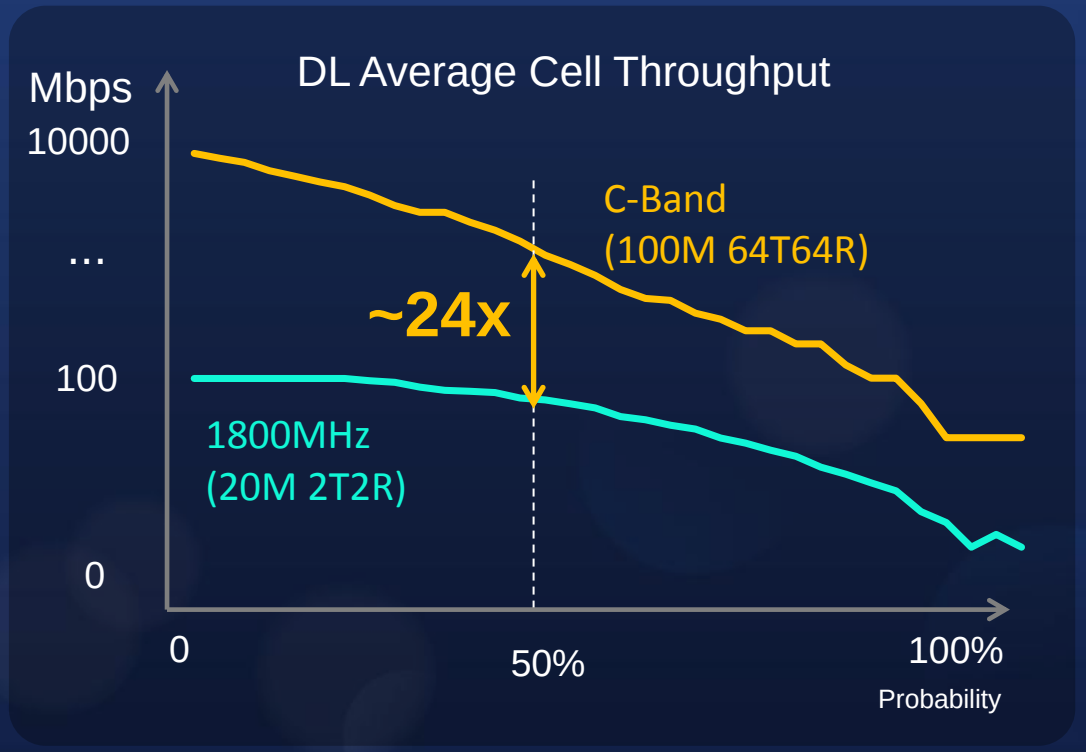
Complementary Capacity Layer
- Hotspot capacity boosting
- Self-backhaul for easy site acquisition
- Fixed wireless access

Primary Capacity Layer
- C-Band with Massive MIMO for capacity & coverage
- UL & DL decoupling extend coverage

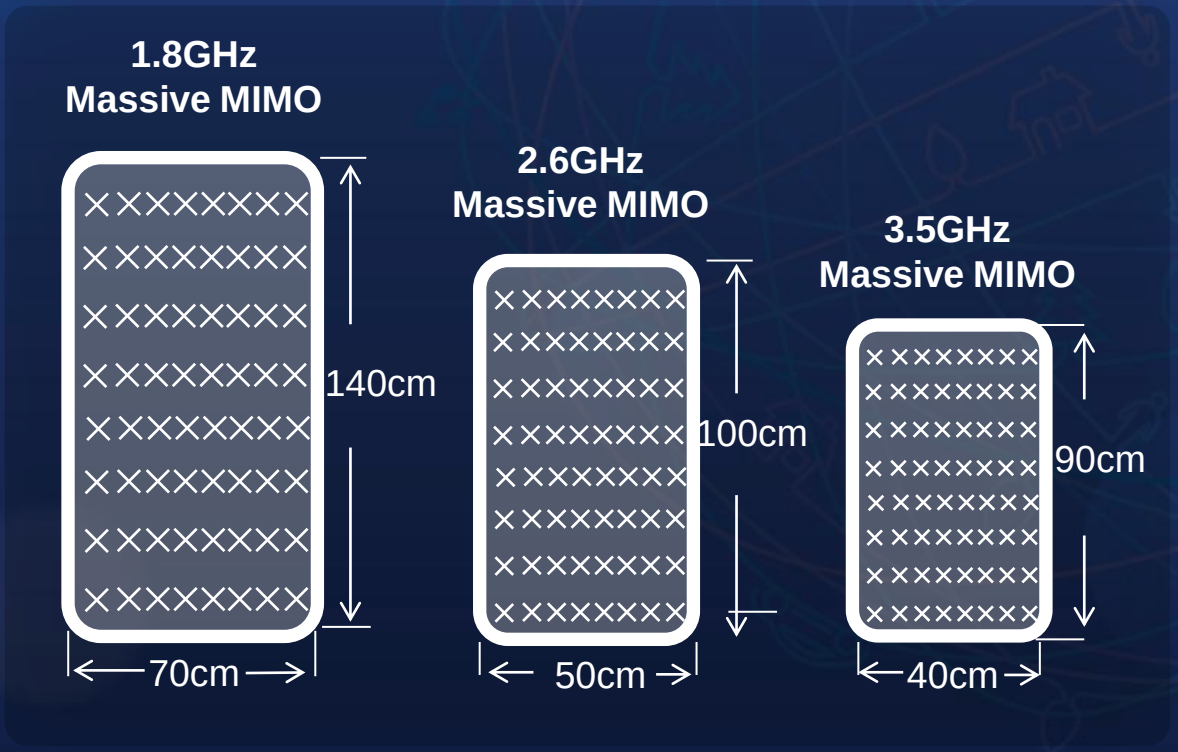
Primary Coverage Layer
- CloudAIR enable NR fast deployment
- 4T4R as basic configuration

C-band M-MIMO Boosts Capacity with Affordable Complexity

C-Band + M-MIMO Boosts DL Capacity



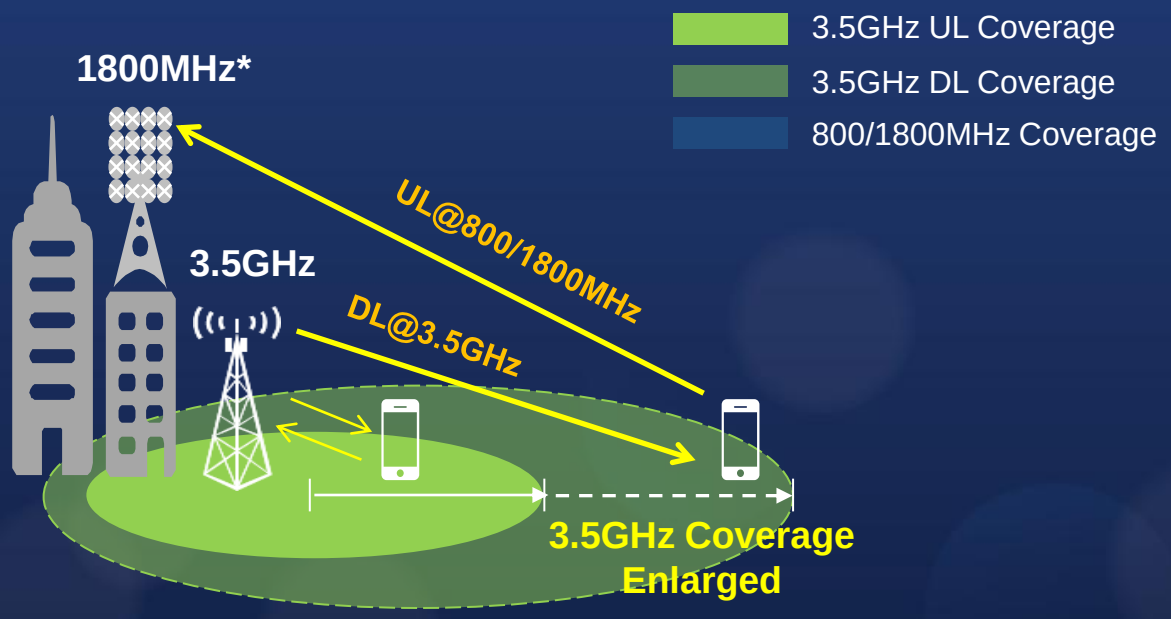
Support M-MIMO with Affordable Complexity



UL&DL Channel Decoupling Enlarges Cellular Coverage

Will comply with 3GPP Release 15.

Implement 3.5GHz Large-Scale Deployment



UL@1800MHz + DL@3.5GHz

~2X Coverage Extended

** Could be any low band frequency*

mmWave Provides Fiber Class Speed in Specific Scenarios

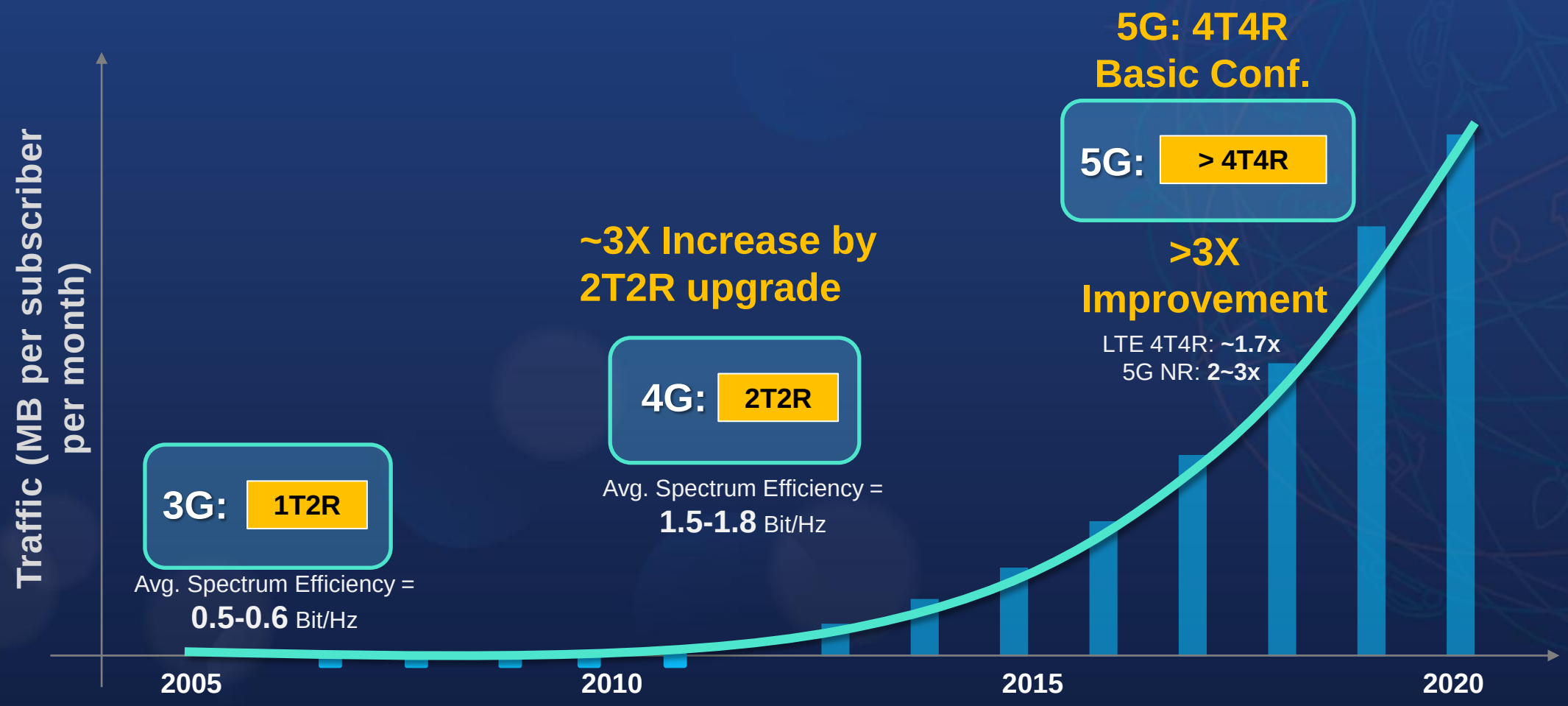
			28GHz	39GHz
System Bandwidth			800MHz	800MHz
Transmission Power (dBm)			36	35
Tx+Rx Antenna Gain(dBi)			26+17	26+17
Coverage (meter) for 100Mbps @Cell Edge	NLOS	**O2O**	**381**	**303**
		O2I (Standard multi-pane glass)	130	91
		O2I (IRR-Glass)	33	14
	LOS	**O2I (Standard multi-pane glass)**	**2917**	**1483**
		O2I (IRR-Glass)	291	130
Coverage (meter) for 1Gbps @Cell Edge	NLOS	**O2O**	**168**	**133**
		O2I (Standard multi-pane glass)	54	34
		O2I (IRR-Glass)	NA	NA
	LOS	**O2I (Standard multi-pane glass)**	**767**	**389**
		O2I (IRR-Glass)	73	26

Indoor & Outdoor Hotspot

Household Last-Mile Access

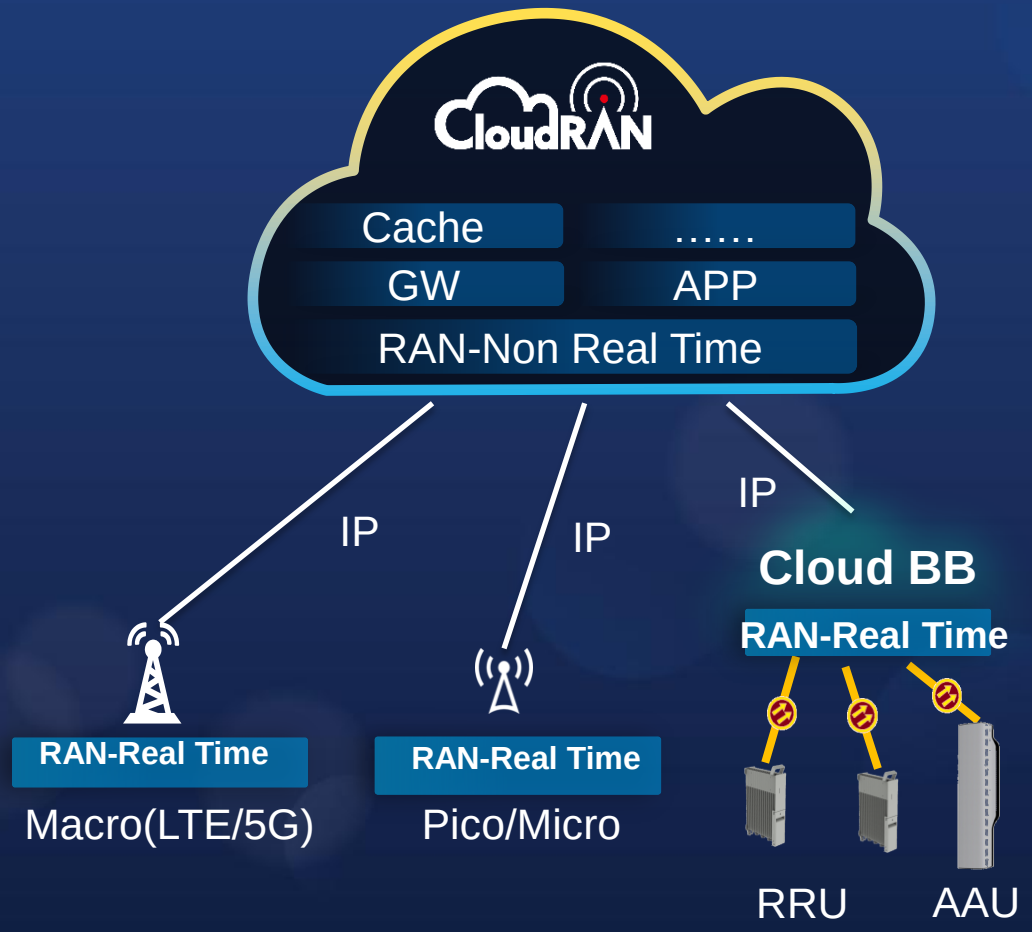
Transmission Backhaul

Sub3GHz: 4T4R will be the Basic Configuration



CloudRAN as 5G Fundamental Architecture

CloudRAN Architecture



Centralized Unit

- COTS hardware, centralized deployment
- On-demand allocation, rapid deployment for new service

Distributed Unit

- Dedicated hardware, distributed deployment
- Better performance, >20X efficiency

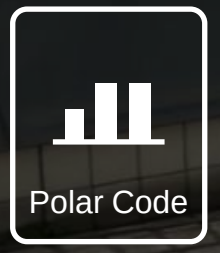
Huawei 5G Update

Joint Efforts to Bring 5G into Reality

5G NR Technologies Trial

SCMA

F-OFDM


Polar Code

MU-MIMO

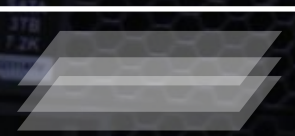
UCNC

Full Spectrum Access Field Trial

C-band

mmWave

5G Network Architecture Trial


Network Slicing

CloudRAN

中国移动 China Mobile

NTT docomo

etisalat

LG U+

МегаФон

Singtel

SoftBank

T ··

Telefónica

TeliaSonera

TELUS

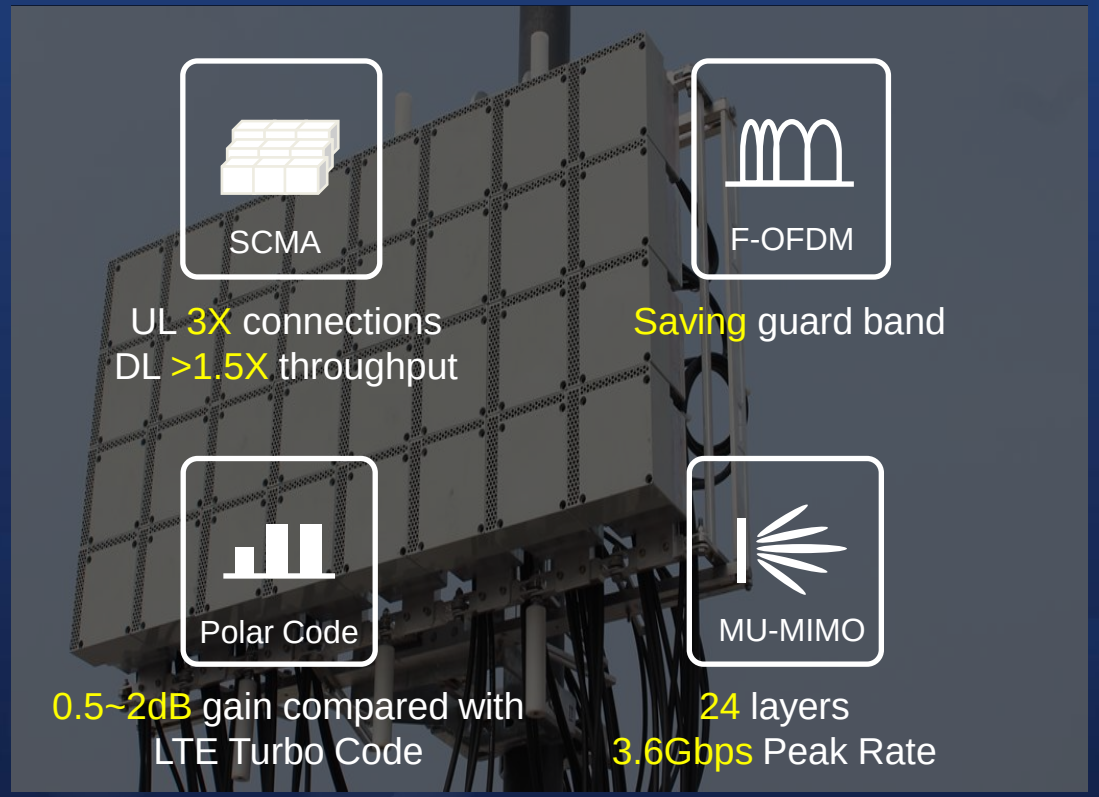
TIM

vodafone

...

First to Finish Verification of 5G Key Technology

World's 1st 5G Large-Scale Trial



SCMA
UL 3X connections
DL >1.5X throughput

F-OFDM
Saving guard band

Polar Code
0.5~2dB gain compared with
LTE Turbo Code

MU-MIMO
24 layers
3.6Gbps Peak Rate

First to Finish NR Trial in IMT-2020 Phase2

Achieve >14Gbps Peak Rate@160MHz, 0.5ms Latency and 4 million connections simultaneously

NTT docomo

IMT-2020

High & Low Band Hybrid Networking Static Test

C-band MU-MIMO

- **10+Gbps**@200MHz BW
- 3D Beamforming
- **26 Layers**

28GHz MU-MIMO

- **40+Gbps**@1GHz BW
- 8 Users
- **16 Layers**

C-band & 28GHz Dual Connectivity

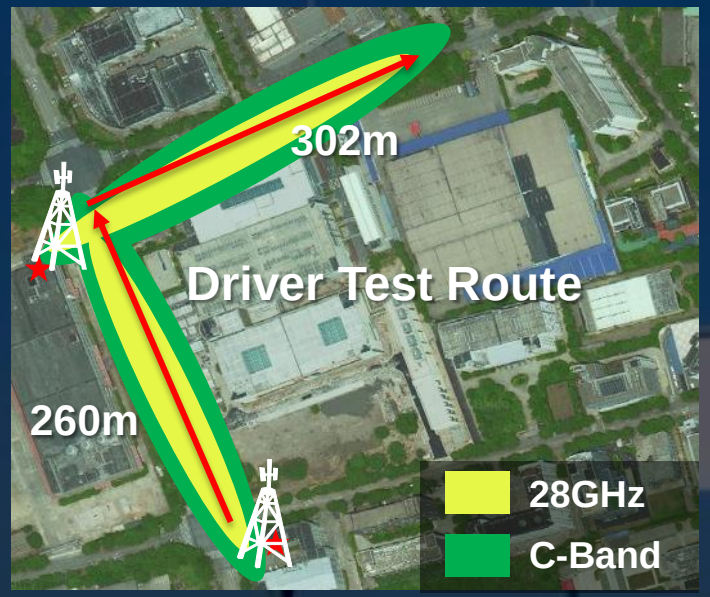
- **5Gbps+15Gbps**
- 8 + 8 Layers

Compact Design for Verification in Commercial Environment

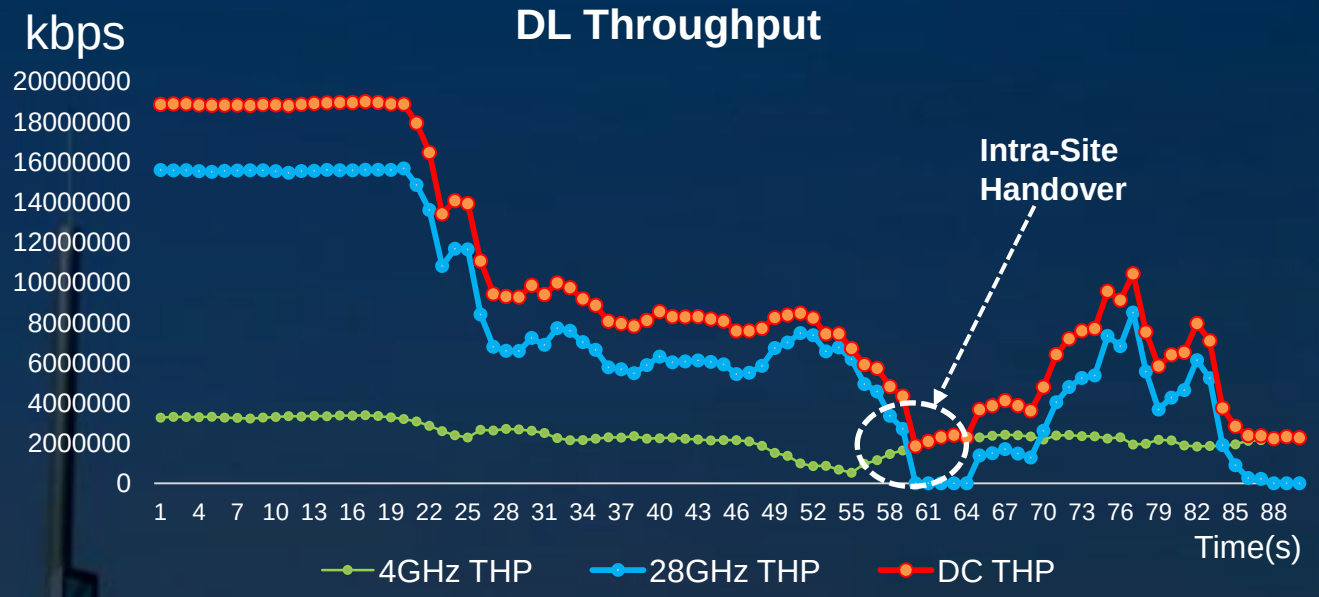
Unified platform for low & high band

中国移动 China Mobile

High & Low Band Hybrid Networking Mobility Test



- C-band & 28GHz co-site
- C-band for continuous coverage
- 28GHz for experience improvement
- Inter-Cell handover when driving



- Peak Throughput of DC: **18Gbps**
- Ave. Throughput: **9.8Gbps**
- (2.3Gbps @ C-band and 7.4Gbps @28GHz)

Joint Exploration of 5G E2E Slicing in MWC2017

- RAN + Transport + Core + BSS/OSS
- C/U Decoupling
- Programmable Network Functions

AR Slice + Robot Slice + FMC Slice

1 Physical Infrastructure, 3 Isolated Slices

Open Collaboration for Global Unified Standard

Industry Collaborations

Europe

- 5G PPP — Board Member
- 5G Innovation Center — Key Founder
- 5GAA Automotive Association — Key Founder

Asia

- IMT-2020 — Board Member (China)
- 5GMF The Fifth Generation Mobile Communications Promotion Forum — Leading R&D Partner (Japan)
- 5G Forum — Leading R&D Partner (Korea)

Operator Collaborations

- ngmn — Leading R&D Partner

docomo, T-Mobile, vodafone, 中国移动 China Mobile, TELUS, Telefónica, TeliaSonera, LG U+, TIM, kt, Singtel, МегаФон, etisalat, BT, SoftBank

20+ operators

5G Research Centers (11)

- **Stockholm, Sweden**
  - •System Architecture
  - •Algorithms
- **New Jersey, USA**
  - •5G Transmission
- **Paris, France**
  - •Standardization
- **Ottawa, Canada**
  - •5G Radio
  - •Network Architecture
- **Munich, Germany**
  - •Verticals
- **Moscow, Russia**
  - •Fundamental Algorithms
- **5G Research Centers in China**
  - •Shenzhen
  - •Shanghai
  - •Cheng du
  - •Beijing
  - •Hangzhou

Thank You