5G Industry development and Spectrum evolution

International Conference On Regulation of Electronic Communications

Tunis, March 13th 2018

Agenda

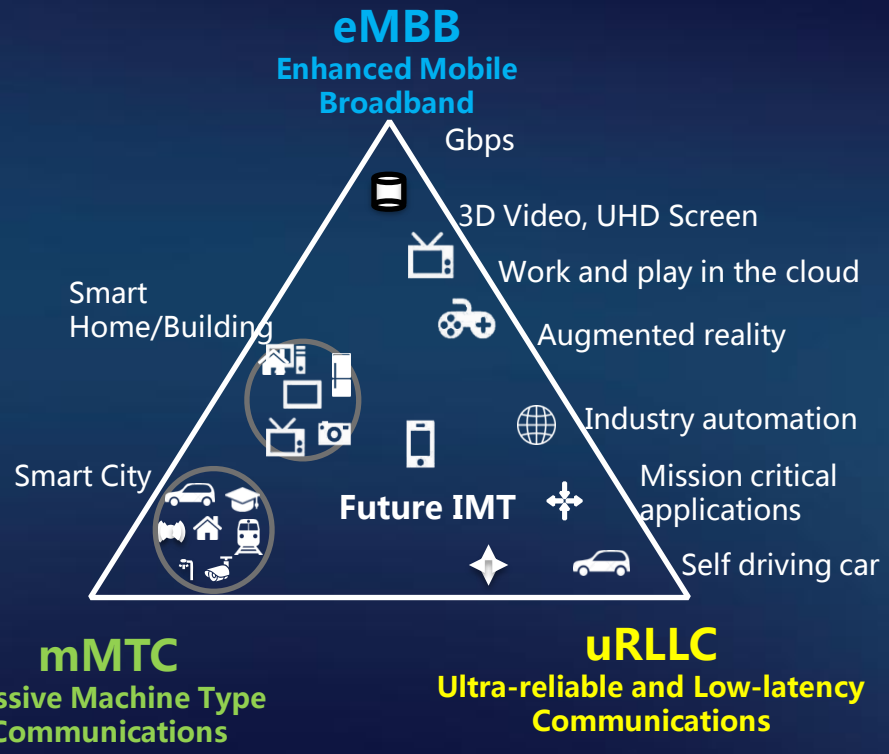
- **5G technology an ecosystem development**
- **Key spectrum aspects**
- **Highlights**

5G: The 3rd Paradigm Shift for Mobile Industry

1980s

2000s

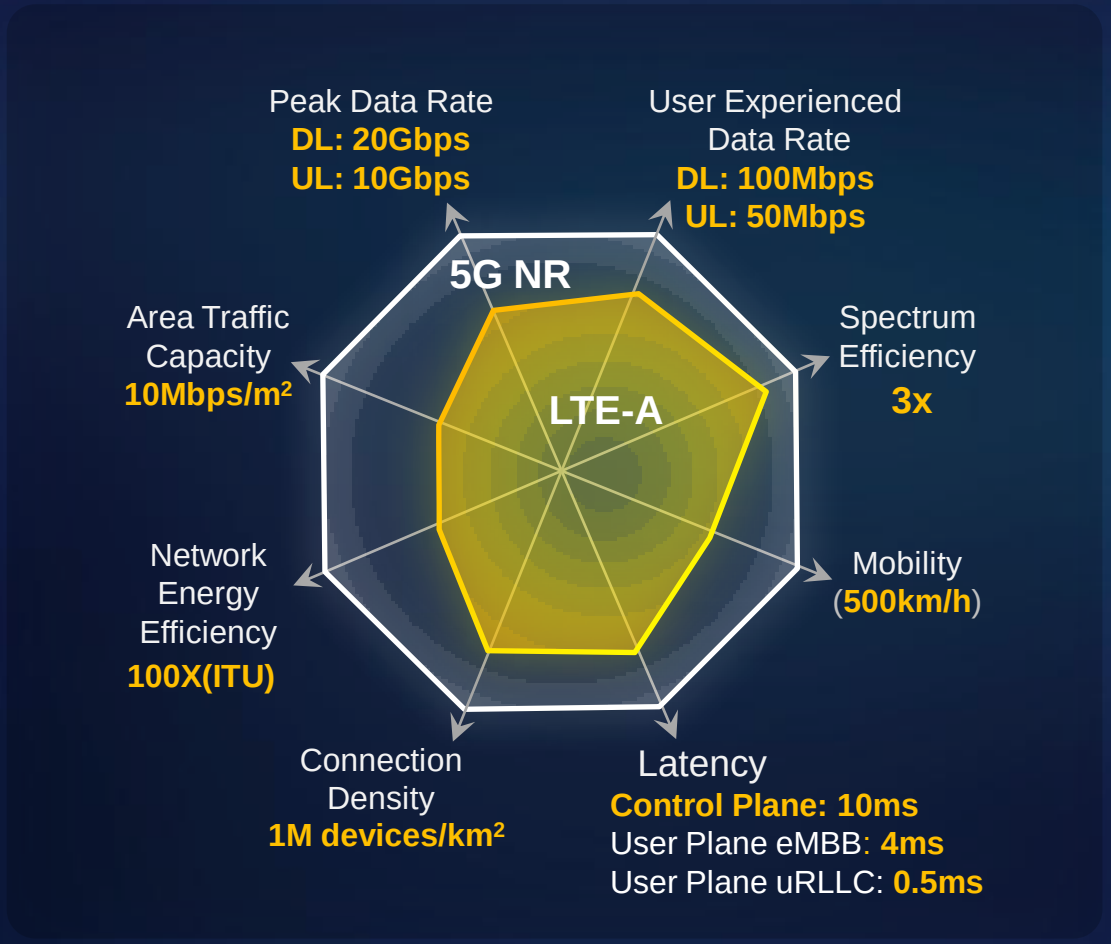
2020s

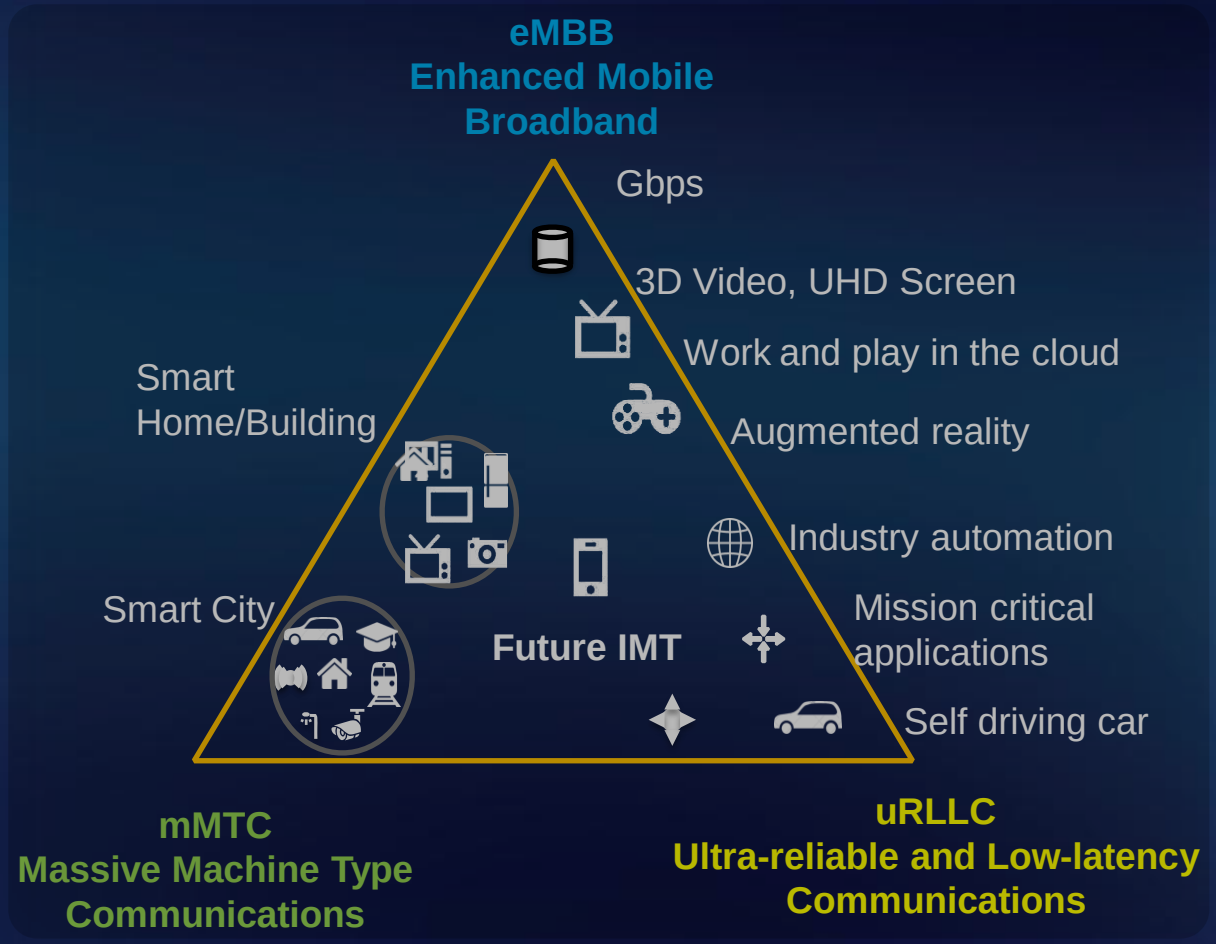


Mobile Voice Era (1G&2G) | **Mobile Broadband Era** (3G&4G) | **Super Connected World** (5G)

Voice | **Broadband** | **Connection** eMBB + uRLLC + mMTC

5G Capability requirements defined by 3GPP

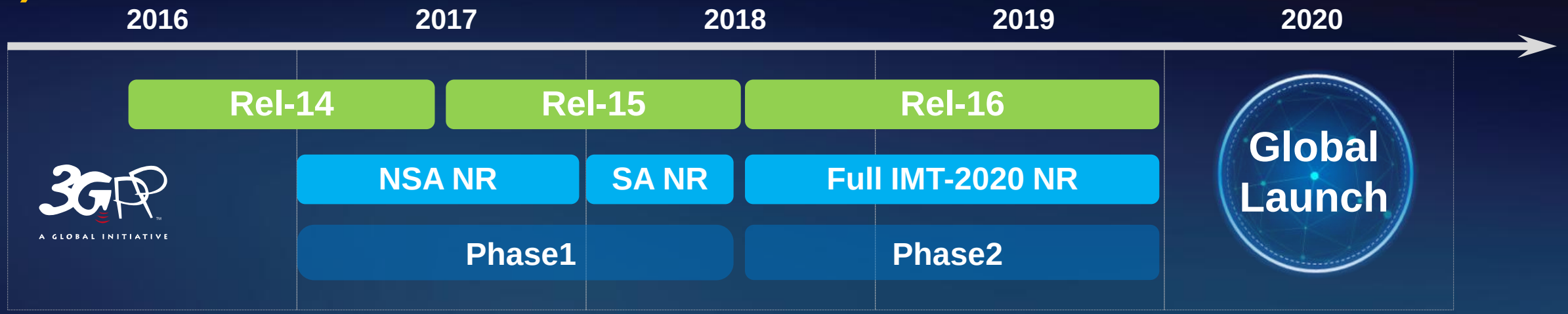




Source: 3GPP TR 38.913

First 5G NR Non Standalone specifications are ready

Initial description of 3GPP 5G solution submitted to ITU-R Jan.18 (SRIT & NR RIT)



Phase 1

NR Framework
- Waveform & Channel Coding
- Frame Structure, Numerology
- Native MIMO
- Flexible Duplex

Architecture
- NR/LTE Co-existing
- UL&DL Decoupling
- CU-DU Split
- NSA / SA

Use: eMBB focus. uRLLC (low latency, multiplexing)

Phase 2

NR Improvement
- New Multiple Access
- eMBB Sub6G Enhancement
- Self-Backhaul

Vertical Digitalization
- uRLLC Enhancement
- mMTC
- D2D
- V2X
- Unlicensed

Use: eMBB, Full uRLLC, mMTC

LTE evolutions (e.g.NB-IoT, eMTC, LTE-V2X) are part of the 5G SRIT submission to ITU-R. They will meet some of the early mMTC and URLCC use cases in timeframe of Rel-15

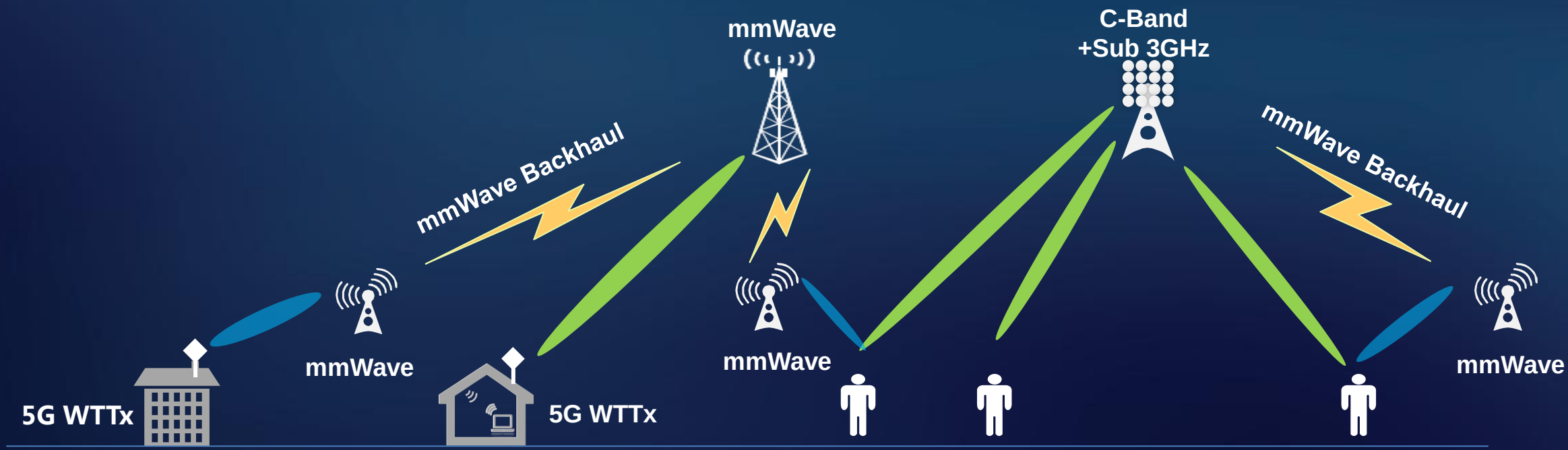
Deployment Scenario

Sub 6Ghz bands for basic capacity &Coverage
mmWave for Ultra High Capacity

C-Band:
- Massive MIMO for capacity & coverage

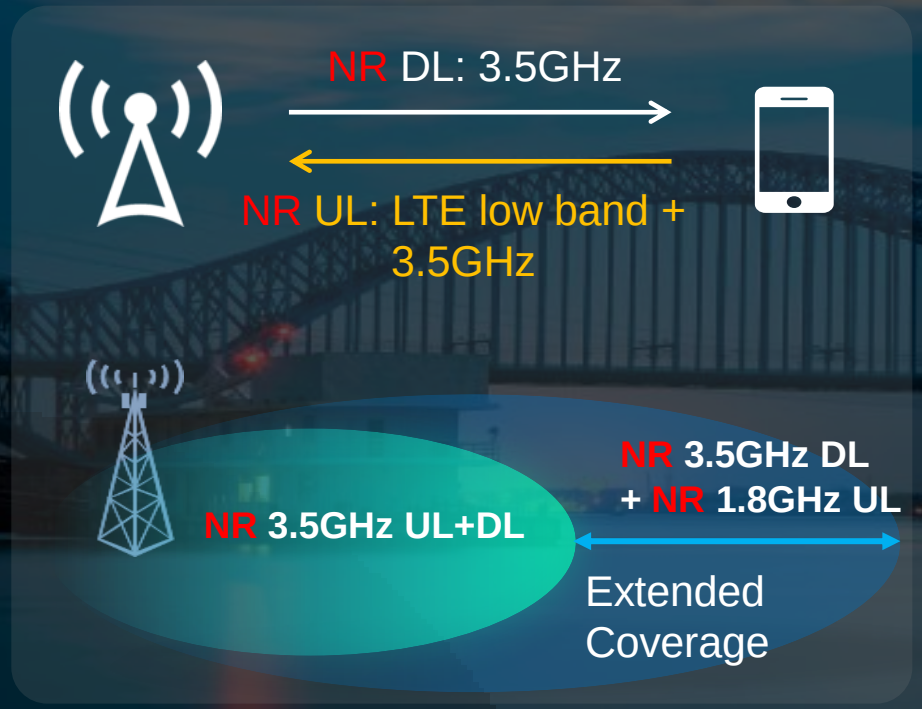
Sub 3GHz:
- Connectivity & coverage & mobility

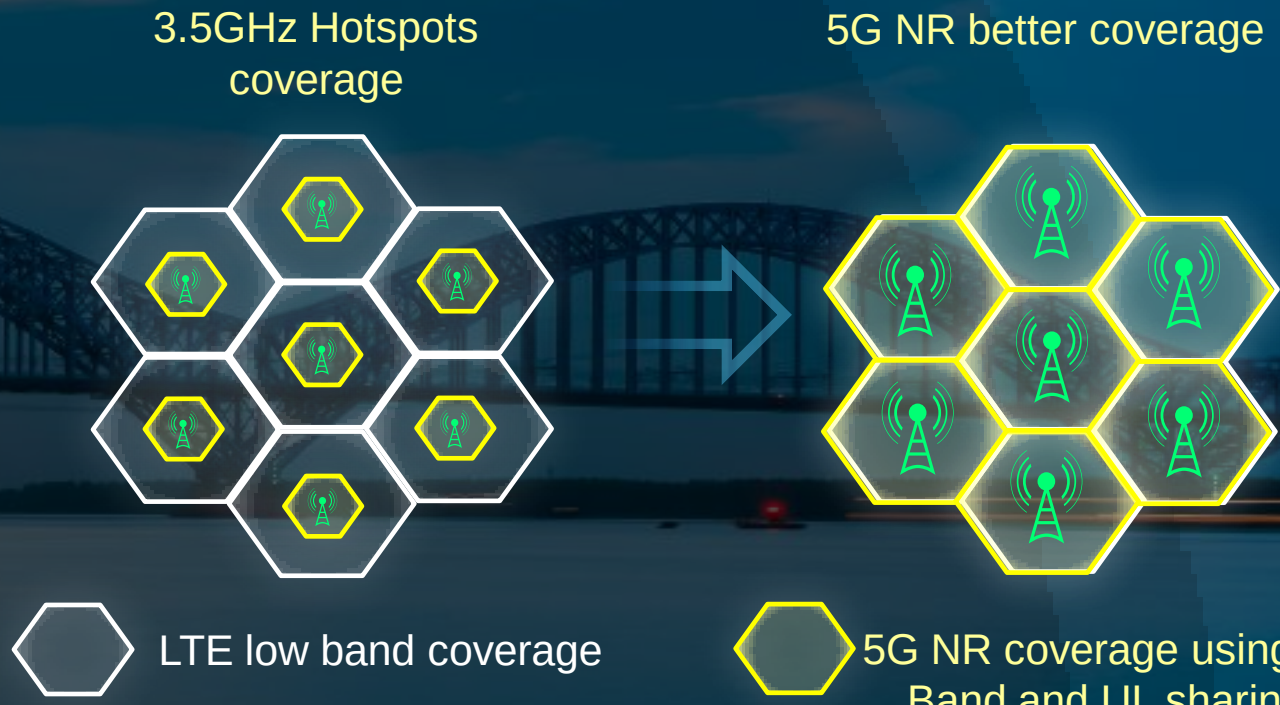
mmWave:
- Capacity boosting for hotspot
- Home broadband access
- Self-Backhaul for easy site acquisition



Uplink coverage assistance from frequencies below 2 GHz

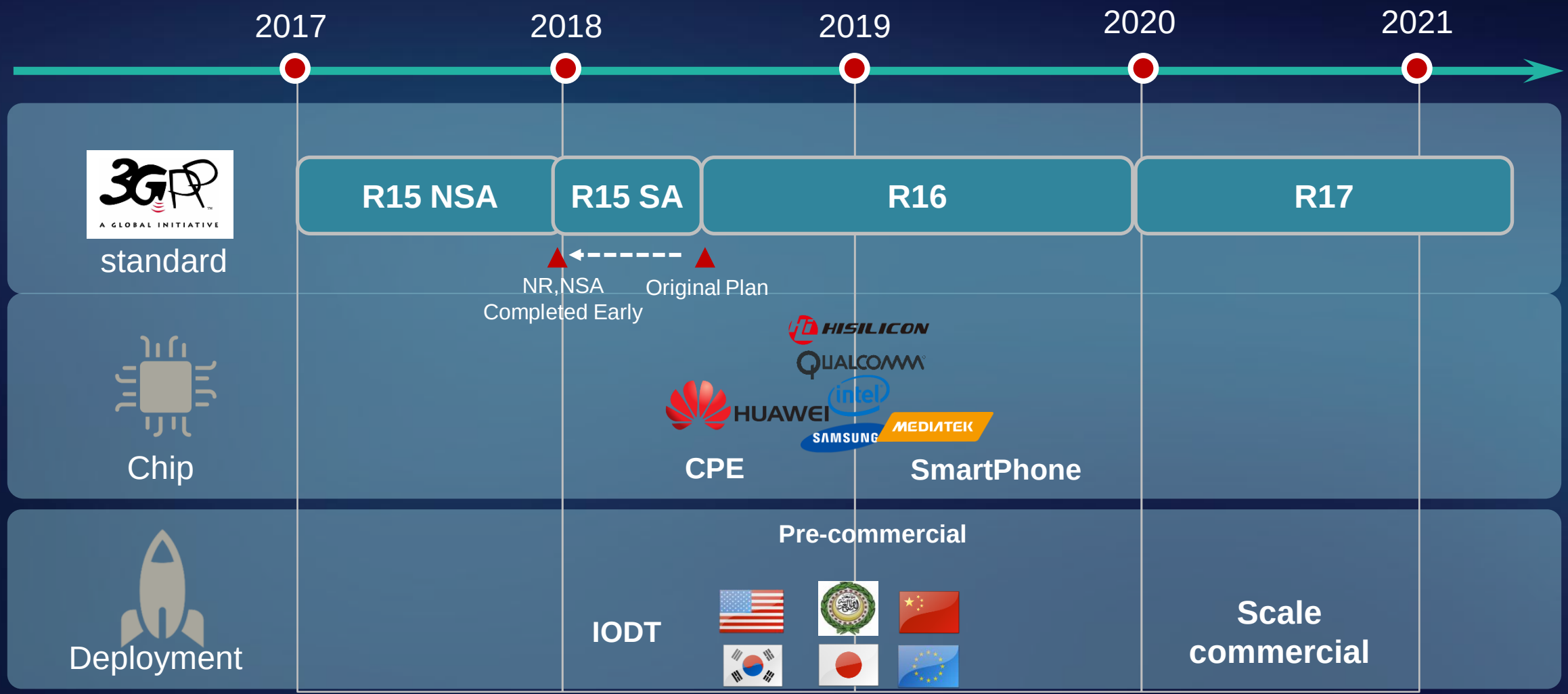
Extend 5G coverage, accelerate deployment



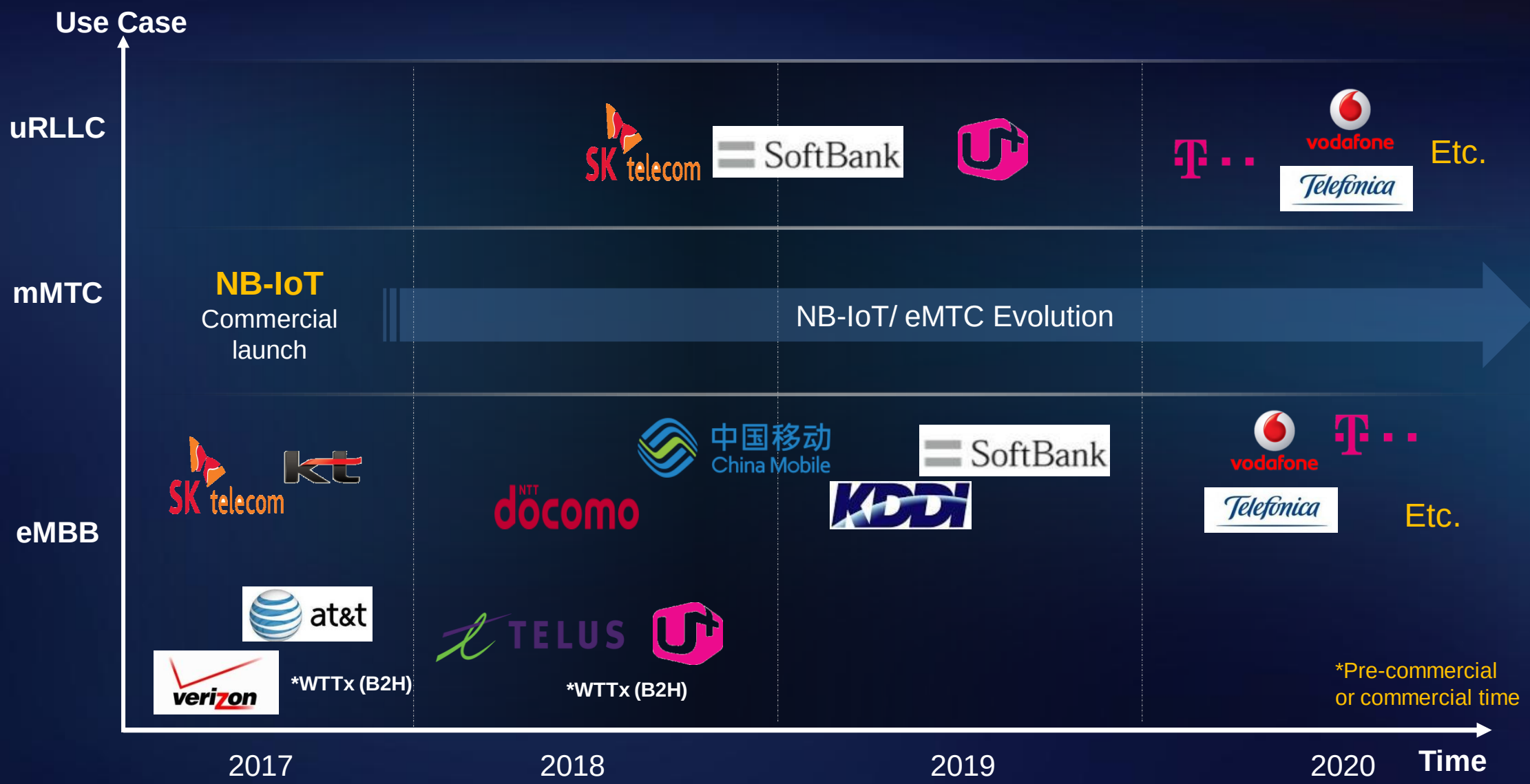


- UL coverage is a bottleneck for C-Band, LTE/NR UL sharing in lower bands improves coverage
- **LTE/NR UL sharing in lower bands combined with C-Band extends 5G UL coverage, improves utilization of legacy bands and helps accelerate 5G deployment**
- **Part of release 15 specifications**

Chipset and Device support 5G Acceleration

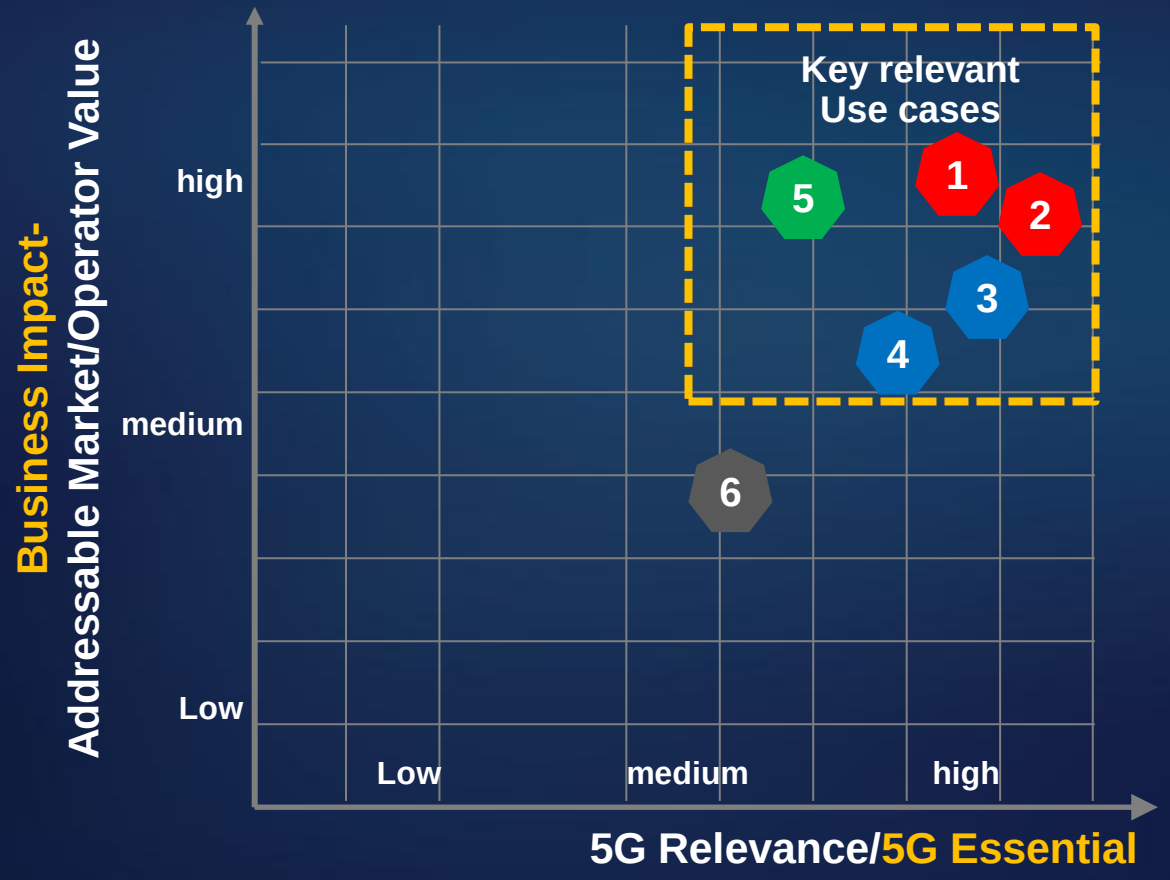


5G Use Cases Viewpoint from Some Operators



5G Use Cases Evaluation & Prioritization

Use Case Evaluation

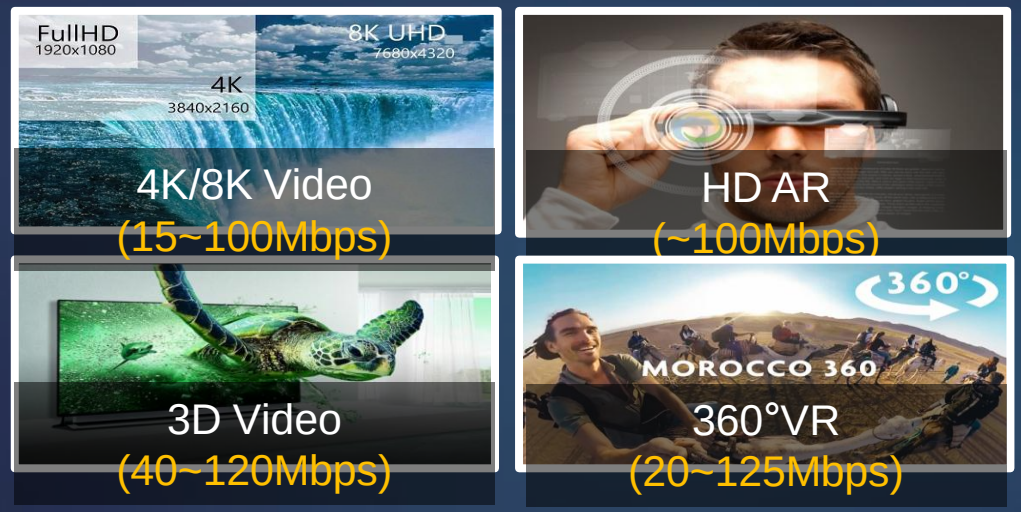


Use Case Example

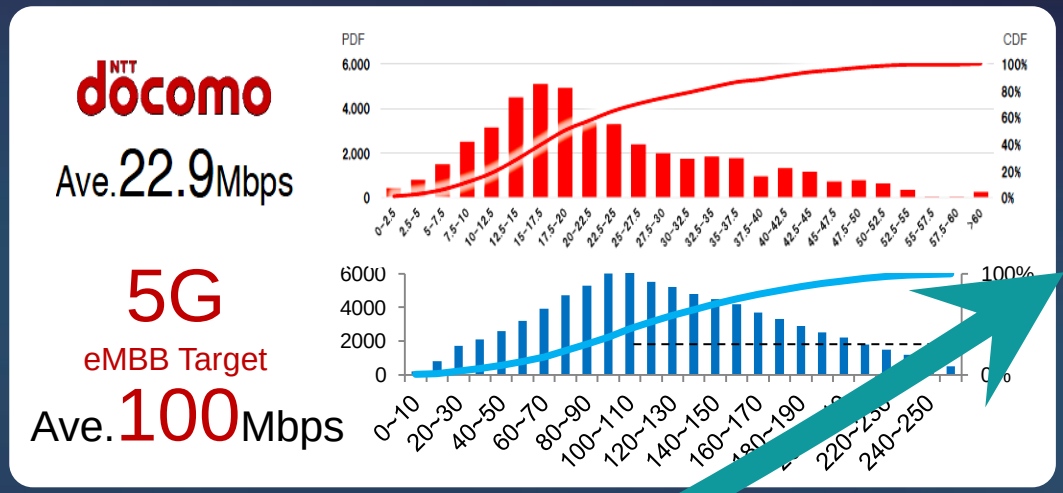
1. UHD/3D/Holo… Video
2. AR/VR
3. Connected Vehicle
4. Smart Manufacturing
5. Fixed Wireless Access
6. Delivery Drone

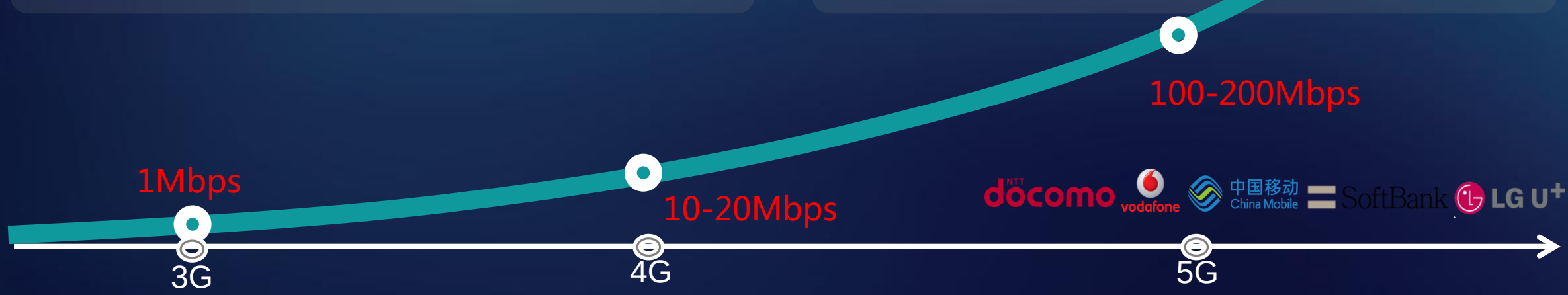
eMBB: 5G will bring 10 times better user experience

100Mbps eMBB user experienced rate



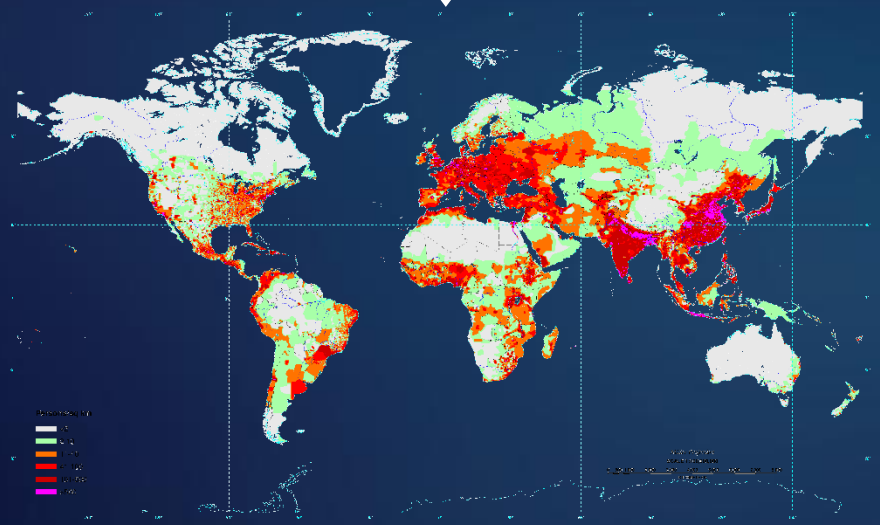
5G eMBB target peak rate >100Mbps





Fixed Wireless Access for Home Broadband

Household with Internet



>10Mbps	0.3bn
<10Mbps	0.4bn
No Access	1bn

Source: ITU 2015 ICT Facts

Great Needs of Internet Worldwide

Wireless Home Access

USA

Australia

New Zealand

China

Greece

Recommended by Regulator for National Broadband Network

5G Early Deployment

2017 5G WTTx Trial in Canada & US

Fiber-like experience

Fast TTM & ROI

Source: Public information

5G Home Access in NA

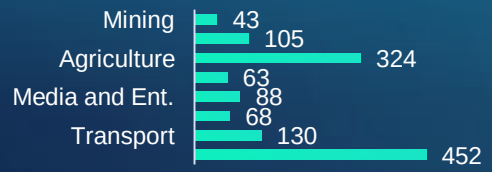
5G Industry Use Cases

Drone

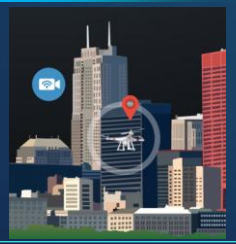
SIG set up in 2017

中国移动 China Mobile | HUAWEI | dji | EWATT 易瓦特

Addressable Market (bn$)



Enable more application:
250Mbps UL, 99.99% reliability, City safe…



Connected Car

SK telecom

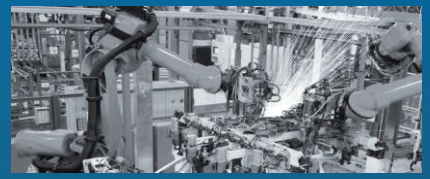
Connected Car

2017H2 — Launch Assisted Driving

Near Future — 4G : Assisted

5G : Autonomous

Smart Factory



Building Strategy

2014~2017

Standardization User Case

BOSCH | SIEMENS | ABB | HUAWEI | BECKHOFF

2017~2019

Deployment

2020~

Ultra Density Network

etisalat

EXPO 2020 إكسبو دبي، الإمارات العربية المتحدة DUBAI, UNITED ARAB EMIRATES

4.38 KM² | 300K People/Day

10Gbps Pavilions **100Mbps** Everywhere

*UDN: ultra density network

2017 Shanghai MWC Use Cases

XLabs Wireless

Guide Helmet

Home Service Robot

Connected Drones

Smart Manufacture

5G Autonomous Driving

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5G needs a multi-layer spectrum approach

eMBB	**High Frequencies** **Super Data Layer** Addressing specific use cases requiring extremely high data rates	**Above 6 GHz** 800 MHz assignments (contiguous)
eMBB, URLLC, mMTC (wide area but no deep coverage)	**Medium Frequencies** **Coverage & Capacity Layer** Best compromise between capacity and coverage	**2 – 6 GHz** 100 MHz assignments (contiguous)
mMTC, eMBB, URLLC	**Low Frequencies** **Coverage Layer** Wide area and deep indoor coverage	**Below 2 GHz** up to 20MHz (paired / unpaired)

5G requires spectrum from the three layers in parallel.
Each MNO will identify its specific most suitable combination of bands.

Technology & Service Neutrality to accelerate new technology deployment and maximize spectrum potential

Lessons from the past

Fast Penetration

Global 2G/3G/4G network using 1.8GHz

+90% pop coverage

3 billion connections

3~6 months

Quick TTM upgrade than new bands

Critical for the Arab region

Source：Huawei mLab

Technology & service neutrality is important for all bands to maximize spectrum potential

C-band pionner 5G band: 100MHz/MNO key for 5G Business Success

Countries planning 300M ~ 500M bandwidth. Target +100MHz/MNO. Inter-operator sync to be required

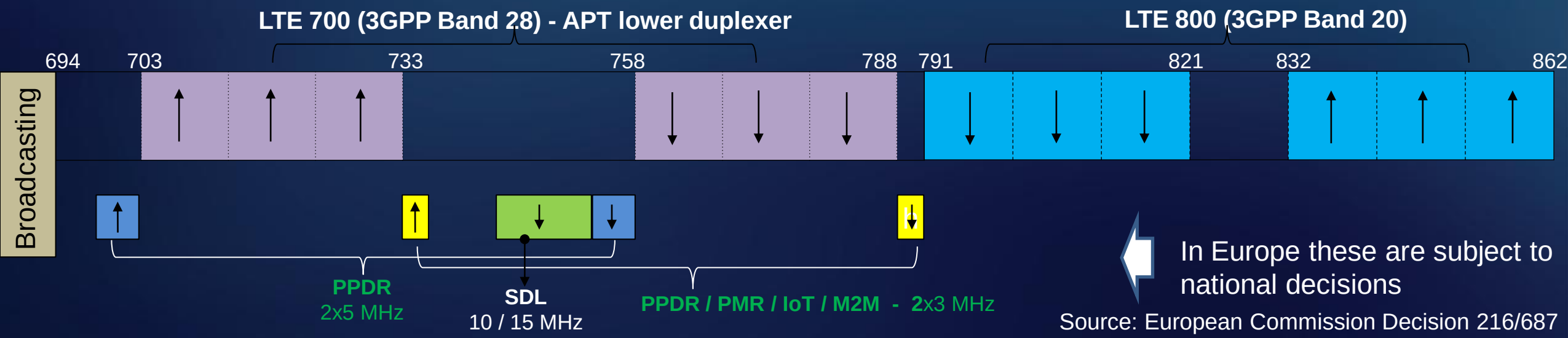
Regulation must be technology and service neutral. Band to be restructure to offer contiguous 5G BW

APT 700MHz Opportunity for 4G and Later 5G

40+ LTE operators deployed APT700 B28 across 25 countries

- EU and ASMG markets started 700MHz release. Some MNOs started with LTE deployment. Some others will go directly to 5G by 2020
- Bands below 1GHz essential for consistent cell edge coverage at any location for highly sensible VoLTE services
- Key to provide wide area IMT user experience, including but not limited to the M2M/IoT services or the URLLC (e.g. 5G eHealth services)
- Preferably allocate **2x10MHz** from band 28 for each MNO

Possible band plan:



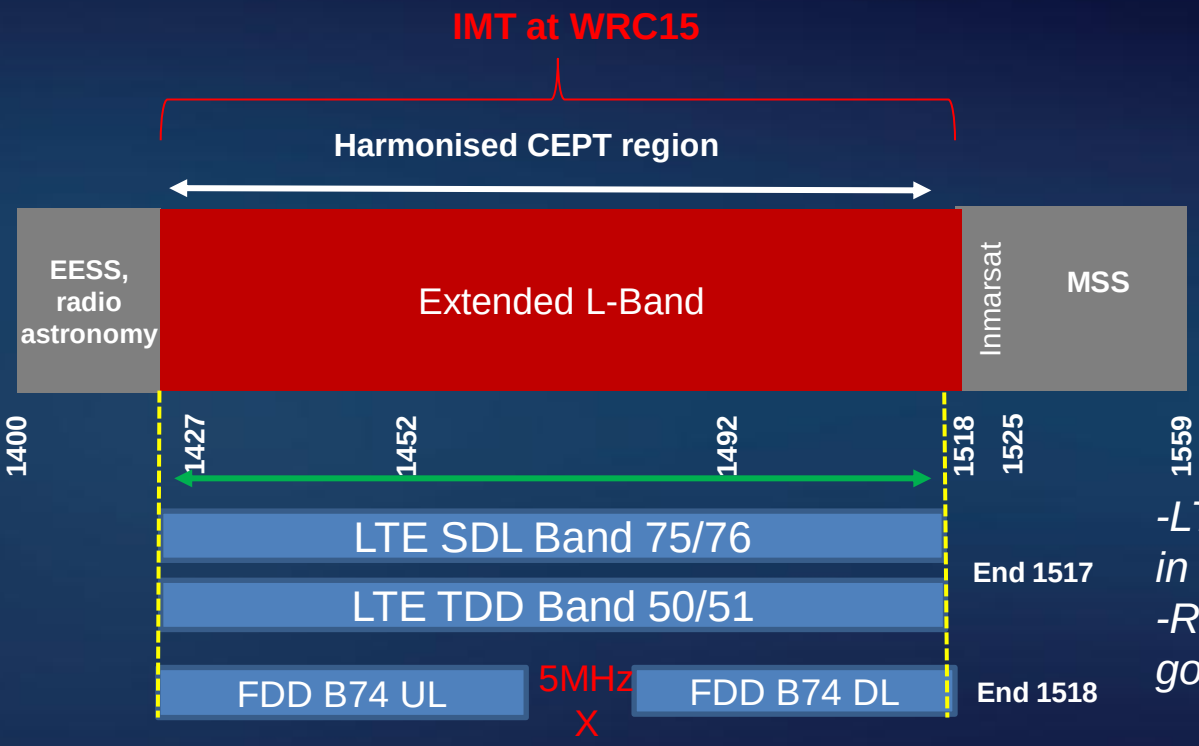
In Europe these are subject to national decisions

Source: European Commission Decision 216/687

L-bands 1427-1518MHz: Coverage and Capacity starting for 2020+

- **Primary IMT allocation to MOBILE service (except aeronautical mobile) or MFCN Decision in Region 1, 2 and 3**
- **Only few countries have not identified for IMT a part of the spectrum**

Regulation



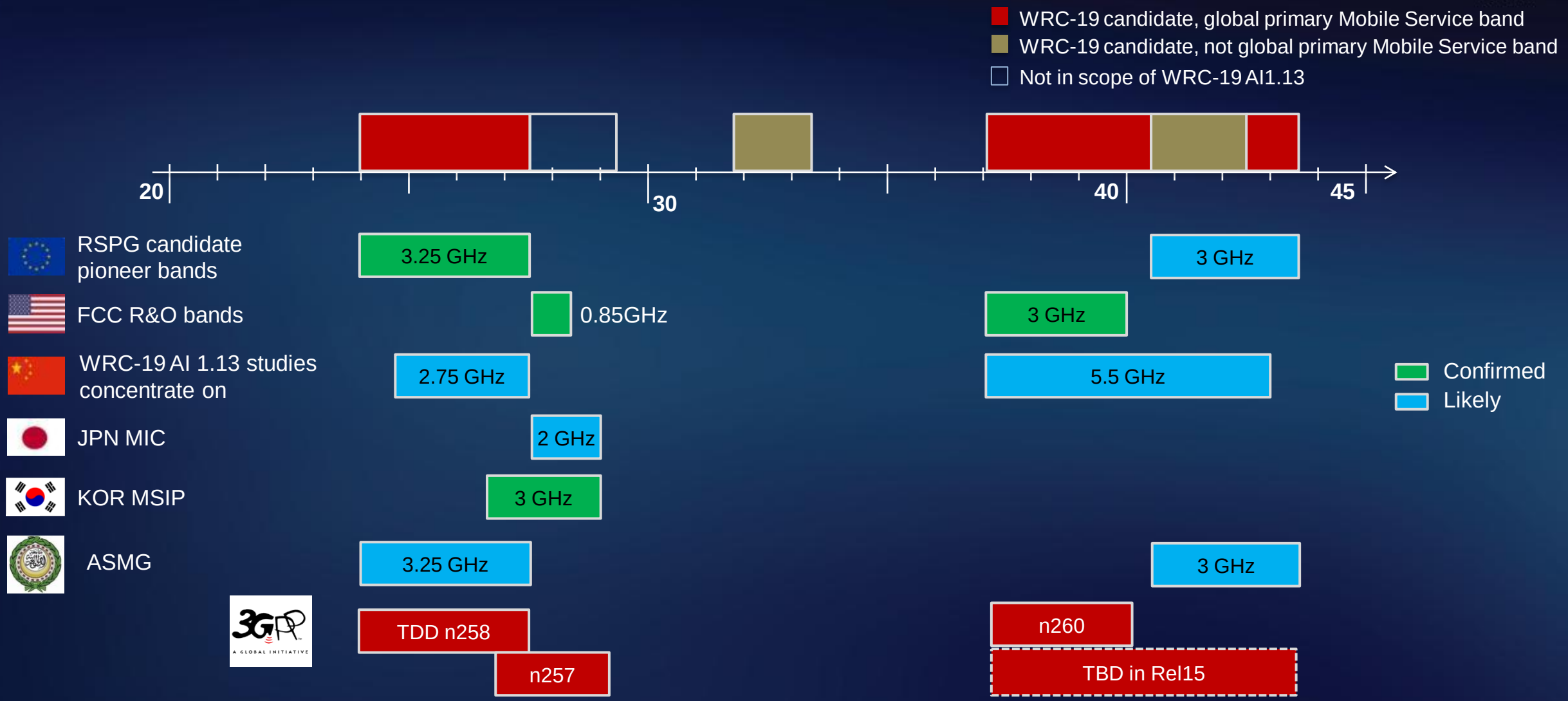
Standard

-LTE extended L-bands completed in 3GPP (09/17)
-Related 5G NR bands spec. on-going, expect completion 06/18

- Different band plans for 1427-1518MHz are currently proposed in ITU-R WP5D and 3GPP by different countries
- CEPT and CITEL adopted SDL. Other regions (ATU, ASMG, APT) didn't finalise yet regional harmonisation process. Different options studied/supported
- SDL is the best coverage/capacity adapted plan for L band.
- For countries that prefer or need necessarily a standalone band (DL&UL), TDD shoud be prefered to FDD

Ultra high Capacity: mmWaves

26GHz & 40GHz: highest potential for 5G early commercialization



The 24.25-27.5 & 37-43.5 GHz are the most promising high frequency ranges for 5G globally.
We recommend to the Region to focus its efforts within these two ranges.

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Recommendations

1. **For capacity: 5G will require large contiguous spectrum allocations in C-band (3.4-3.8GHz) 5G primary band and mmWaves bands (26GHz Pionner mmwaves band)**
   - Fragmentation leads to economically non-viable deployments for operators. Bands needs to be re-structured

2. **For coverage: 700MHz to ensure deep and large coverage. Followed in future by L-Band**
   - Other low bands could also be used in the future to support 5G

3. **Service and technology generation neutrality is key**
   - maximize spectrum potential & offer MNOs necessary flexibility to deploy the latest technologies available

4. **Sustained evolution of LTE network paves the way for first 5G deployments**
   - Lower bands for deep indoor and rural coverage; LTE anchor for early NSA 5G deployments; AAS and Massive Mimo; network densification; NB-IOT (M2M);

5. **Flexible policy enabling operators to deploy flexible service packages and tariffs**
   - Enable a flexible policy to match the future service evolution and enhance operators competitiveness such as Zero-Rating, FMC, etc..

Thank You