



Bringing 5G into Reality

Contents

 Endeavor for 5G Global Unified Standard

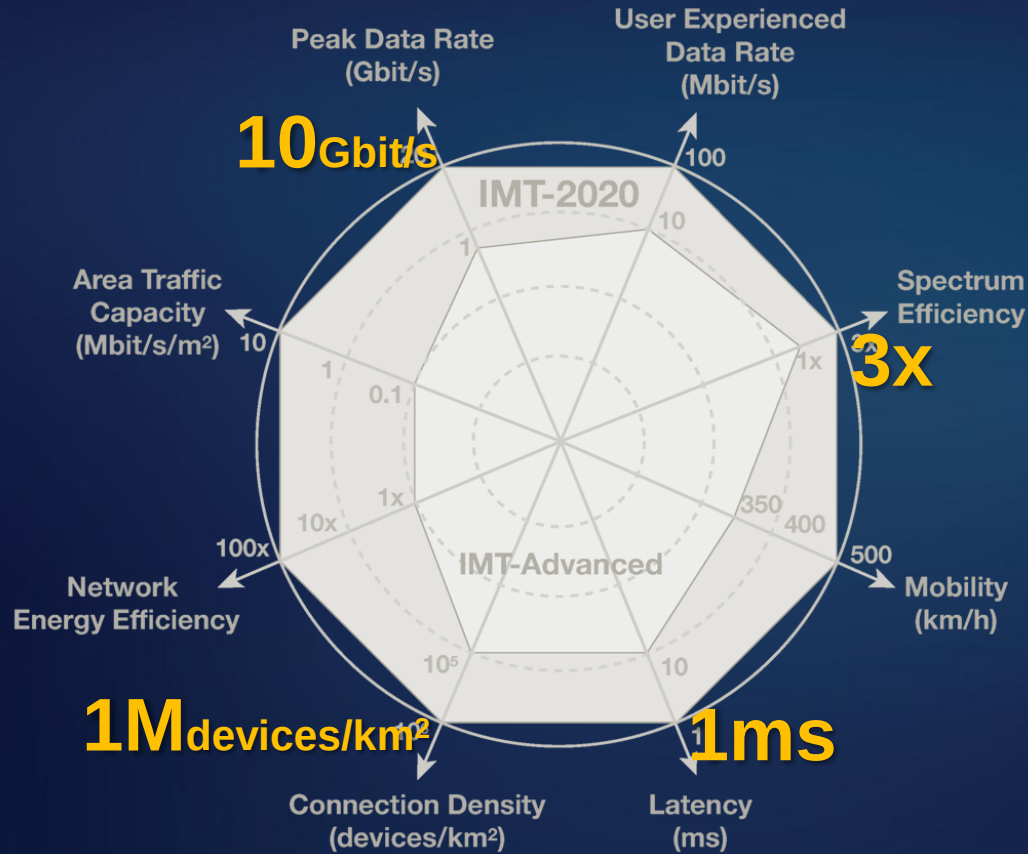
 5G Research & Innovations

 Maximizing Spectrum Value

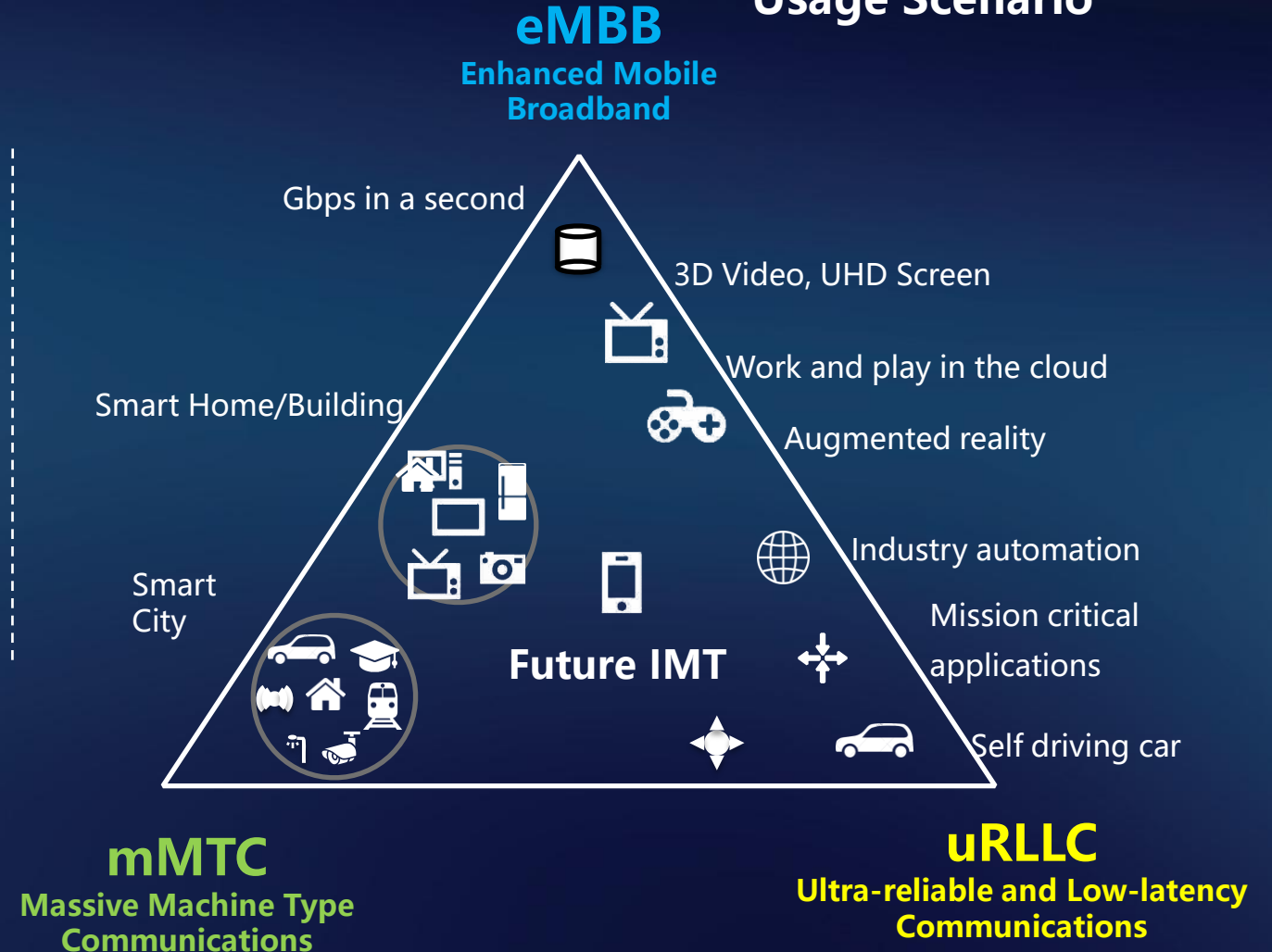
IMT-2020 VISION



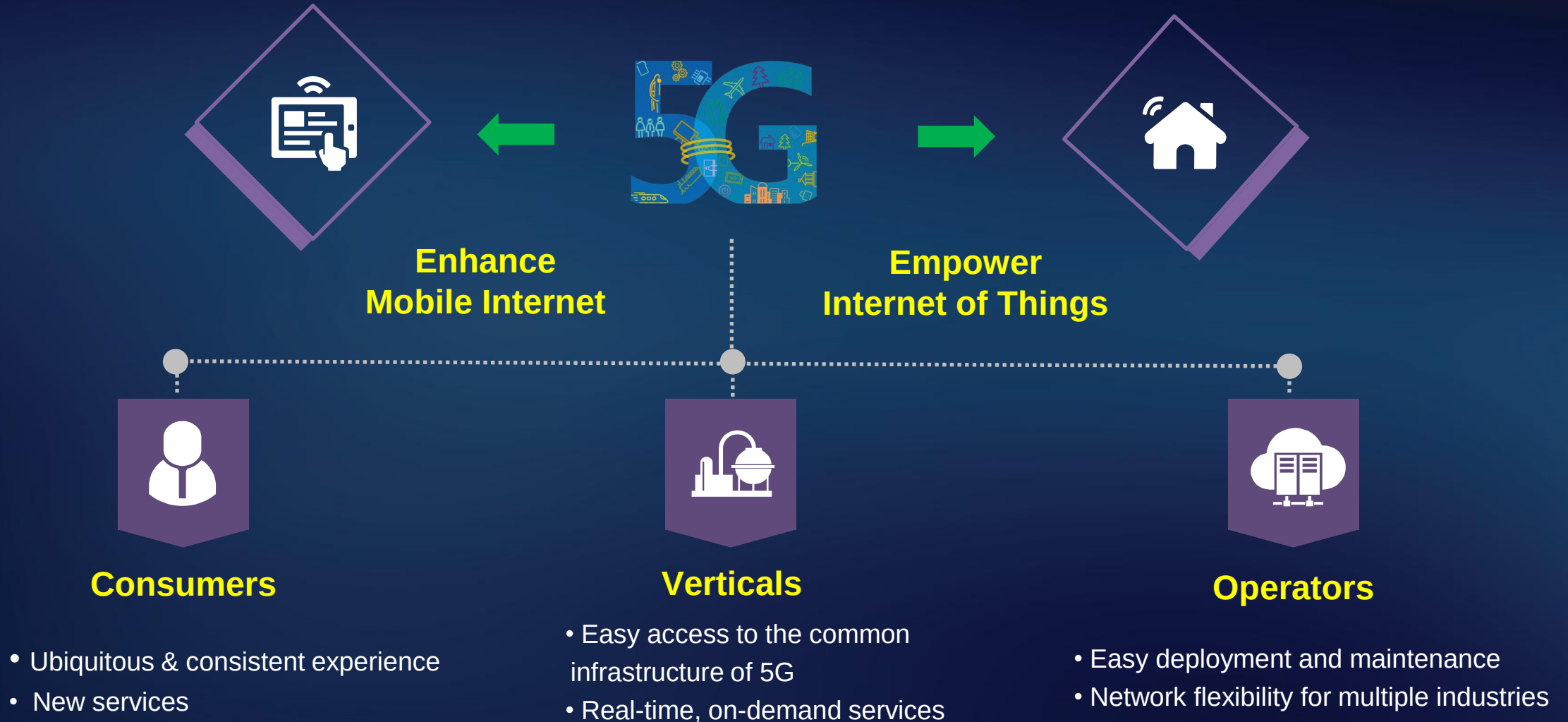
Key Capabilities



Usage Scenario



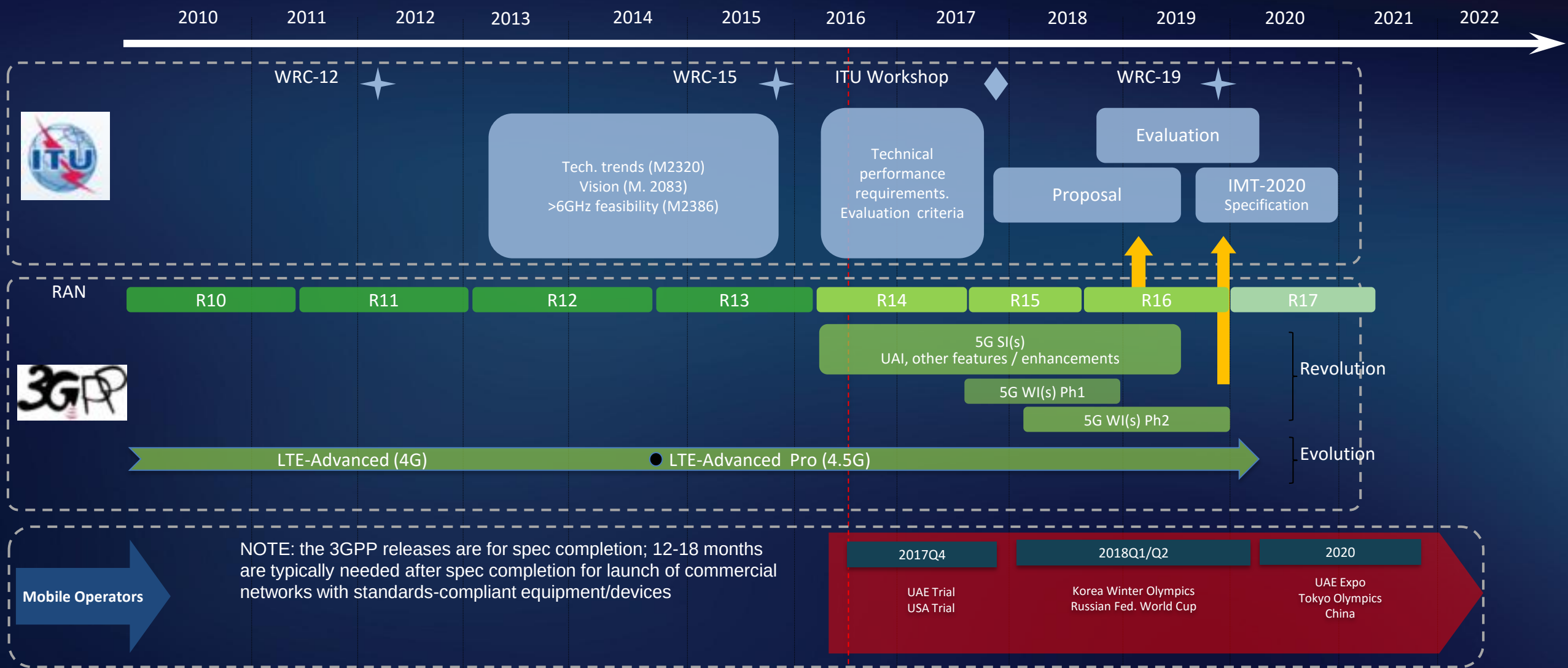
5G Covers Many Industries and Stakeholder Benefits



5G Needs Global Unified Standard



5G Timeline



Contents

-  Together for One Target
-  5G Research & Innovations
-  Maximizing Spectrum Value

Diversified Challenges and Gaps to Reach 5G

5G	Latency	Throughput	Connections	Mobility	Network Architecture
	1 ms Network Latency 	10G bps Peak Throughput 	1,000K Connections Per km ² 	500 km/h High-speed Railway 	Slicing Ability Required 
GAP	30~50x	100x	100x	1.5x	NFV/SDN
LTE	30~50ms	100Mbps	10K	350Km/h	Inflexible

5G Deep Innovation for the Future

Industry Collaborations



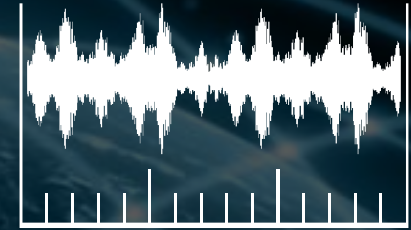
- Cross-industry Communication & Collaboration
- Global Unified Standard

Technology Innovations



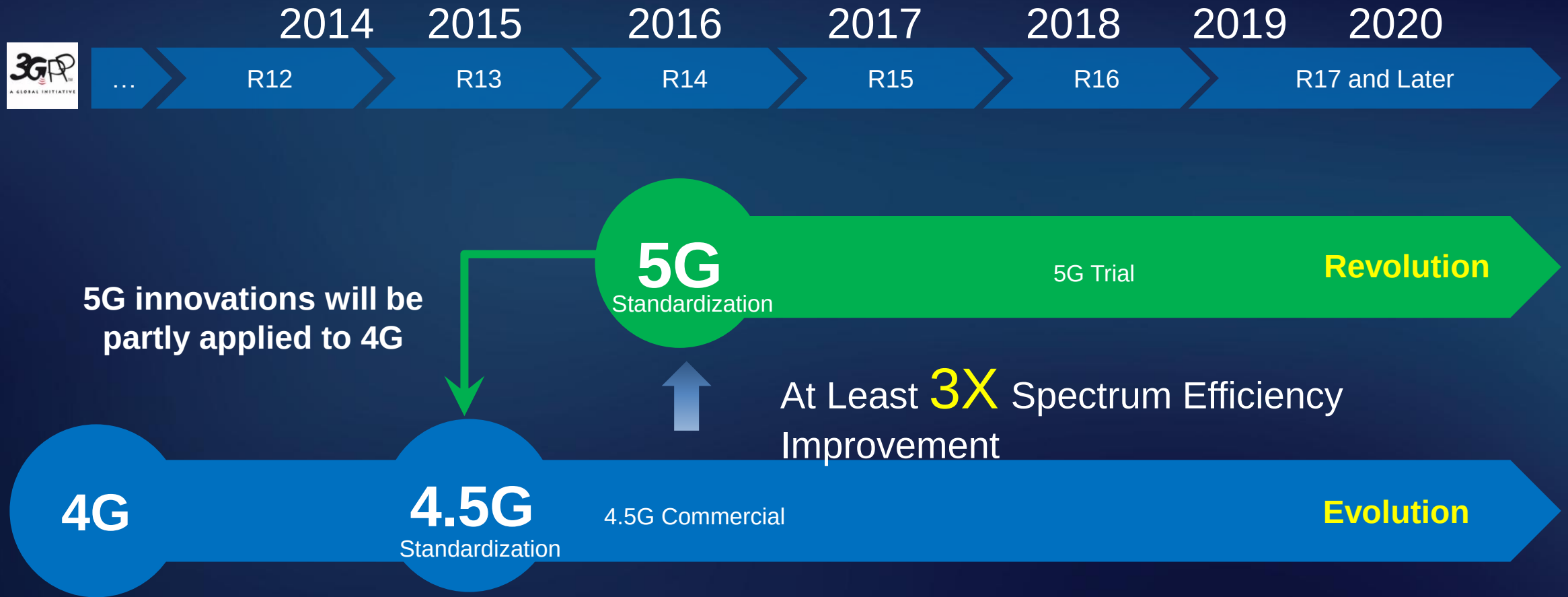
- Revolutionary Innovations
- Spectral Efficiency Improved by at Least 3 Times

Spectrum Support

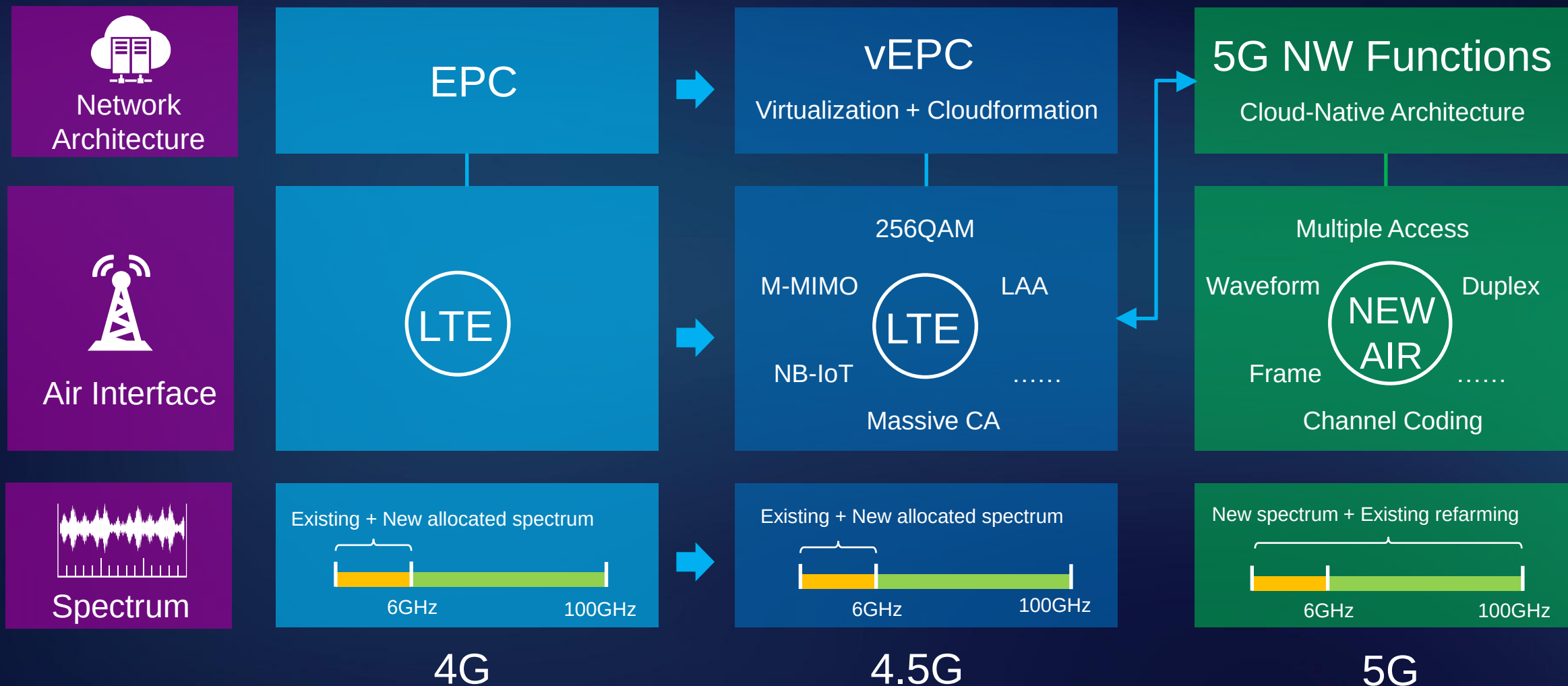


- Government & regulators open more spectrum resources
- Technology aggregates all available bands

5G Needs Revolutionary Innovation



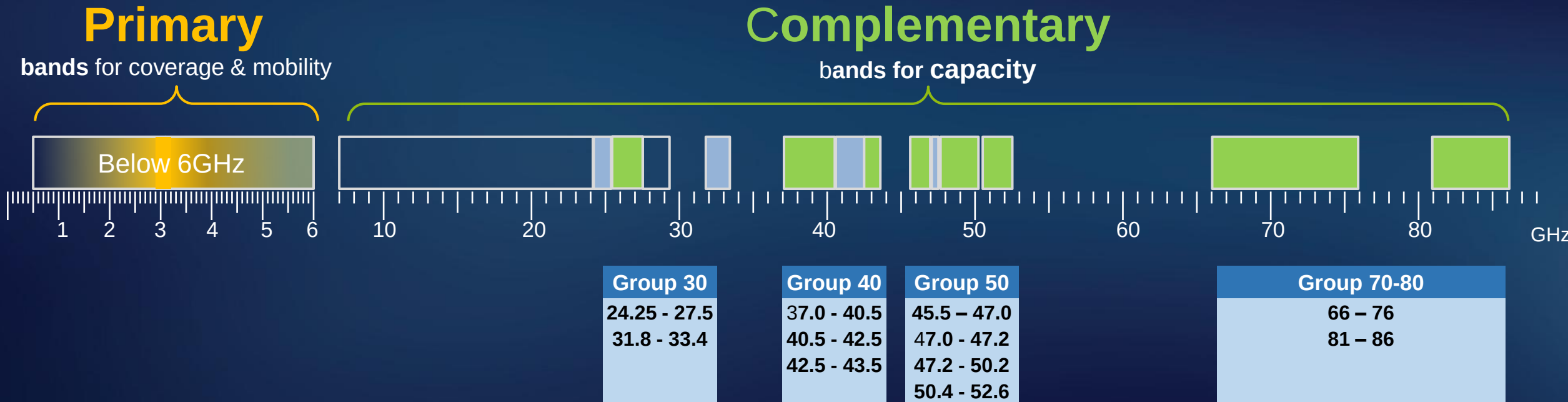
5G Revolutionary Road



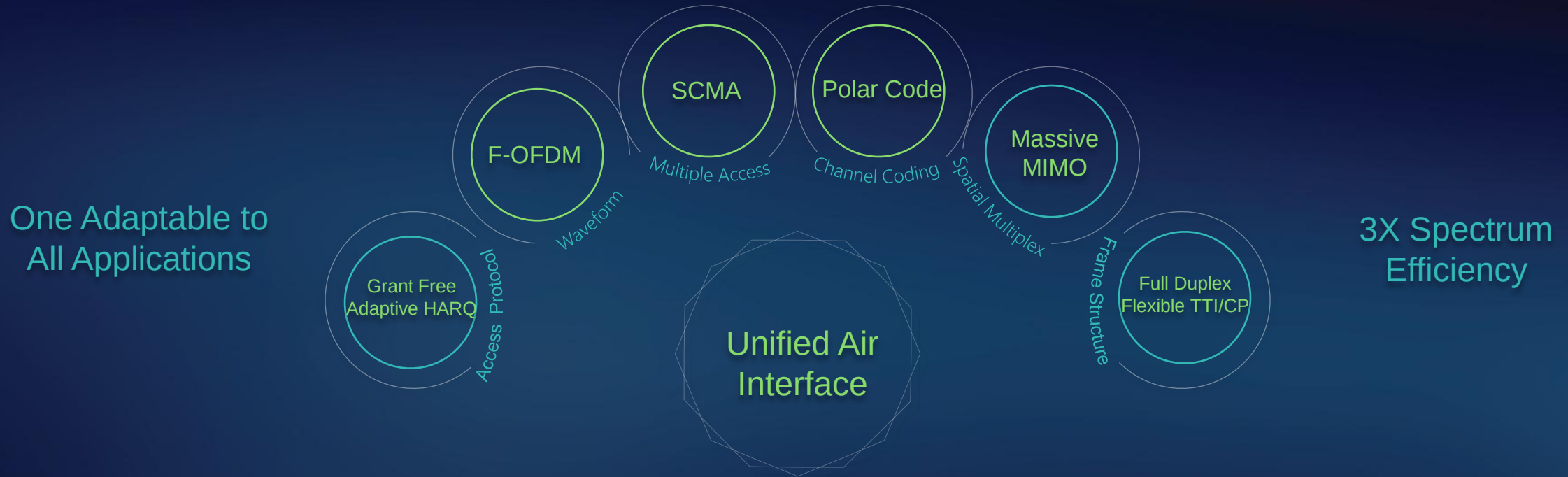
5G Full Spectrum Access



- In scope of WRC-19, allocated to Mobile Service already
- In scope of WRC-19, may require allocation to Mobile Service
- Not in scope of WRC-19



Unified New Air Interface for Diverse Applications



eMBB



uRLLC



mMTC



Schedule Milestone of 5G Radio Test Bed

5G Radio Test Bed

2014



Lab Test

- Low band: > 10Gbps
- High Band: >115Gbps

2015~2016



Field Test

- New air interface field trial (F-OFDM /SCMA/Polar Code/MU-MIMO/Full Duplex)
- High band field trial (70Gbps)
- High band & low band hybrid networking

2017~2018



Pre-Commercial Trials

- Field Trial with strategic partners

Open Collaboration for Global Unified Standard



Industry Collaborations

Europe



Board Member



5G
Innovation
Center

Key
Founder



Key
Founder

Asia



Board Member
(China)



Leading R&D Partner
(Japan)



Leading R&D Partner
(Korea)

Operator Collaborations



Leading R&D Partner



vodafone



TeliaSonera



... 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 •Beijing
- Shanghai •Hangzhou
- Cheng du

Huawei Won the World's First 5G Award



Jun, 2015

“Biggest Contribution to 5G Development”

"Huawei is spending considerable effort and funds for 5G and is making significant advances in R&D, particularly in air interface and test bed developments. This award recognizes Huawei's continuous efforts for innovation and R&D excellence and acknowledges the vendor's standardization activities."

—Dimitris Mavrakis, Principal Analyst at Ovum and one of this year's award judges commented



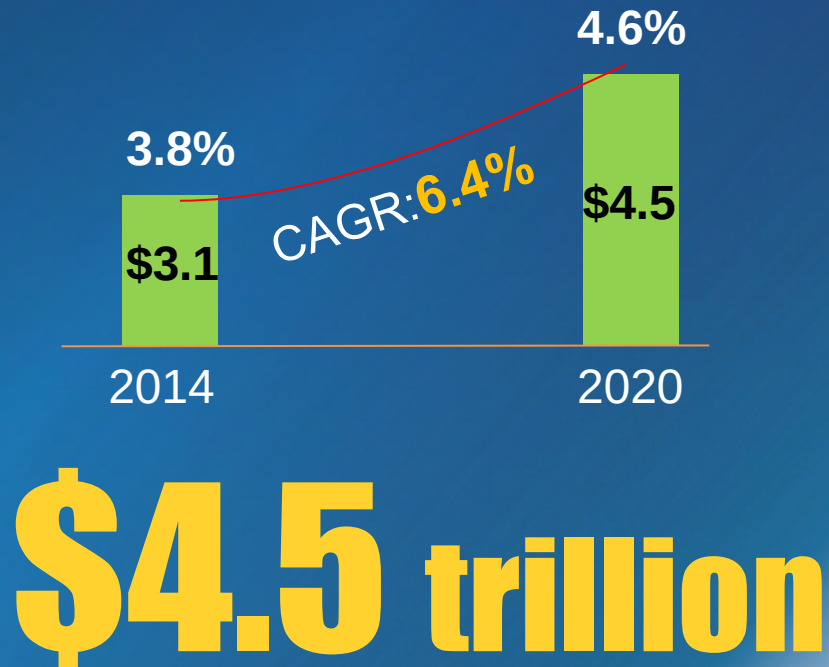
Contents

-  Together for One Target
-  5G Research & Innovations
-  Maximizing Spectrum Value

Mobile Broadband is the driving force of GDP

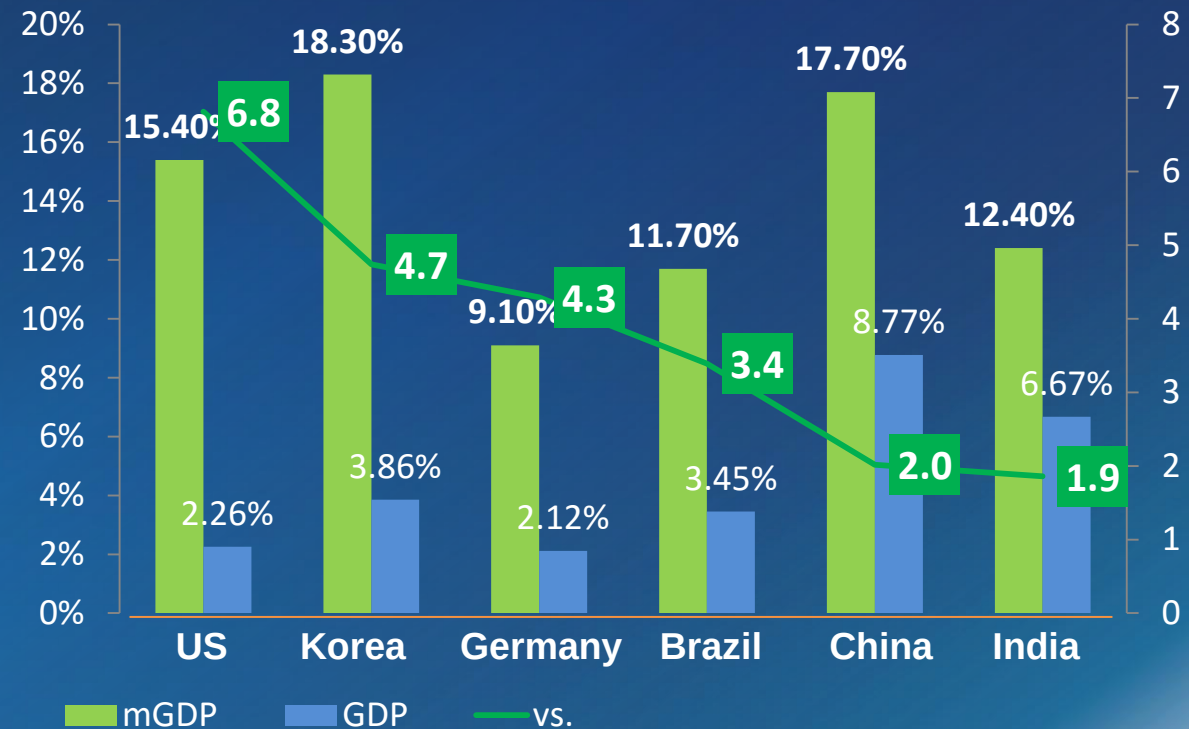
Mobile Industry Contribution to Global GDP

mGDP (trillion dollars)



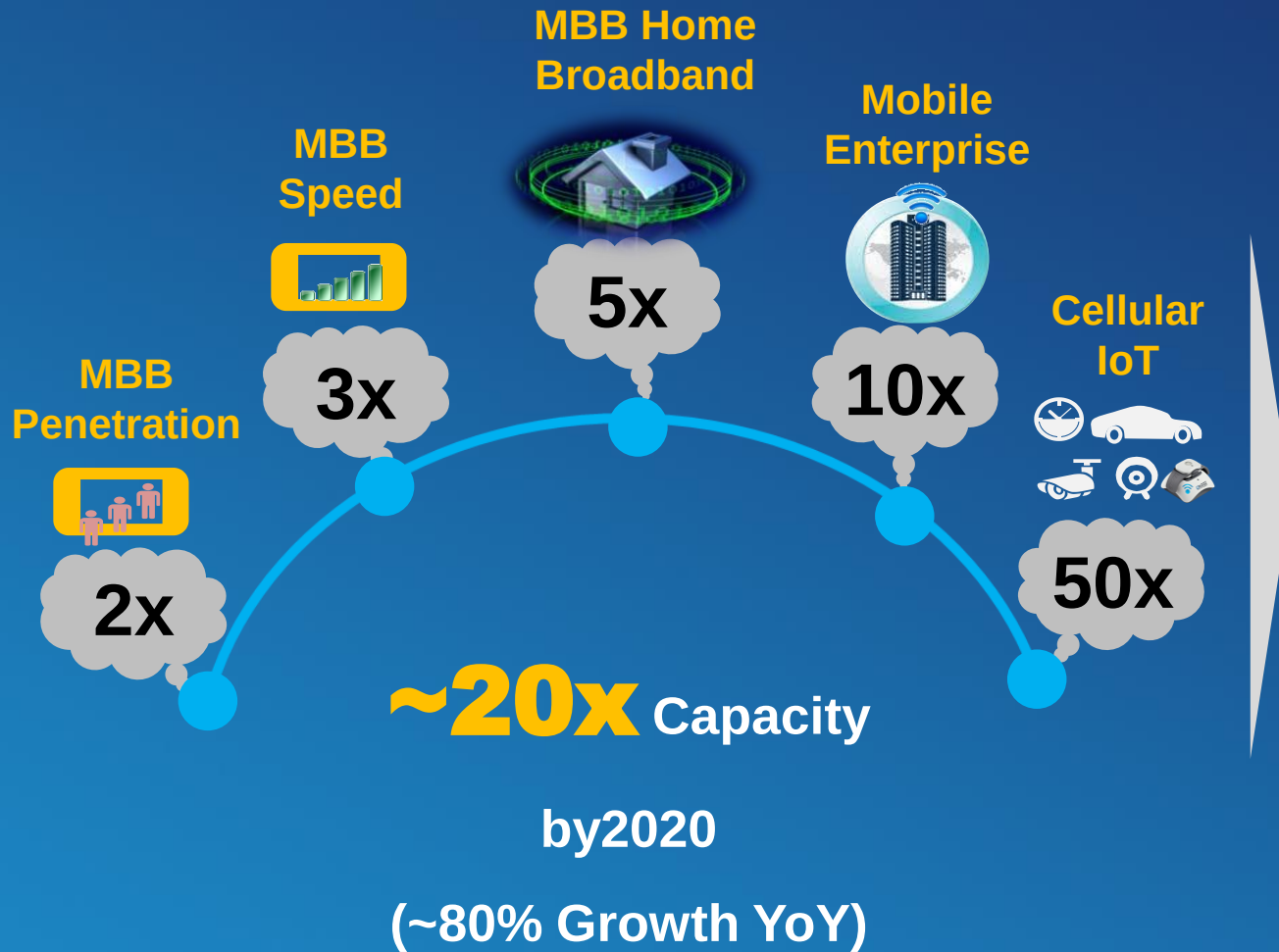
mGDP vs. GDP CAGR 2009-2014 in 6 Countries: 2~7x

CAGR 2009-2014



Source: Huawei mLab

Services Trigger Spectrum by 2020: 2GHz@sub 6GHz



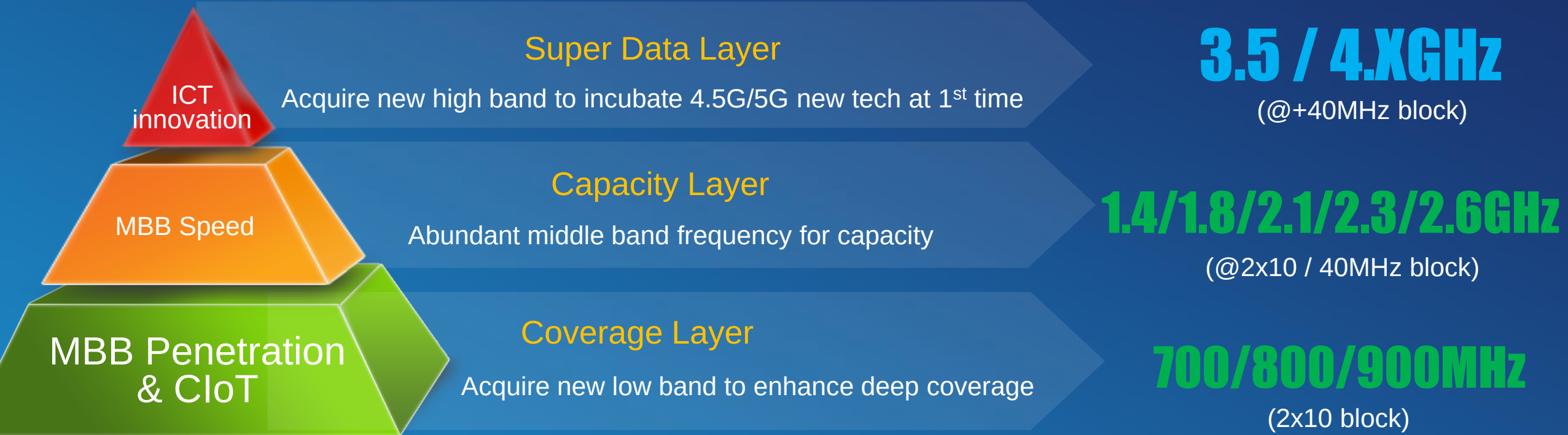
**2000MHz
By 2020**

2020 Assumptions	High Density Area*
Capacity	20x
Site Num (new adding site)	1.4x
Spectrum Efficiency (2G-3G-4G)	5x
Require Spectrum Bandwidth	3x

* Assume 600-700Mhz is currently used

Moving to Post 4G Era with 3 Layers Spectrum Planning

Low Band + Wide Band + Super Band Combination



WRC-15 : New 709MHz for IMT, but Various Among Countries

Almost Global Harmonization

700MHz
694/698-790MHz

L-Band
1427-1518MHz

C-Band
3400-3600MHz

Identification by National footnotes

UHF
470-694/698MHz

C-band
3300-3400 /3600-3700MHz

C-band
4800-4990MHz

 Regional Identification for IMT
  Multi-countries Identification for IMT (C. = Number of Countries)
  Possible national uses for IMT without ITU-R Identification
  Opposed Identification for IMT

¹not included in final total for Region 2&3

²not included in final total for all

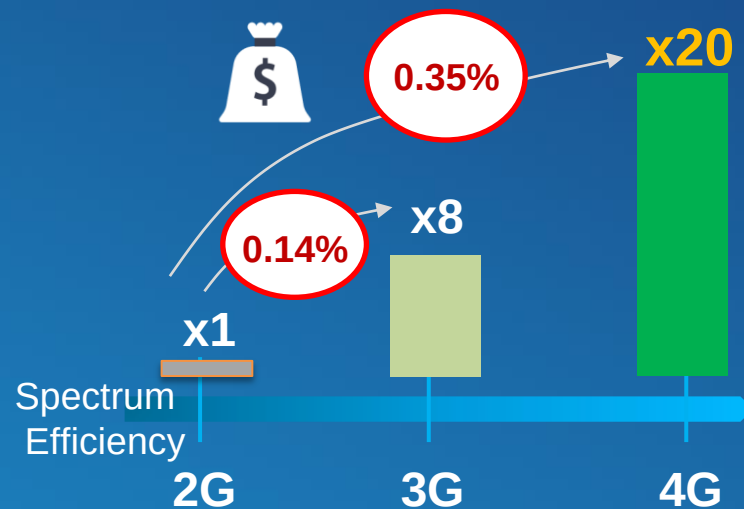
Frequency bands (MHz)	Region 1				Region 2		Region 3
	Europe	Africa	Arab	RCC	NA	LA	Asia Pacific
UHF (470-698)	WRC-23 Resolution (470-694)				470-698 by 5 C. 614-698 by 2 C.		7 C.
694/698-790 ¹							26 C.
1427-1452							
1452-1492		53 C.					
1492-1518							
3300-3400		33 C.				6 C.	6 C.
3400-3600 ²							3400-3500 by 9 C. 3500-3600 by 11 C.
3600-3700							
3700-3800							
4800-4990						1 C.	3 C.
Final total at WRC-15	147	287	187	147	419	709	609

Source: Different regional organizations, WRC-15 results as of Dec 2015

Spectrum Technology Neutral to Drive GDP

Higher GDP with 4G

GDP gain for every 25% substitution of technology penetration



Source: Huawei mLab

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



Source: Huawei mLab

Technology neutral is important for all bands to maximize spectrum potential

Building Smart City with High & Low Bands Target



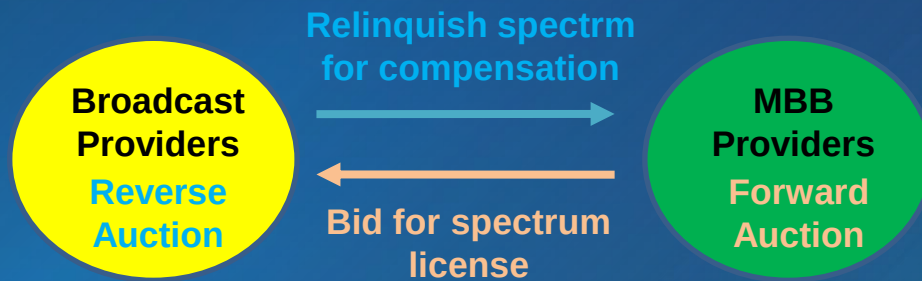
Aim for higher service requirement to boost ICT development

Unlock Higher Value Application with IMT



Incentives Auction to Monetize the Value of 600MHz Spectrum

- FCC offer broadcasters the opportunity to sell spectrum rights while retaining flexibility to remain on the air



- Options for Broadcasters:
 1. Relinquish spectrum and go off air
 2. Channel Sharing
 3. Exchange for other channels



Why Open

Smartphone Facilitate
Unconnected Data



NetBook + Modem

SP

\$100

\$60

Low cost SP :
40% cheaper = 1st data device
for unconnected user



Malaysia

2.3Ghz WBA allows selling SP
with data and voice-over-data
service

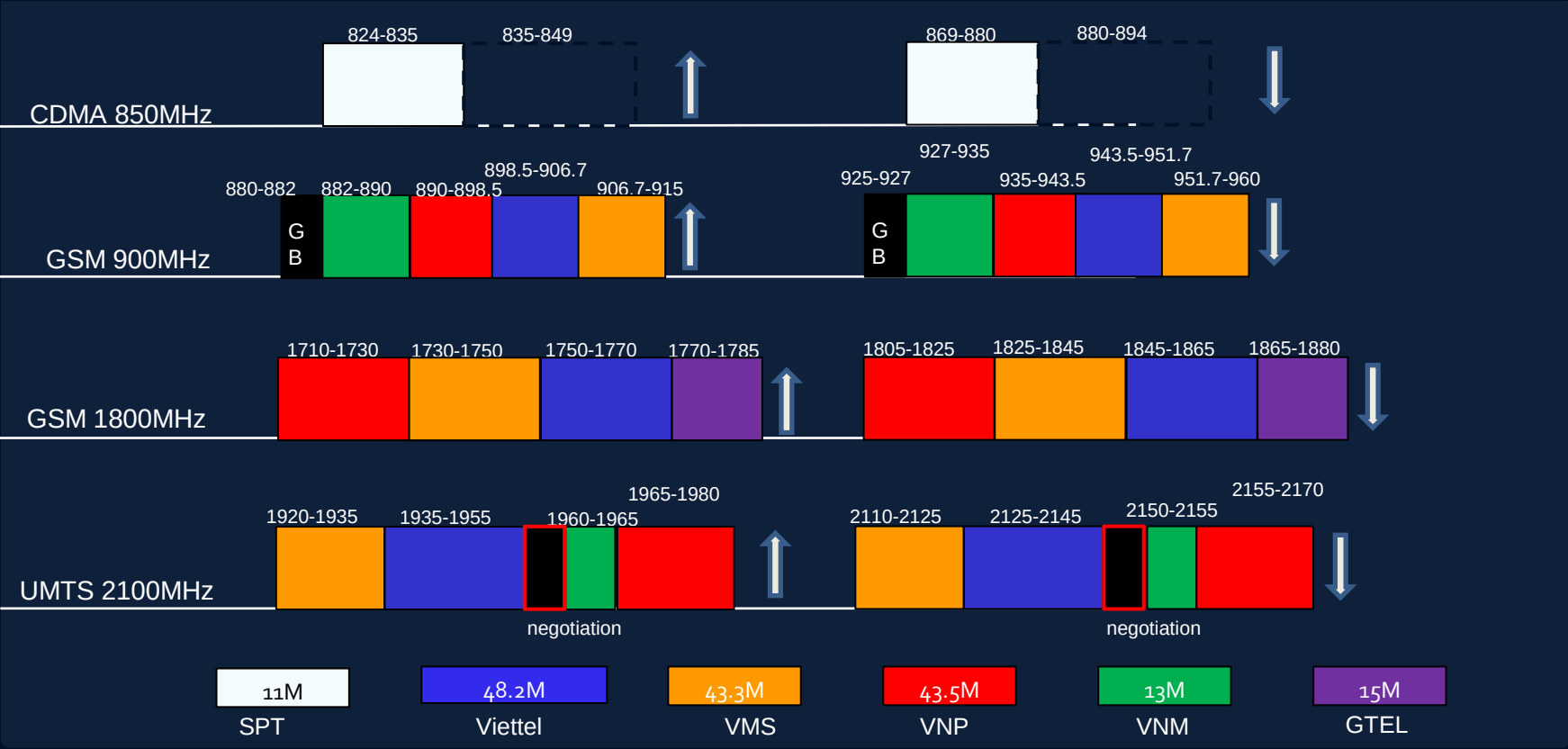
Thank you

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越南频段信息

	850	900	1800	2100
SPT	11			
Viettel		8.2	20	20+2.5
VNP		8.4	20	15
VMS		8.2	20	15
VNM		8+2		5+2.5
GTEL			15	



MIC 频段发放计划

- 1) 2014年通过频段中立的法案，开放U900部署，但是LTE的部署仍然需要MIC审批。
- 2) 2015年有计划发放LTE 1800实验局许可。
- 3) 2016年发放LTE1800牌照，2600M频段无明确计划。