Qualcomm

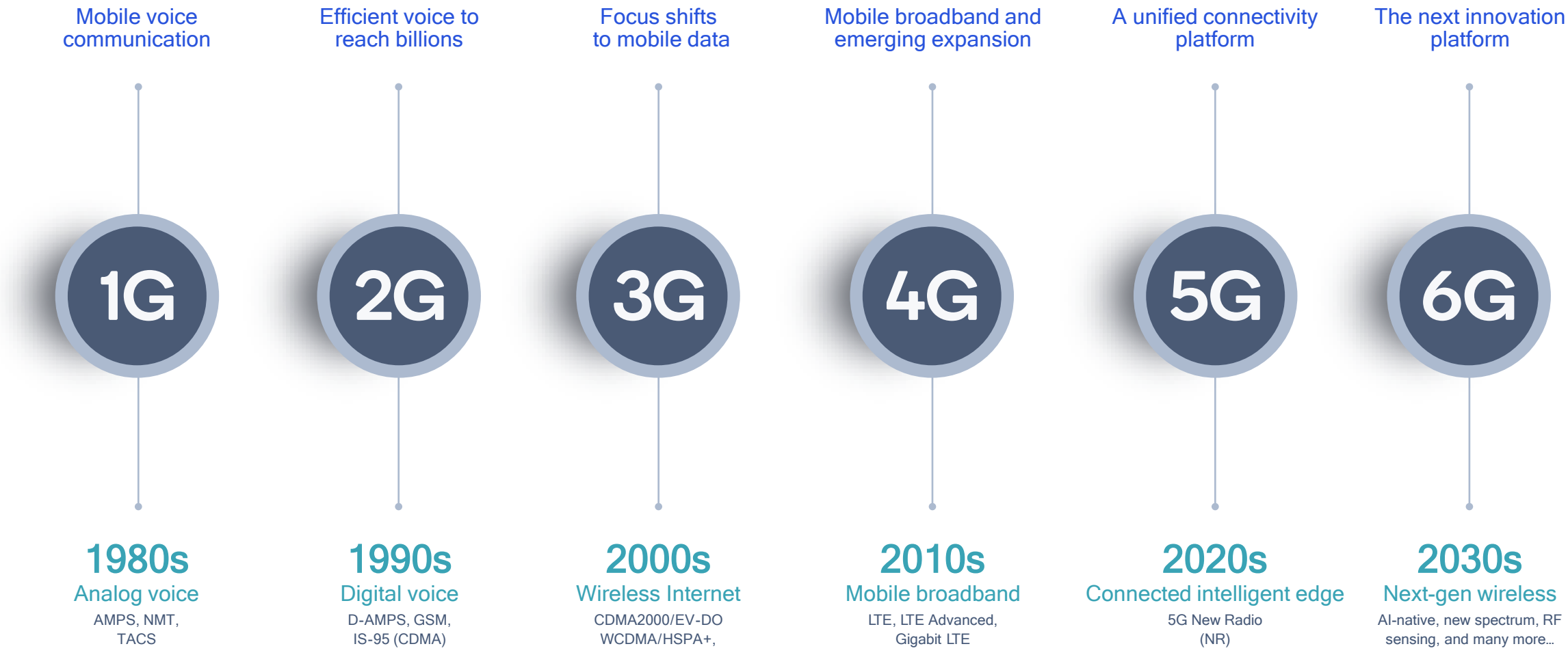
New Delhi

7th November 2024

ISMC : Spectrum Roadmap

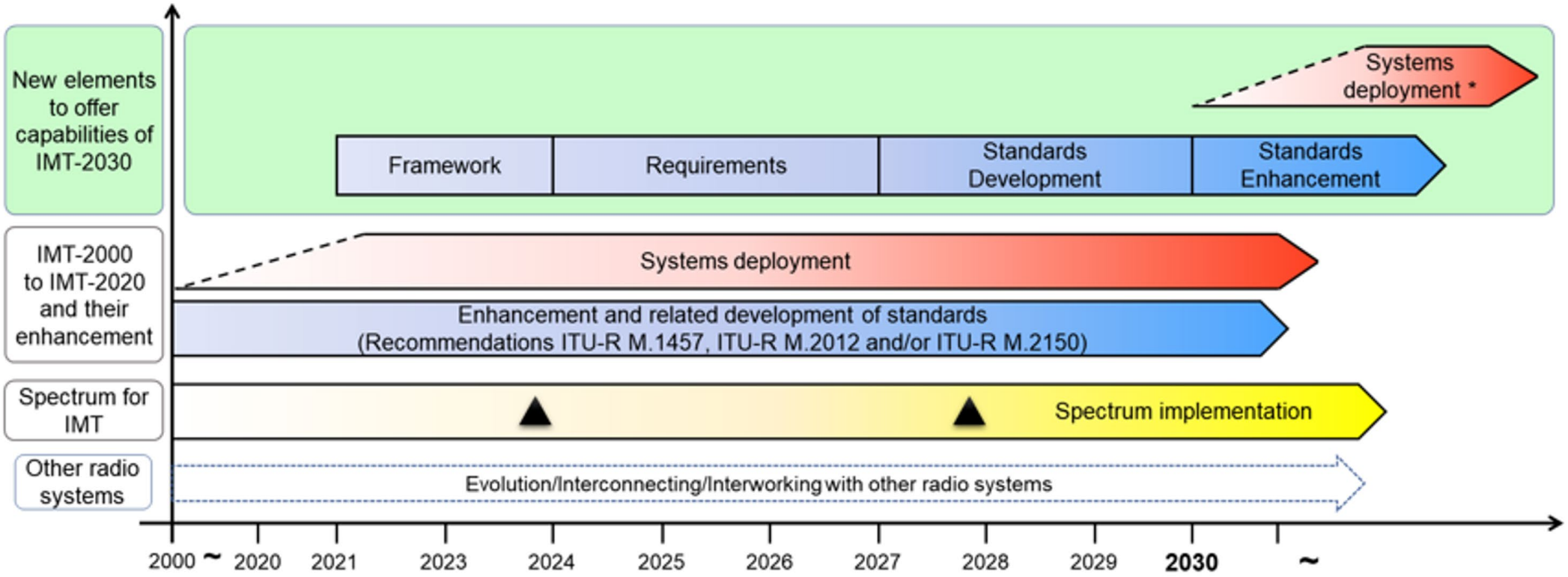
Jitendra Singh

Mobile has made a leap every ~10 years



Relationship and Timelines

- Roadmap for technology/standard development, deployment and spectrum
- In addition, enhancement of existing IMTs and relationship with other radio systems

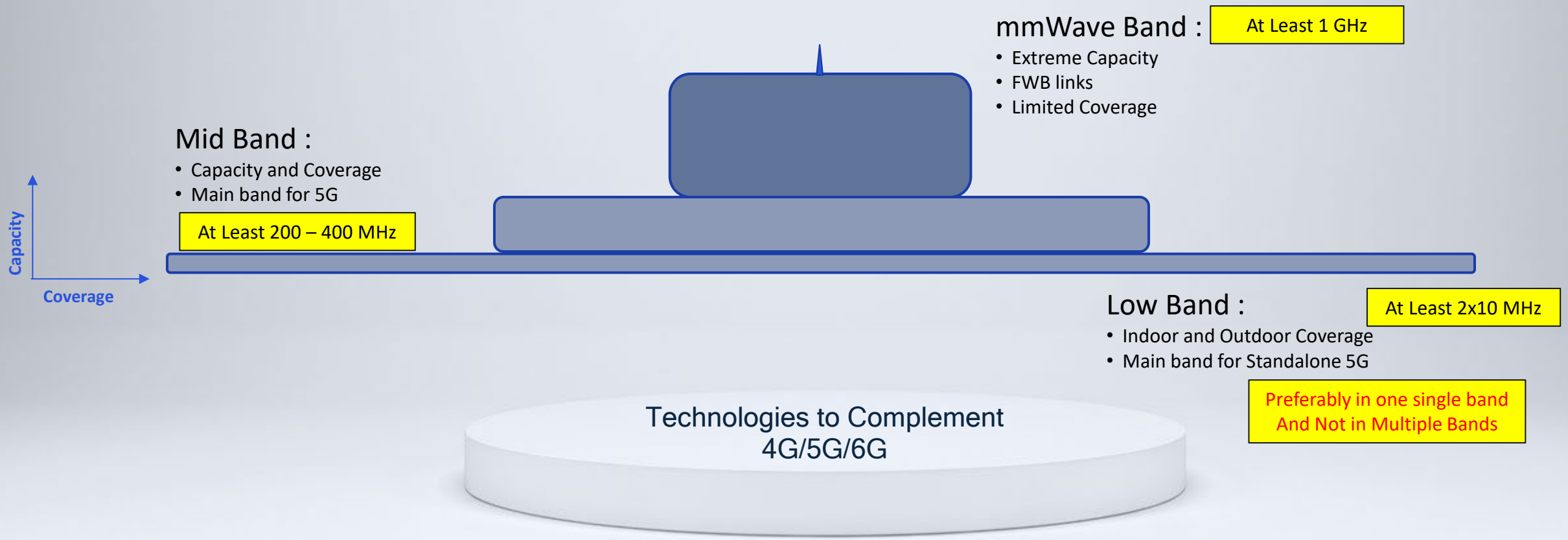


The sloped dotted lines in systems deployment indicate that the exact starting point cannot yet be fixed.

▲ : Possible spectrum identification at WRC-23, WRC-27 and future WRCs

• : Systems to satisfy the technical performance requirements of IMT-2030 could be developed before year 2030 in some countries.
: Possible deployment around the year 2030 in some countries (including trial systems)

To Unlock The Full Value of Technology



An Operator Must Have Sufficient Spectrum in all Three Categories of Bands

6G will support an unprecedented range of frequency bands

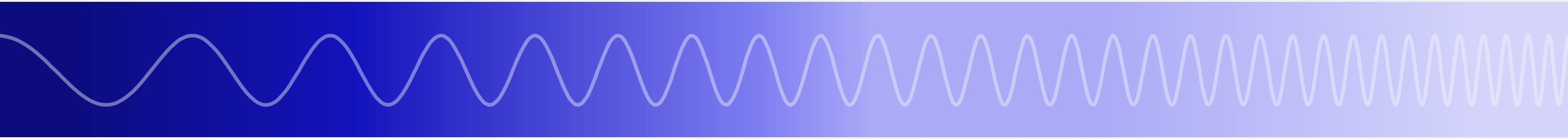
LOW BANDS
below 1 GHz (~20 MHz BW)

MID BANDS
1 — 7 GHz (~100 MHZ BW)

UPPER MID-BANDS
7 – 24 GHz (~500 MHz BW)

mmWAVE BANDS
24-71 GHz

SUB-THZ
above 100 GHz



With 6G, lower frequencies with narrower bandwidths will provide even better long-range coverage.

Bandwidths up to ~100 MHz, shorter wavelengths, massive MIMO antennas and MU-MIMO enable high capacities

New 6G spectrum with bandwidths up to ~500 MHz bring additional wide-area capacity for communications and sensing

6G spectrum bringing additional local-area capacity for communications and sensing

Higher frequencies with wide bandwidths provide excellent precision

Improving coverage and capacity in legacy bands and supporting new frequency bands for growth

Spectrum Management National Level

Aggregation by Harmonization

- Fragmented Assignments
- Multiple Auctions
- Non-Co-Terminus Licenses
- Merger and Acquisition
- Assignments in Narrow Blocks

Fragmented Assignments

De-fragmented Assignments

Aggregation by Refarming

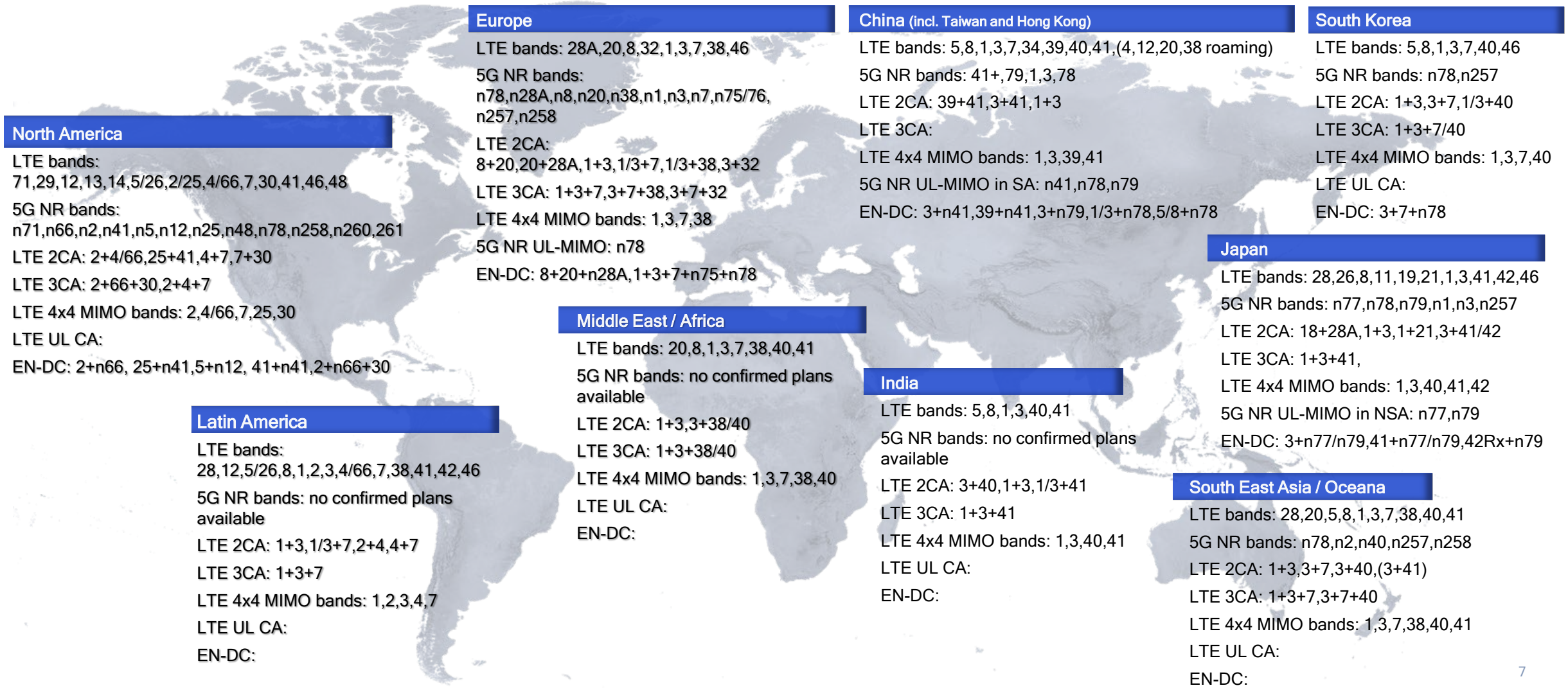
- Band Planning, TDD, FDD, Exclusive, Non-Exclusive etc.
- Government Agencies in Commercial Bands
- Adjacent Band Assignments to Government agencies
- Unused Spectrum

After Refarming and Harmonization

Additional Complexity : India has 22 Licensed Service Areas (Metro - 3, Cat A - 5, Cat B – 8, Cat C - 6)

Spectrum Aggregation is essential for 5G

10,000+ early 5G band combinations



North America

LTE bands: 71,29,12,13,14,5/26,2/25,4/66,7,30,41,46,48

5G NR bands: n71,n66,n2,n41,n5,n12,n25,n48,n78,n258,n260,261

LTE 2CA: 2+4/66,25+41,4+7,7+30

LTE 3CA: 2+66+30,2+4+7

LTE 4x4 MIMO bands: 2,4/66,7,25,30

LTE UL CA:

EN-DC: 2+n66, 25+n41,5+n12, 41+n41,2+n66+30

Latin America

LTE bands: 28,12,5/26,8,1,2,3,4/66,7,38,41,42,46

5G NR bands: no confirmed plans available

LTE 2CA: 1+3,1/3+7,2+4,4+7

LTE 3CA: 1+3+7

LTE 4x4 MIMO bands: 1,2,3,4,7

LTE UL CA:

EN-DC:

Europe

LTE bands: 28A,20,8,32,1,3,7,38,46

5G NR bands: n78,n28A,n8,n20,n38,n1,n3,n7,n75/76, n257,n258

LTE 2CA: 8+20,20+28A,1+3,1/3+7,1/3+38,3+32

LTE 3CA: 1+3+7,3+7+38,3+7+32

LTE 4x4 MIMO bands: 1,3,7,38

5G NR UL-MIMO: n78

EN-DC: 8+20+n28A,1+3+7+n75+n78

Middle East / Africa

LTE bands: 20,8,1,3,7,38,40,41

5G NR bands: no confirmed plans available

LTE 2CA: 1+3,3+38/40

LTE 3CA: 1+3+38/40

LTE 4x4 MIMO bands: 1,3,7,38,40

LTE UL CA:

EN-DC:

China (incl. Taiwan and Hong Kong)

LTE bands: 5,8,1,3,7,34,39,40,41,(4,12,20,38 roaming)

5G NR bands: 41+,79,1,3,78

LTE 2CA: 39+41,3+41,1+3

LTE 3CA:

LTE 4x4 MIMO bands: 1,3,39,41

5G NR UL-MIMO in SA: n41,n78,n79

EN-DC: 3+n41,39+n41,3+n79,1/3+n78,5/8+n78

India

LTE bands: 5,8,1,3,40,41

5G NR bands: no confirmed plans available

LTE 2CA: 3+40,1+3,1/3+41

LTE 3CA: 1+3+41

LTE 4x4 MIMO bands: 1,3,40,41

LTE UL CA:

EN-DC:

South Korea

LTE bands: 5,8,1,3,7,40,46

5G NR bands: n78,n257

LTE 2CA: 1+3,3+7,1/3+40

LTE 3CA: 1+3+7/40

LTE 4x4 MIMO bands: 1,3,7,40

LTE UL CA:

EN-DC: 3+7+n78

Japan

LTE bands: 28,26,8,11,19,21,1,3,41,42,46

5G NR bands: n77,n78,n79,n1,n3,n257

LTE 2CA: 18+28A,1+3,1+21,3+41/42

LTE 3CA: 1+3+41,

LTE 4x4 MIMO bands: 1,3,40,41,42

5G NR UL-MIMO in NSA: n77,n79

EN-DC: 3+n77/n79,41+n77/n79,42Rx+n79

South East Asia / Oceana

LTE bands: 28,20,5,8,1,3,7,38,40,41

5G NR bands: n78,n2,n40,n257,n258

LTE 2CA: 1+3,3+7,3+40,(3+41)

LTE 3CA: 1+3+7,3+7+40

LTE 4x4 MIMO bands: 1,3,7,38,40,41

LTE UL CA:

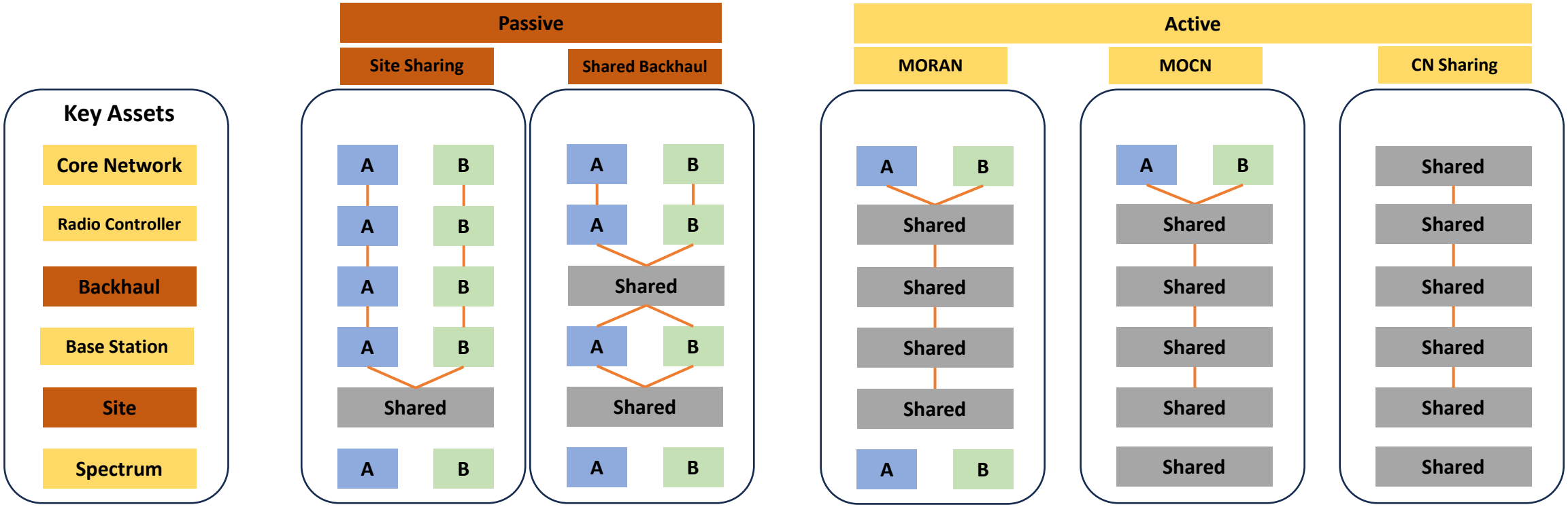
EN-DC:

TRAI Recommendation : Spectrum Sharing

- TRAI Recommendation on Telecom Infra and Spectrum Sharing
  - Allow to share passive infra (e.g. building, tower, electrical equipment, dark fiber, duct space, RoW, etc.)
  - Allow to share all types of active infra elements owned, established and operated by licensees
  - Sharing of core network elements not to be done if number of independent core networks is <2 by such a sharing arrangement
  - Inter-band access spectrum sharing in an LSA using common RAN to be restricted within specific band groups
    - 600, 700, 800 and 900 MHz
    - 1800 and 2100 MHz
    - 2300, 2500 and 3300-3670 MHz
    - 26, 37-40, 42.5-43.5 GHz
  - Sharing not more than one TSP in an LSA
  - Spectrum Cap rules to apply

TRAI Recommendation : Spectrum Sharing

Network Resource Sharing Models

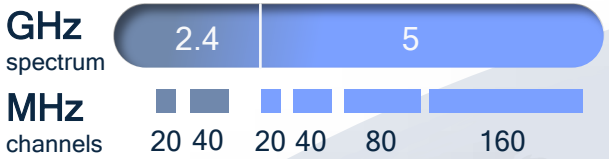


Complimentary Technologies

Possible Wi-Fi configurations based on spectrum availability

Qualcomm networking pro series Wi-Fi 7

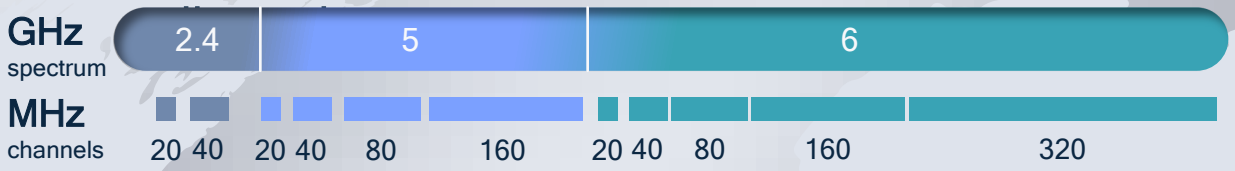
Regions without 6GHz allocation



Tri-Band
10 Gbps

160
80
40

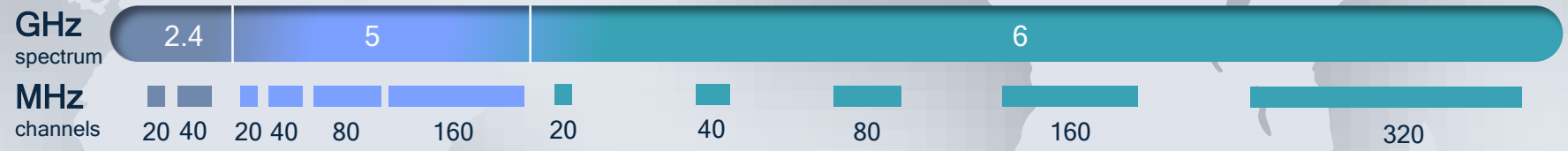
Regions with 480MHz of Lower 6GHz



Quad-Band
27 Gbps

320
240
160
40
4x4 channels

Regions with 1200MHz of 6GHz allocated



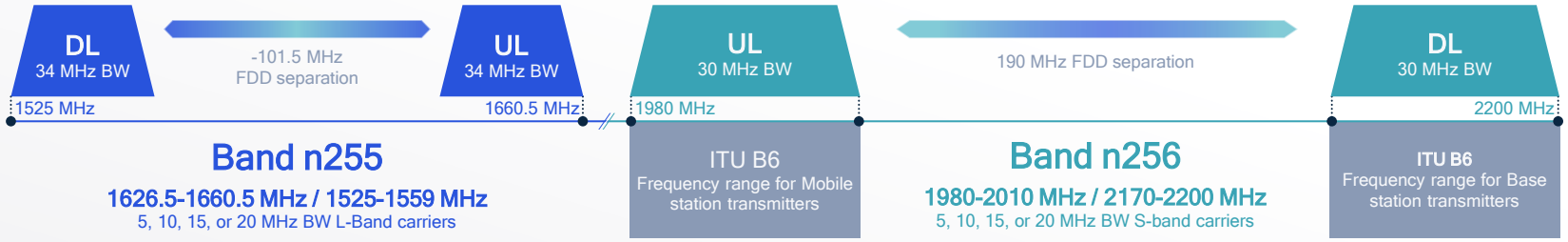
Quad-Band
33 Gbps

320
320
240
40

Leverage a global NTN ecosystem

with 3GPP standardized frequency bands

FR1 FDD frequency bands for 5G NTN in 3GPP Release 17



FDD frequency band candidates > 10 GHz for 5G NTN in 3GPP Release 18

* Reference: R4-2220239 WF for above 10GHz band definition and system parameters_v8

WRC-27 Mobile Satellite Service Agenda Items

- Triggered by the ubiquitous connectivity goal of UN sustainable development, there is growing demand for mobile satellite service.

WP 4C leads
WP 5D,4B and others contribute

WRC-27 AI1.12
MSS allocation for Low-data-rate NGSO mobile satellite system

Frequency bands:
1 427-1 432 MHz (s-to-E),
1 645.5-1 646.5 MHz (s-to-E) (E-to-s),
1 880-1 920 MHz (s-to-E) (E-to-s),
2 010-2 025 MHz (s-to-E) (E-to-s)

Potential Technology:
3GPP IoT NTN
Proprietary satellite access tech

WP 4C leads
WP 5D,4B and others contribute

WRC-27 AI1.13
MSS allocation in IMT bands for direct connectivity to complement the terrestrial IMT network coverage

Frequency bands:
the frequency bands between 694/698 MHz to 2700 MHz range with terrestrial IMT deployment in M.1036

Potential Technology:
3GPP LTE, 5G NR
3GPP LTE NTN, NR NTN

WP 4C leads
WP 5D,4B and others contribute

WRC-27 AI1.14
Additional allocation to mobile satellite system

Frequency bands:
2 010-2 025 MHz (E-to-s) in R1&R3
2 160-2 170 MHz (s-to-E) in R1&R3
2 120-2 160 MHz (s-to-E)

Potential Technology:
3GPP NR NTN
Proprietary satellite access tech

Thank you

- @qualcomm

Follow us on:

For more information, visit us at qualcomm.com & qualcomm.com/blog