KEYSIGHT

6G Spectrum Reality Check: From Sub-7 GHz to FR3 & Beyond

Policy sets the playing field; here's what that means for engineering

Spectrum

The Foundation of Wireless Evolution

Policy & Economics

Spectrum allocation determines what's technologically possible

Historical Impact

From maritime distress calls to global 6G conversations

Cellular Generations

Each new generation depends on unlocking new spectrum

5G Examples

Midband Reallocation	Millimeter-Wave
3.4 – 4.9 GHz offered favorable propagation characteristics	Provided very large contiguous bandwidths for high-speed applications

KEYSIGHT

6G Spectrum

Three Key Frequency Ranges

6G Spectrum

Three Key Frequency Ranges

Below 7 GHz

- Reliable coverage but limited availability
- Requires refarming and efficiency gains

6G Spectrum

Three Key Frequency Ranges

Below 7 GHz

- Reliable coverage but limited availability
- Requires refarming and efficiency gains

7-24 GHz (FR3)

- Upper midband - most promising near-term candidate
- Widely considered the sweet spot for 6G

6G Spectrum

Three Key Frequency Ranges

Below 7 GHz

- Reliable coverage but limited availability
- Requires refarming and efficiency gains

7-24 GHz (FR3)

- Upper midband - most promising near-term candidate
- Widely considered the sweet spot for 6G

110-300 GHz (Sub-THz)

- Massive bandwidth potential
- Future phases of 6G deployment

SOS and Early Radio Policy

01

1906: SOS Standardized

International distress signal established at 500 kHz frequency, creating the first globally coordinated spectrum allocation

02

1912: Titanic Disaster

Tragedy sparked mandatory 24/7 distress monitoring requirements, demonstrating spectrum's critical role in safety

Who Decides Spectrum Use?

Specifications

3GPP develops technical standards defining how spectrum is used in cellular systems

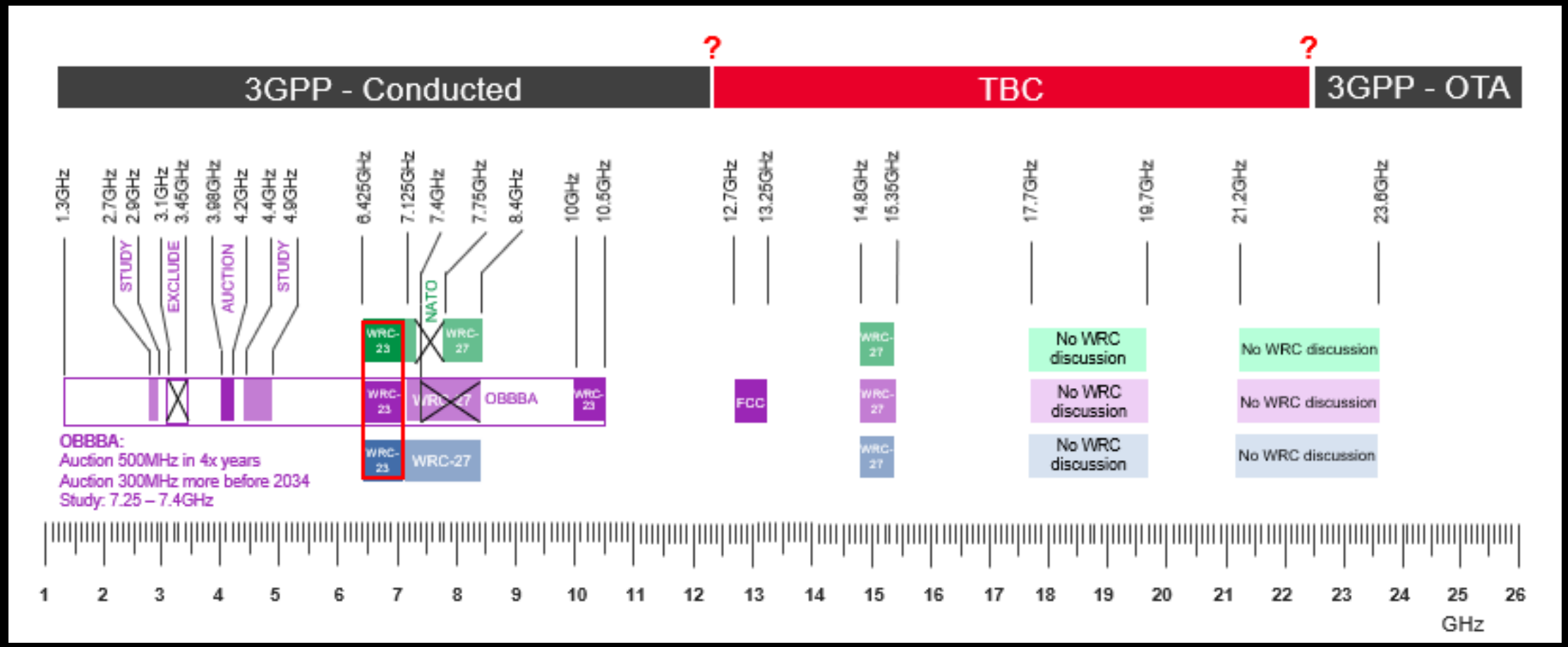
Standards

Industry and ITU adoption creates global interoperability and equipment ecosystems

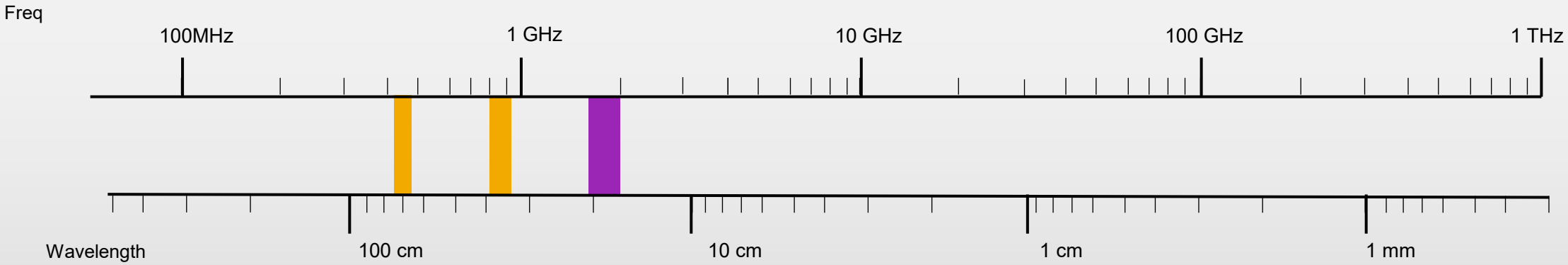
Policy

Government law determines actual spectrum allocation and licensing frameworks

WRC Meeting and OBBBA Takeaways



Cellular Generations and Spectrum Expansion

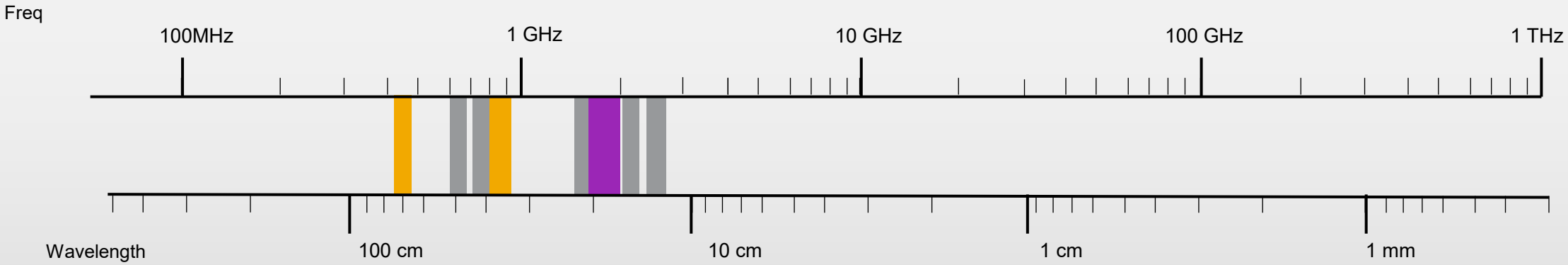


Spectrum allocation by generation

1G

2G/3G

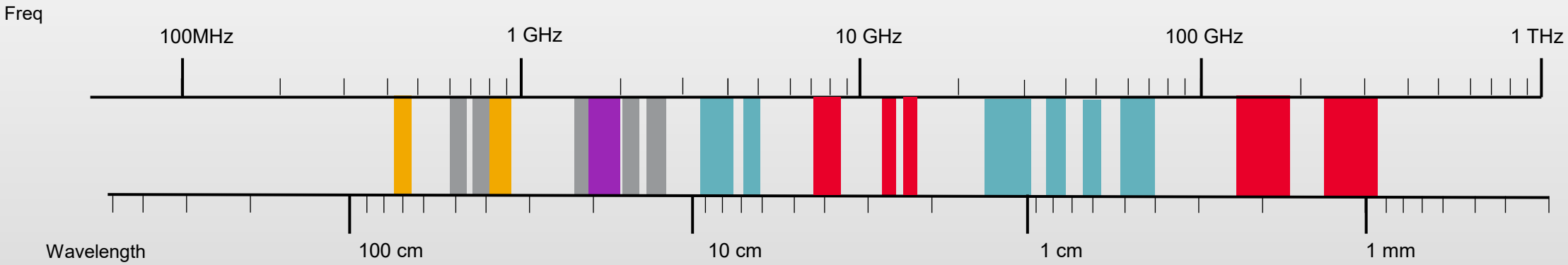
Cellular Generations and Spectrum Expansion



Spectrum allocation by generation

1G 2G/3G 4G

Cellular Generations and Spectrum Expansion



Spectrum allocation by generation

1G 2G/3G 4G 5G 6G

Exploring New Spectrum Frontiers

Expanding into Higher Frequencies for Wider Bandwidths

- R&D above 95 GHz driving innovation in mmWave, sub-THz, and THz bands
- Regulators (e.g., FCC) shaping frameworks for NextG spectrum use
- FR3 (7–24 GHz): early 6G candidate with balance of coverage & capacity
- Trade-off: better penetration than FR2, but higher bands (15–24 GHz) need denser deployments

The FR3 Debate: 7-24 GHz Sweet Spot

Promising Range

FR3 offers balance between coverage and capacity, ideal for urban and suburban deployment scenarios

Shared Incumbents

Military radar, satellite communications, and GPS navigation systems create complex coordination challenges

Fragmented Spectrum

Discontinuous bands require sophisticated carrier aggregation and interference management techniques

Link Budget Challenges

Higher frequencies demand advanced antenna systems and signal processing for viable coverage

FR3 Must Address Coexistence and Density Challenges

Figure 2. Simplified global allocation mobile / fixed frequency allocation, 7 to 24 GHz

Coexistence and smart spectrum sharing are two major research areas. For the higher frequencies, density and deployment must also be addressed as electromagnetic waves start to behave like FR2.

mmWave in Action: FR2 Today

Current Reality

FR2 deployment remains limited due to high infrastructure costs and coverage limitations. Success stories emerge in specific use cases.

Stadium and arena ultra-high capacity

Fixed wireless access for rural broadband

Indoor enterprise applications

FR2 will continue evolving through 5G Advanced and into 6G networks with improved efficiency.

Sub-THz Research: Above 110 GHz

Point-to-Point Links

Ultra-high-speed backhaul connections for dense urban networks and data center interconnects

Industrial Applications

Precision sensing, imaging, and manufacturing process monitoring in controlled environments

Experimental Research

Academic and industry research exploring 110-300 GHz bands for future wireless innovations

KEYSIGHT

Key Takeaways

Key Takeaways

Spectrum = Physics + Policy

Technical capabilities constrained by regulatory frameworks and international coordination

Key Takeaways

Spectrum = Physics + Policy

Technical capabilities constrained by regulatory frameworks and international coordination

3GPP ≠ Band Assignment

Standards bodies define usage; governments control actual spectrum allocation

Key Takeaways

Spectrum = Physics + Policy

Technical capabilities constrained by regulatory frameworks and international coordination

3GPP ≠ Band Assignment

Standards bodies define usage; governments control actual spectrum allocation

6G Spectrum Strategy

Sub-7 GHz foundation, FR3 expansion, selective FR2 / sub-THz deployment

Key Takeaways

Spectrum = Physics + Policy

Technical capabilities constrained by regulatory frameworks and international coordination

3GPP ≠ Band Assignment

Standards bodies define usage; governments control actual spectrum allocation

6G Spectrum Strategy

Sub-7 GHz foundation, FR3 expansion, selective FR2 / sub-THz deployment

FR3: Promise & Challenge

Optimal balance point requiring innovative technical solutions

Key Takeaways

Spectrum = Physics + Policy

Technical capabilities constrained by regulatory frameworks and international coordination

3GPP ≠ Band Assignment

Standards bodies define usage; governments control actual spectrum allocation

6G Spectrum Strategy

Sub-7 GHz foundation, FR3 expansion, selective FR2 / sub-THz deployment

FR3: Promise & Challenge

Optimal balance point requiring innovative technical solutions

FR2 and Sub-THz Use Cases

Targeted applications drive continued mmWave and sub-THz evolution

The Future of 6G: Defined by Spectrum

Spectrum strategy defines the future of wireless innovation and is the fundamental foundation of 6G.

Join us this week for a deeper dive into 6G spectrum candidates, featuring insights from Keysight experts and Prof. Jornet's researchers at Northeastern University.

KEYSIGHT