Background

- International Telecommunication Union ("**ITU**") developed the specifications for IMT, including IMT-2000 (3G), IMT-Advanced (4G) and IMT-2020 (5G)

- In 2022, ITU started the work on the development of "IMT towards 2030 and beyond", and confirmed the name of the next generation of IMT (aka **6G**) to be **IMT-2030**

- 3rd Generation Partnership Project ("**3GPP**") has produced the specifications for previous generations of IMT to ITU for adoption, and has committed to produce the specifications for 6G

- This paper shares information from ITU and 3GPP regarding the technology trends, usage scenarios, characteristics, candidate frequency bands and timelines for IMT-2030

ITU Organisation

ITU is the United Nations specialised agency for **information and communication technologies ("ICTs")**

Three Sectors

ITU Radiocommunication ("ITU-R")
Coordinating radio-frequency spectrum and **assigning** orbital slots for satellites
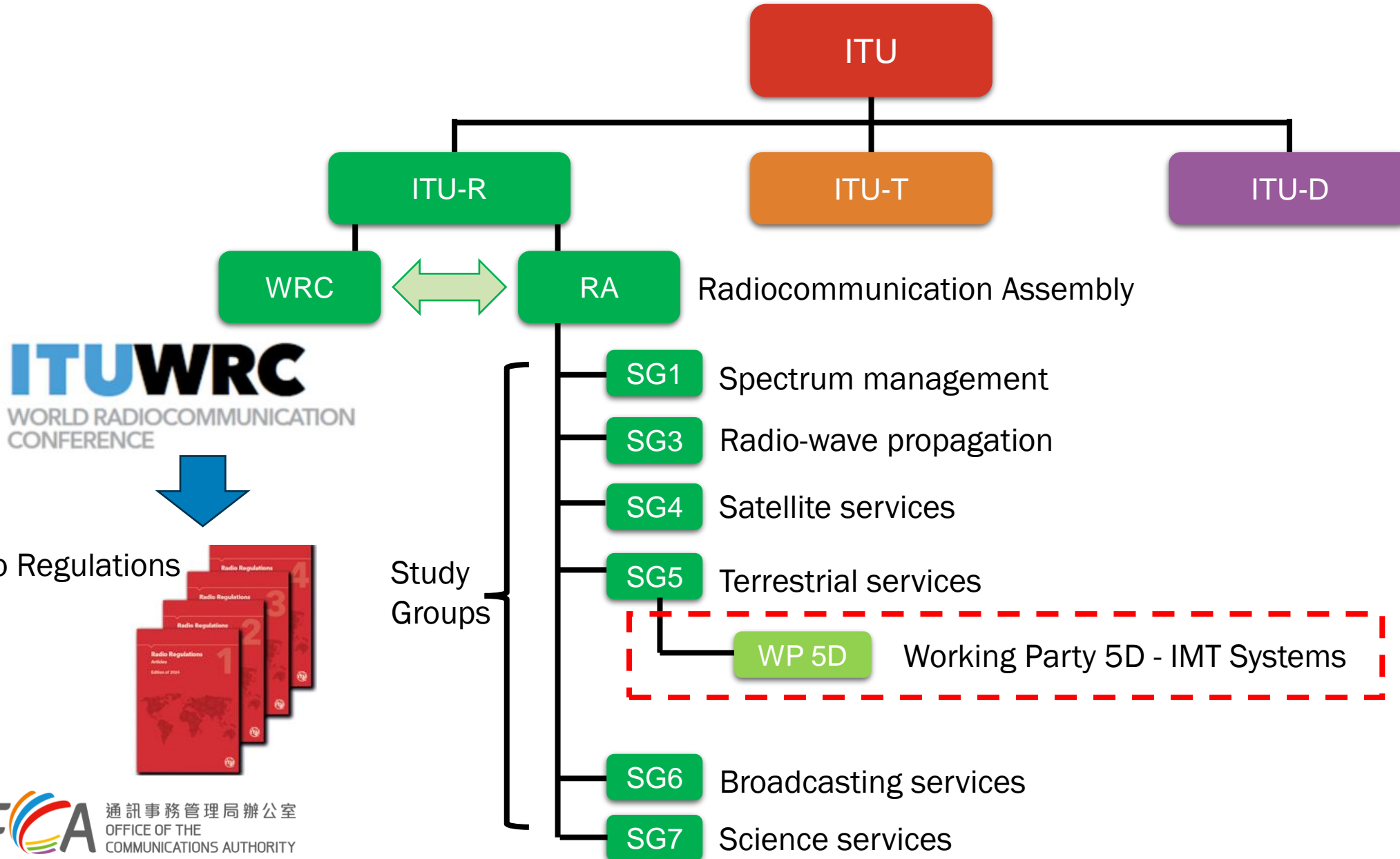
ITU Standardization ("ITU-T")
Establishing global standards

ITU Development ("ITU-D")
Bridging the digital divide

Structure of ITU

3rd Generation Partnership Project ("3GPP")

- 3GPP unites seven telecommunications standard development organisations to produce the reports and specifications that define cellular telecommunications technologies

- 3GPP specifications cover radio access, core network and service capabilities, for cellular telecommunications technologies
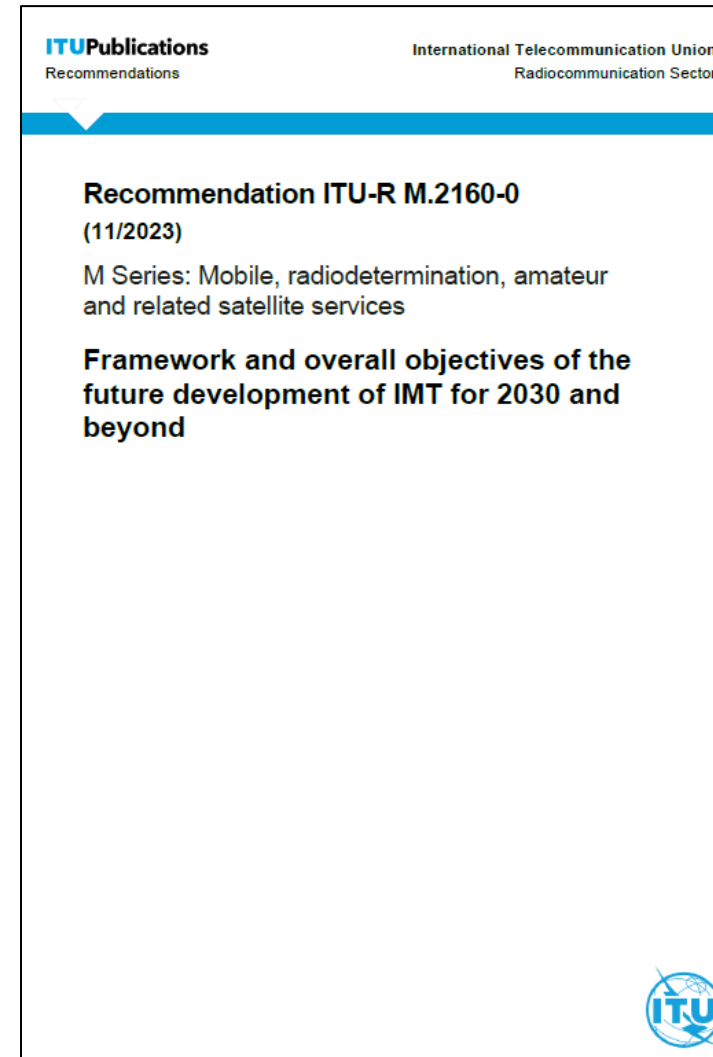

CCSA
China

ETSI
Europe

atis
North America

TTA
Korea

tsdsi
India

ARIB
Japan

TTC Telecommunication Technology Committee
Japan

ITU Publications on IMT-2030

M.2516

M.2160

Emerging Technology Trends and Enablers

AI — **AI-native communications**

Sensing — **Integrated sensing and communication**

Computing — **Convergence of communication and computing**

Device-to-device — **Device-to-device communications**

Efficient utilisation of spectrum — **Spectrum**

Enhanced energy efficiency and low power consumption — **Energy**

Native support of real-time services and communications — **Real-time Services**
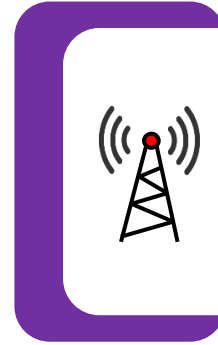
Enhanced trustworthiness — **Security**

Technologies to Enhance Radio Interface
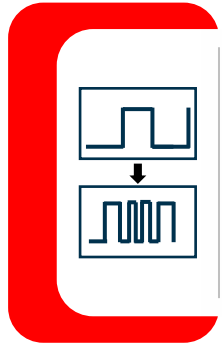
Advanced modulation, coding and multiple access schemes

Advanced antenna technologies

In-band full duplex communications

Multiple physical dimension transmission

THz communications

Ultra-high accuracy positioning

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Technologies to Enhance Radio Network

RAN slicing

New RAN architecture

Digital twin network

Resilient and soft networks for guaranteed QoS

Interconnection with non-terrestrial networks

Ultra-dense radio network deployments

Enhanced RAN infrastructure sharing

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Non-Terrestrial Networks ("NTN") for IMT

- IMT-2030 aims to provide ubiquitous connectivity for "connecting the unconnected"

- NTN operates above the Earth's surface, involving satellites at low Earth orbit ("LEO") and geostationary orbit ("GEO"), which can provide coverage to areas not covered by terrestrial network ("TN")

GEO

LEO

Feeder link

Service link

Ground gateway
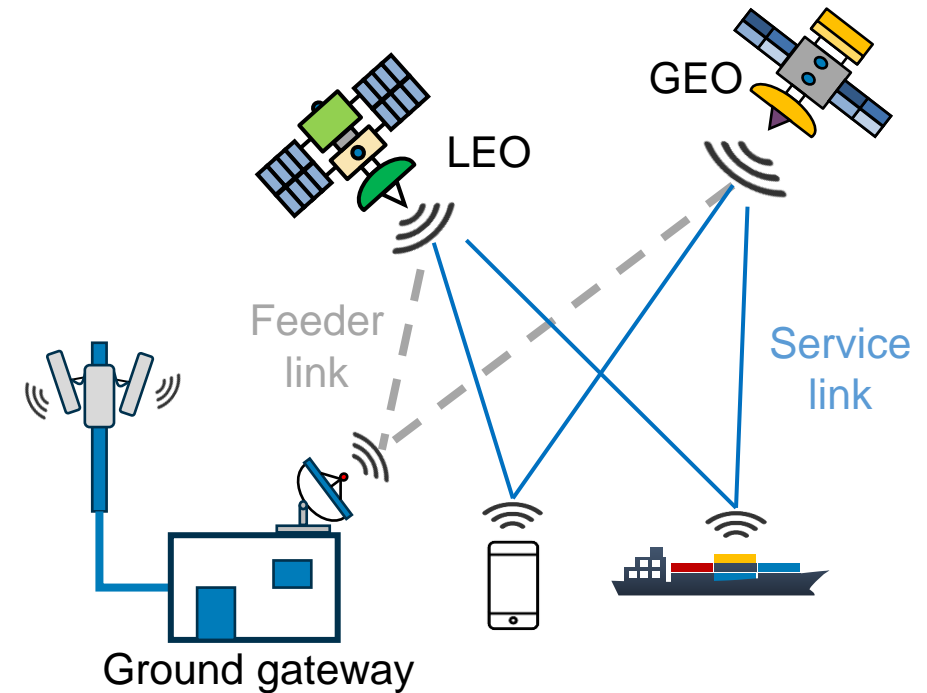
Design Principles and Usage Scenarios of IMT-2030

Source: https://www.itu.int/rec/R-REC-M.2160/en
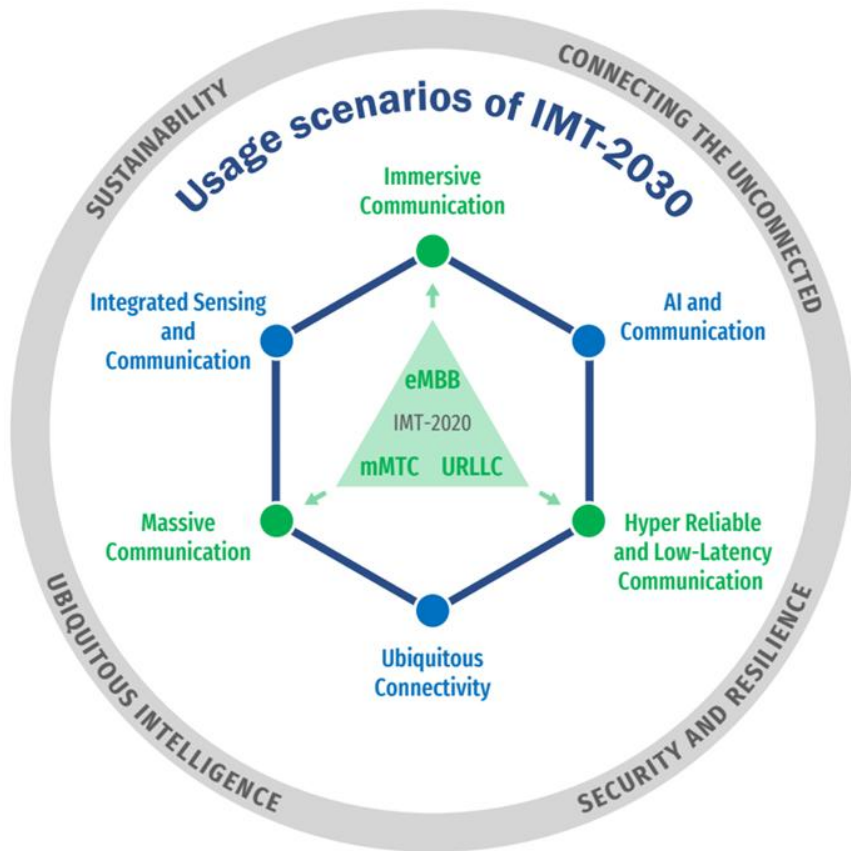
Four Design Principles:
Sustainability, Connecting the unconnected, Ubiquitous Intelligence, Security and Resilience

Six Usage Scenarios:

Extension from IMT-2020
- Immersive Communications
  - ← Enhanced Mobile Broadband ("eMBB")
- Massive Communications
  - ← Massive Machine-Type Communications ("mMTC")
- Hyper Reliable & Low-Latency Communication ("HRLLC")
  - ← Ultra-Reliable Low-Latency Communication ("URLLC")

New in IMT-2030
- Ubiquitous Connectivity
- AI and Communication
- Integrated Sensing and Communication

Design Principles of IMT-2030

Sustainability

- High energy efficiency
- Reduce greenhouse gas emission

Connecting the unconnected

- Affordable connectivity
- Extended coverage to sparsely populated areas

Ubiquitous Intelligence

- AI-enabling infrastructure
- Autonomous network management, self-optimization

Security and Resilience

- Secure by design
- Continue operating during a disruptive event

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Usage Scenarios of IMT-2030

Immersive Communication

- Provide rich and interactive video experience to users
- e.g. extended reality (XR), holographic communications

Artificial Intelligence & Communication

- Support distributed computing and AI applications
- e.g. automated driving, digital twins

Massive Communication

- Support massive number of IoT sensors for various applications
- e.g. battery-less IoT, smart cities

Ubiquitous Connectivity

- Enhance connectivity with the aim to bridge the digital divide
- e.g. interworking with satellite networks

Hyper Reliable & Low-Latency Communication

- Support applications with stringent requirements on reliability and latency
- e.g. tele-medicine, machine interactions

Integrated Sensing & Communication

- Provide spatial information about both connected devices and unconnected objects
- e.g. environmental monitoring, vehicle detection, gesture recognition

6G Usage Scenarios

Capabilities of IMT-2030
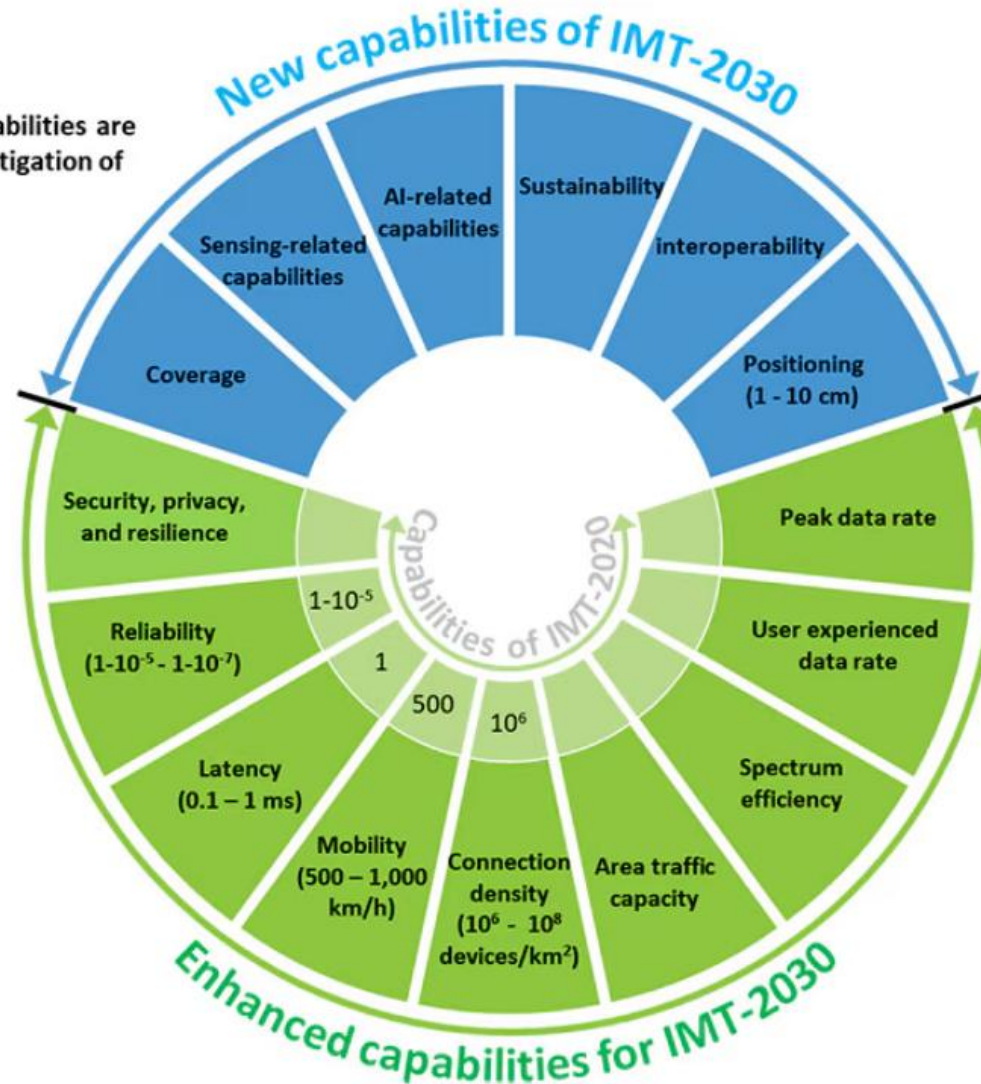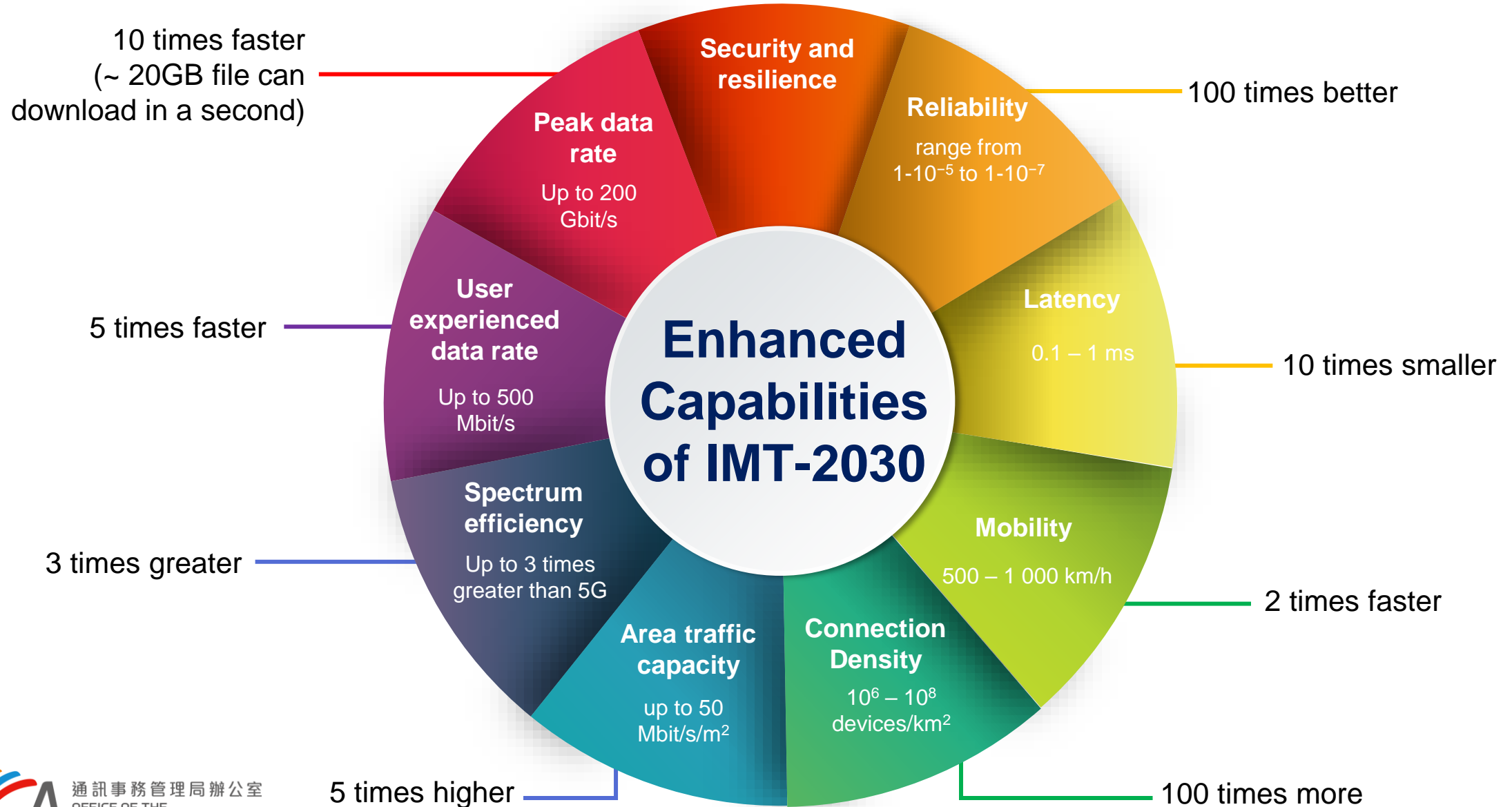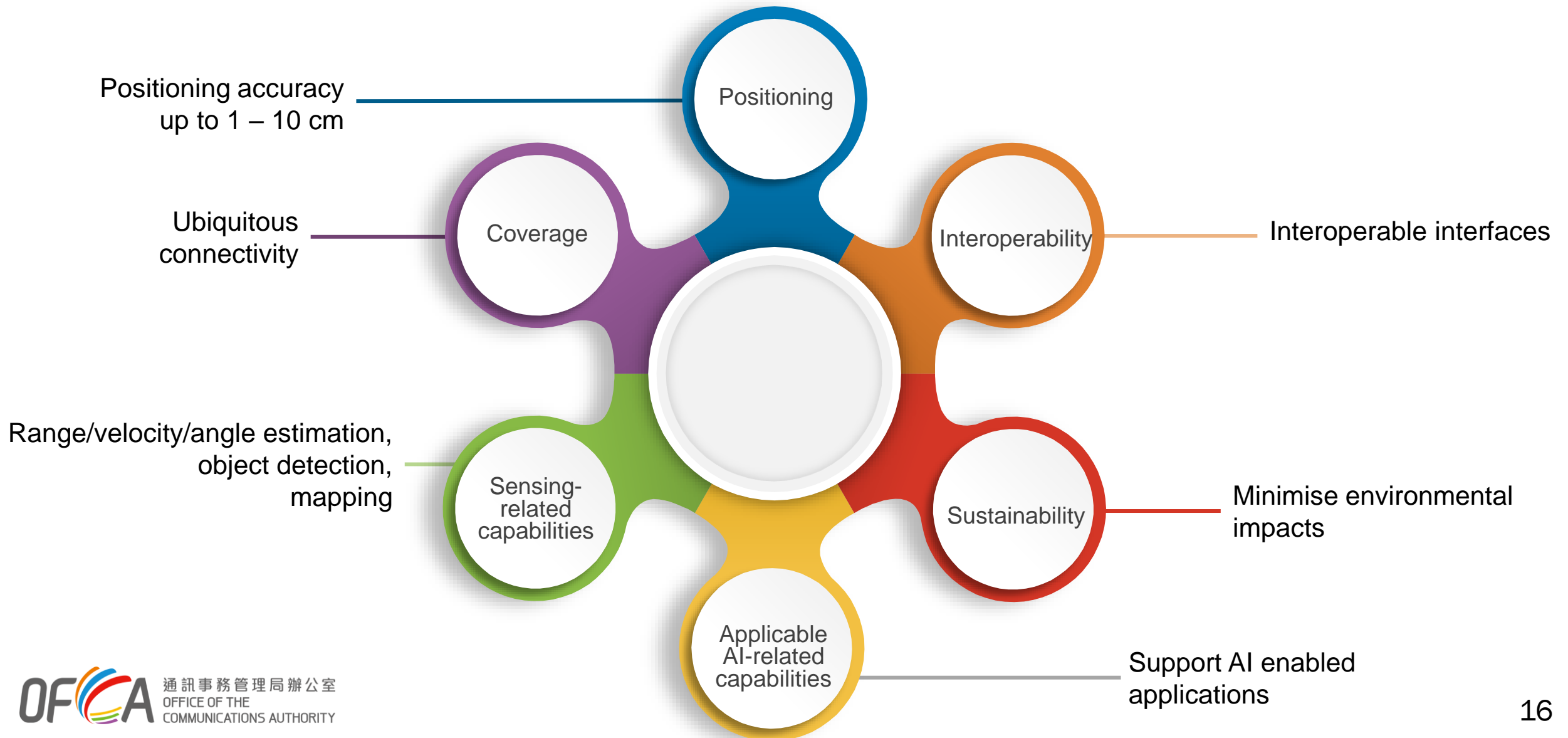

NOTE: The range of values given for capabilities are estimated targets for research and investigation of IMT-2030.

Source: https://www.itu.int/rec/R-REC-M.2160/en

Enhanced Capabilities of IMT-2030 (compared to IMT-2020)

Enhanced Capabilities of IMT-2030

- **Security and resilience**
- **Reliability** range from $1-10^{-5}$ to $1-10^{-7}$ — 100 times better
- **Latency** 0.1 – 1 ms — 10 times smaller
- **Mobility** 500 – 1 000 km/h — 2 times faster
- **Connection Density** $10^6 – 10^8$ devices/km² — 100 times more
- **Area traffic capacity** up to 50 Mbit/s/m² — 5 times higher
- **Spectrum efficiency** Up to 3 times greater than 5G — 3 times greater
- **User experienced data rate** Up to 500 Mbit/s — 5 times faster
- **Peak data rate** Up to 200 Gbit/s — 10 times faster (~ 20GB file can download in a second)

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New Capabilities of IMT-2030

Positioning accuracy up to 1 – 10 cm — Positioning

Ubiquitous connectivity — Coverage

Interoperable interfaces — Interoperability

Range/velocity/angle estimation, object detection, mapping — Sensing-related capabilities

Minimise environmental impacts — Sustainability

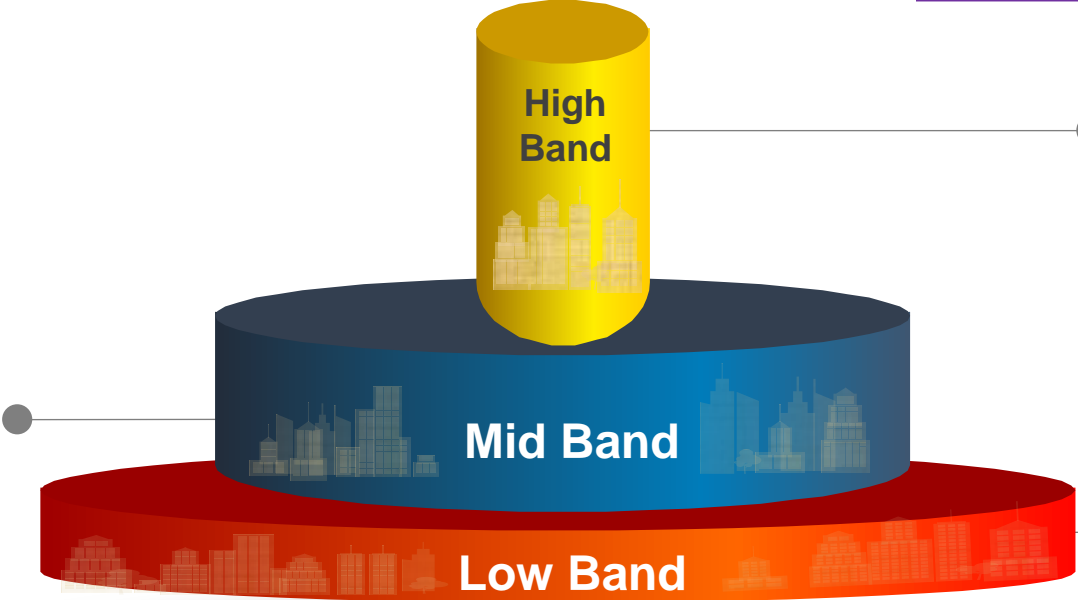Support AI enabled applications — Applicable AI-related capabilities

Candidate Frequency Bands for Terrestrial Component of IMT

- WRC-27 Agenda Item 1.7 studies the following bands:

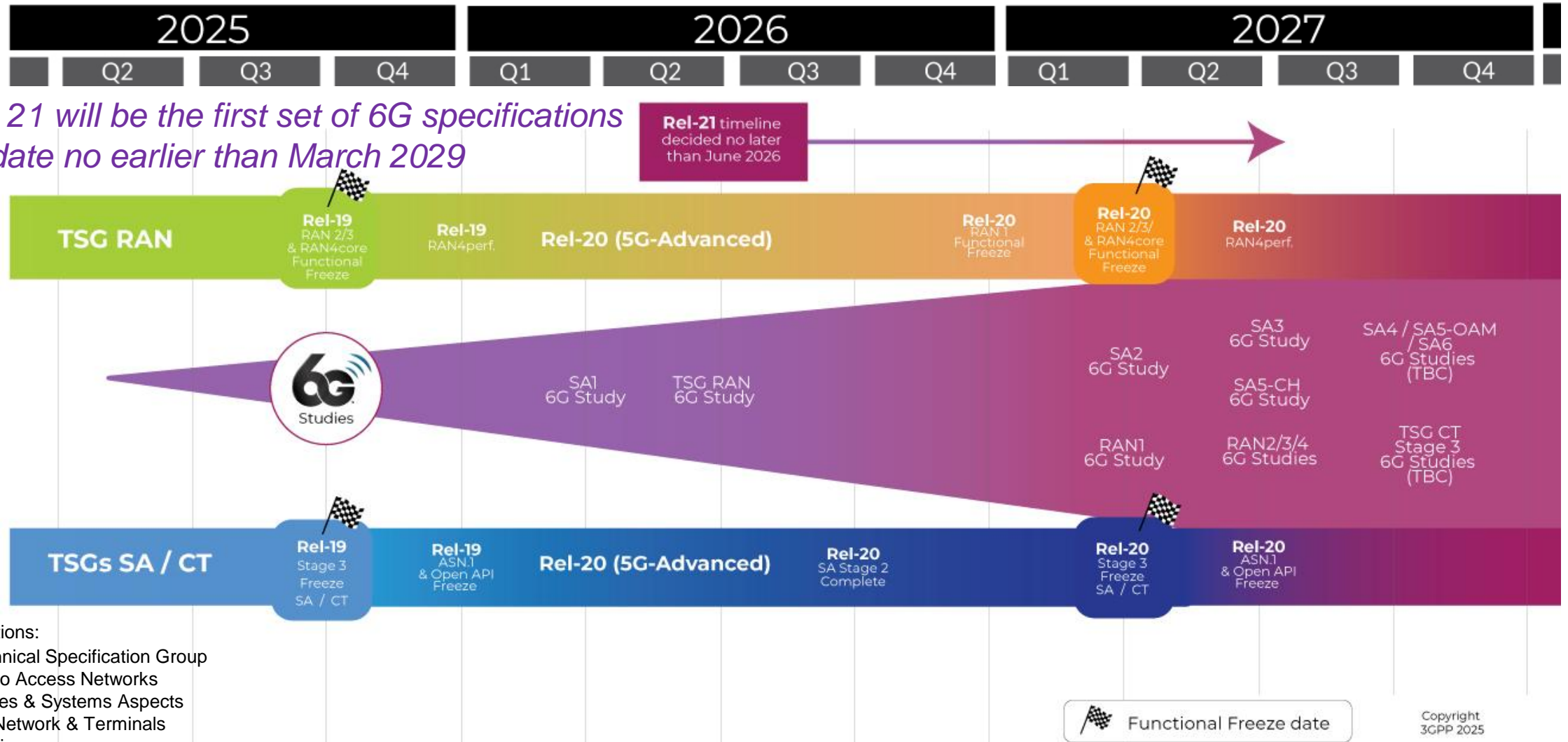| Region 1	Region 2	Region 3
4 400 – 4 800 MHz		4 400 – 4 800 MHz
7 125 – 7 250 MHz 7 750 – 8 400 MHz	7 125 – 8 400 MHz	7 125 – 8 400 MHz
14.8 – 15.35 GHz	14.8 – 15.35 GHz	14.8 – 15.35 GHz

High Band — Frequency > **7 GHz** (Capacity layer) For achieving high speed and high capacity

Frequency **between 1 GHz and 7 GHz** (Balance of coverage and capacity layer) — **Mid Band**

Low Band — Frequency < **1 GHz** (Coverage layer) For wide area coverage

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3GPP 6G Timeline

Release 21 will be the first set of 6G specifications Freeze date no earlier than March 2029

*Abbreviations:
TSG: Technical Specification Group
RAN: Radio Access Networks
SA: Services & Systems Aspects
CT: Core Network & Terminals
CH: Charging
OAM: Operations, Administration, and Maintenance

Source: https://www.3gpp.org/specifications-technologies/releases/release-20

ITU IMT-2030 Timeline

Source: https://www.itu.int/en/ITU-R/study-groups/rsg5/rwp5d/imt-2030/pages/default.aspx
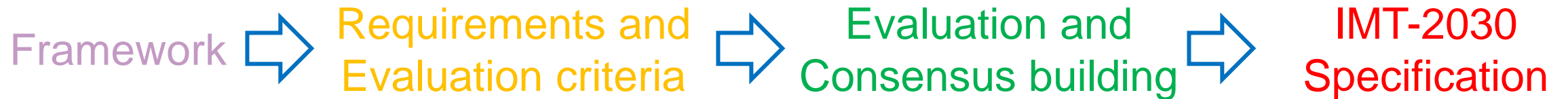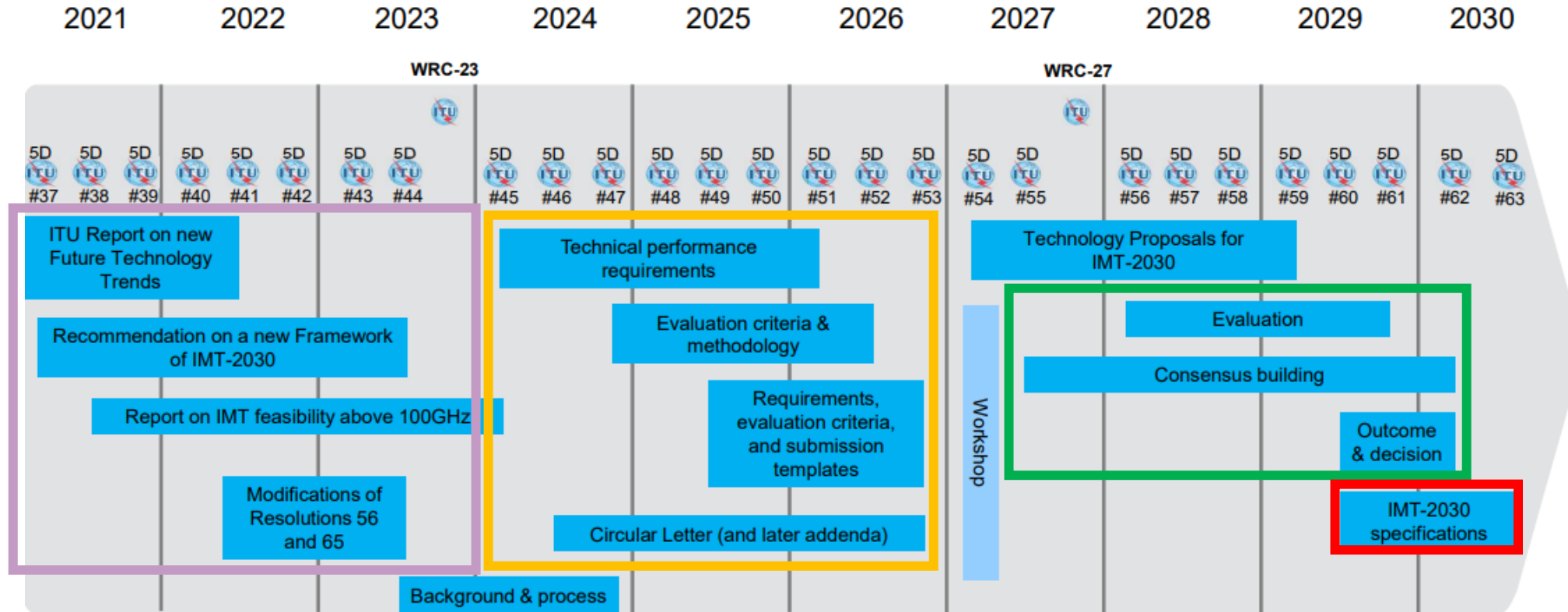
Way Forward

- OFCA will continue to monitor **international development of 6G standard, telecommunications equipment availability** and the **local market demand** to ensure **timely supply of radio spectrum to the industry** for facilitating the development of 6G services in Hong Kong

THANK YOU