Spectrum roadmaps for a thriving 5G era

GSMA Ministerial Programme

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Introduction

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Spectrum needs

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IMT 2020 requirements drive the need for spectrum

One of the pillars in the vision for 5G is to provide ubiquitous high-speed wireless mobile connectivity:

"IMT-2020 is expected to provide a user experience matching, as far as possible, that of fixed networks".

5G must deliver a near guaranteed user experienced mobile data rate of 100 Mbit/s in the downlink and 50 Mbit/s in the uplink and accommodate 1 million connections per km².

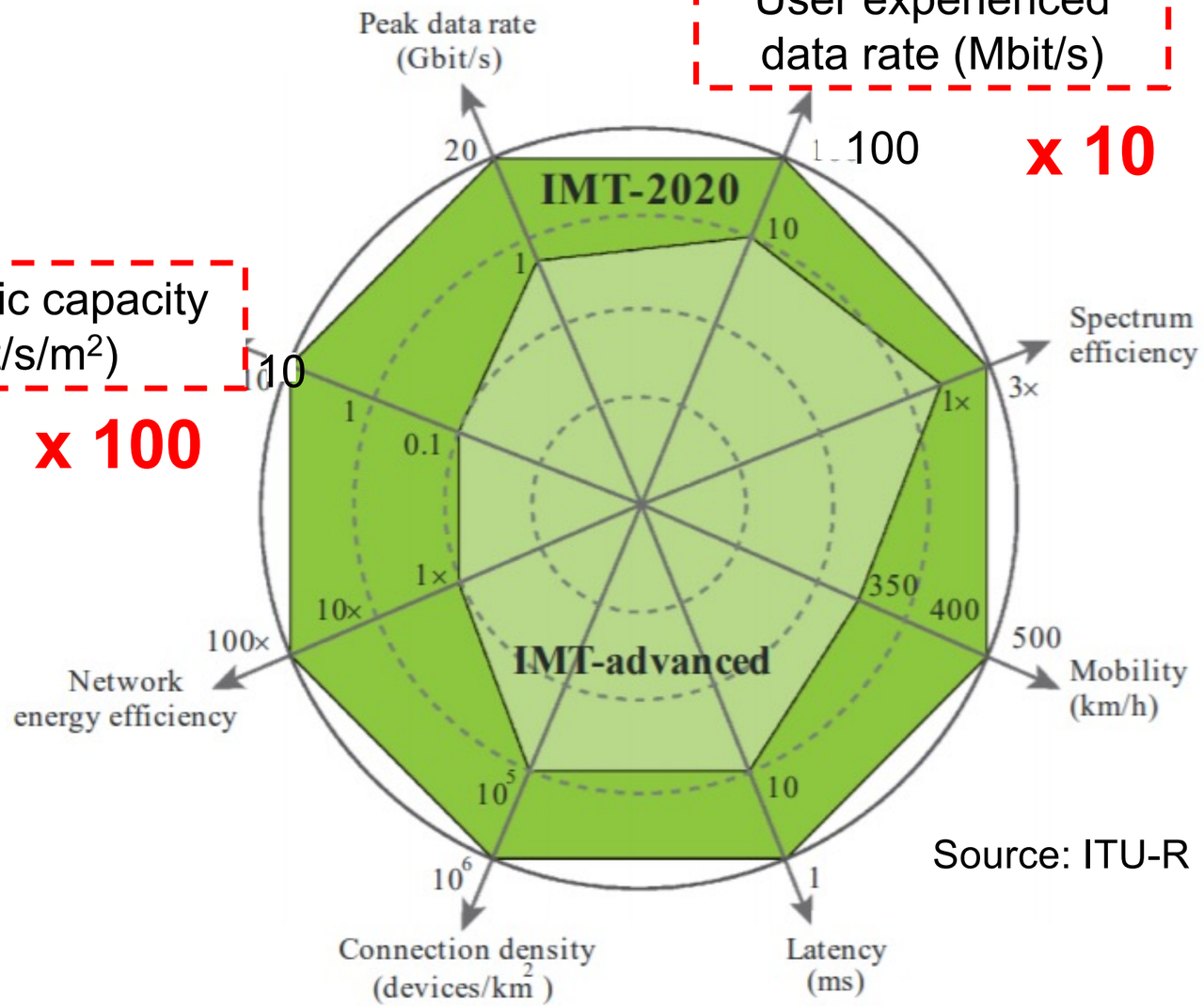
Enhancement of capabilities from IMT-Advanced to IMT-2020

User experienced data rate (Mbit/s)

x 10

Area traffic capacity (Mbit/s/m²)

x 100



Source: ITU-R

To deliver the 5G vision poses huge challenge in cities with a high traffic density and a substantial amount of mid-bands spectrum is required

Sub-1GHz band 600 - 900 MHz
deep indoor and rural coverage layer, legacy technologies and 5G

Lower mid-band 1.5 – 2.6 GHz
basic capacity layer, legacy technologies and 5G

Upper mid-band 3.3-4.2, 4.5-4.99, 6GHz
city-wide speed coverage layer, 5G only

IMT 2020 Requirements

User experienced 100 Mbit/s DL and 50 Mbit/s UL rate

Area traffic capacity of 10 Mbit/s/m^2

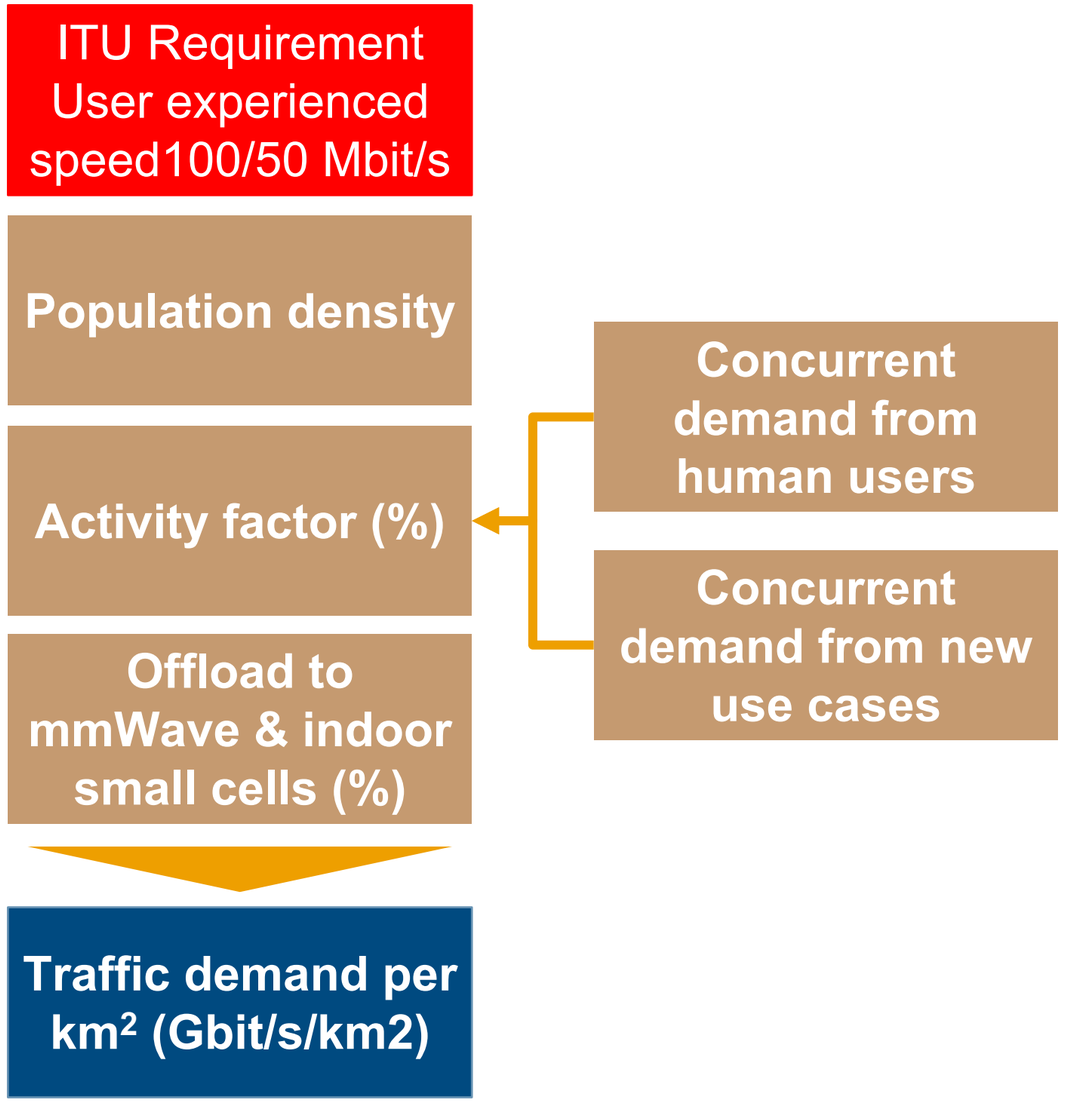
High-band 26GHz & other mmWave, Super high capacity hot-spots, 5G only

Dense Urban **Urban** **Suburban** **Rural**

The required 100 Mbit/s DL and 50 Mbit/s UL user experienced data rate is the key driver to for additional mid-band spectrum

Area Traffic Demand

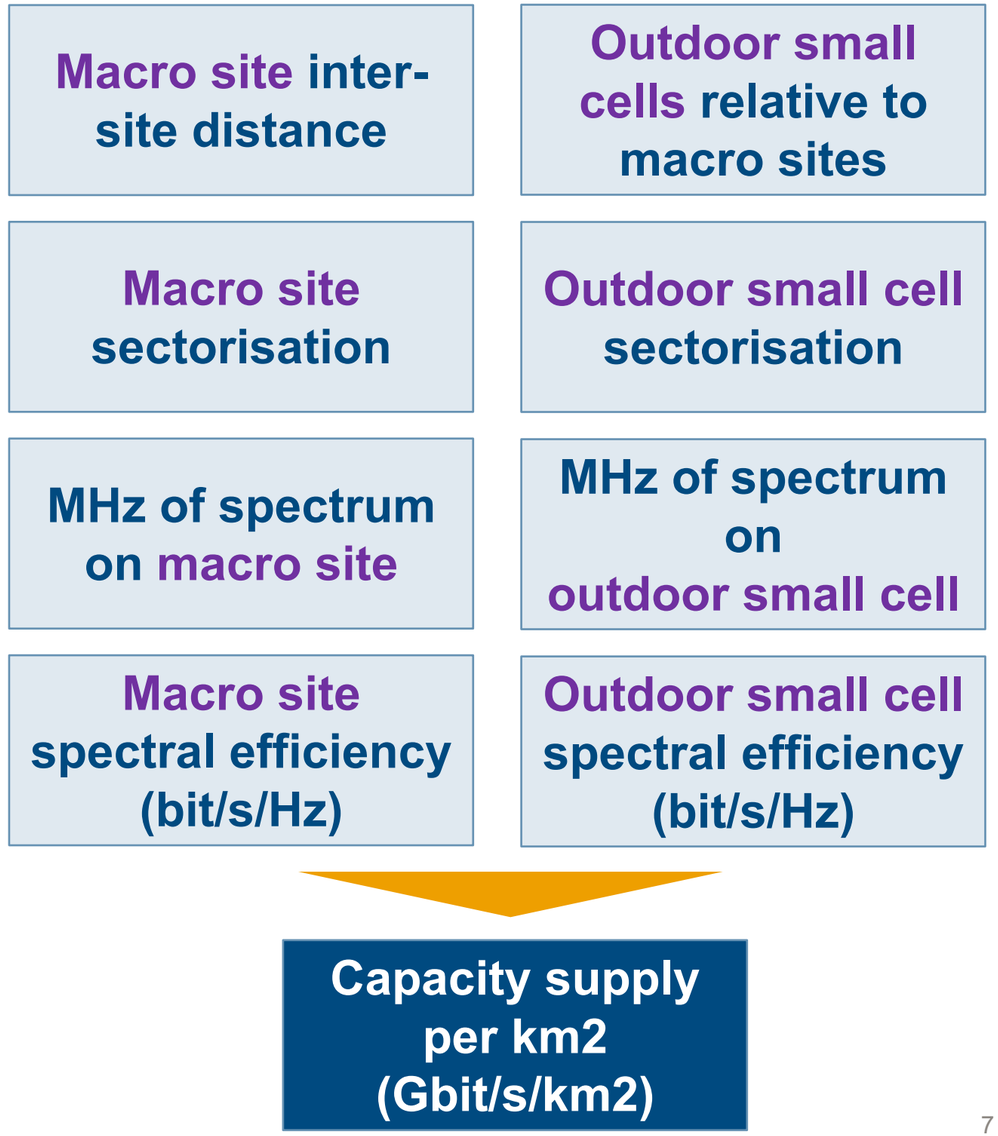
- We use the **population density** in cities as a proxy for mobile area traffic demand density that is triggered by both human and non-human users.
- Concurrent bandwidth demand from both human users and other use cases is presented in the form of an **activity factor** ranging from 10% to 25%. The activity factor is a proxy for the demand by both human users and non-human users.
- The mobile area traffic density demand is the net demand after deducting **offloading traffic to high bands sites and indoor small cells**.



We assume that in the 2025-2030 time frame all spectrum is used for 5G and there will be 3 outdoor mid-band small cells per macro site

Area Traffic Capacity Supply

- The “baseline spectrum” for each city includes spectrum already in use by mobile operators as well as expected future assignments in the period of 2021 to 2025.
- Depending on the specific city among the 35 cities addressed, the baseline spectrum varies from 725 MHz up to 1,420 MHz.
- We assume that within the 2025 to 2030 time frame, mobile operators will have made the investment to use all “baseline spectrum” for 5G.
- We assume that each operator will deploy 3 outdoor small cells per each of its macro sites, invest in MIMO upgrades, install indoor small cells, and deploy high-bands (mmWave) spectrum on outdoor and indoor sites.



Despite the investments to supply mobile area traffic capacity, there will be a significant shortfall of upper mid-band spectrum

In 36 cities we examined, substantial amounts of mid-band spectrum are found to be required to deliver the 5G vision in an economically feasible manner, taking different national income levels into consideration.

Category by income grouping *	Minimum estimate	Maximum estimate
High income cities	1,260 MHz	3,690 MHz
Upper middle income cities	1,020 MHz	2,870 MHz
Lower middle income cities	1,320 MHz	3,260 MHz

* World bank income classification GDP per capita

- Policymakers will, therefore, need to consider making more spectrum in mid-band and prepare national spectrum roadmaps that consider future 5G area traffic demand density.
- There is a concern in the mobile industry that regulators may not be fully aware of the scale of the 5G traffic density challenge in urban areas.
- Specifically, there is a concern that regulators may not be planning to clear and award enough mid-band licensed 5G spectrum between now and 2030.

Small cell densification beyond what we assumed in our model is not an economically feasible substitute for additional mid band spectrum

The small cell vs. spectrum trade off

- Our spectrum demand model assumes 3 small cells per macro site.
- Beyond that, a city with a population density of 18,000 per km^2 and 7.2 macro sites per km^2, 177 additional outdoor small cells per km^2 are required to deliver the same capacity as an additional 1,250 MHz.
- Considering an urban area of 100 km^2, 17,700 additional small cells would be required (compared to 720 macro sites) in the absence of an additional 1,250 MHz of mid-band spectrum.

Not having additional mid bands spectrum is highly problematic

- The significant numbers of outdoor small cells with relatively small inter-site distances
  - will have a negative impact on the city environment from an aesthetics point of view,
  - will increase power consumption, and
  - would be very costly thus making 5G less affordable for lower income groups.
- Such small inter-site distances, over such large areas, may not be practically possible from an interference point of view. Operators would push against the technical limits of network densification.

Outside cities additional upper mid-band spectrum provides a sustainable path to bridge the urban-rural digital divide

Additional spectrum would provide sufficient bandwidth to ensure that FWA will be a cost effective solution spectrum able to address the needs for 100 Mbit/s connectivity as a long-term solution for rural small towns and villages.

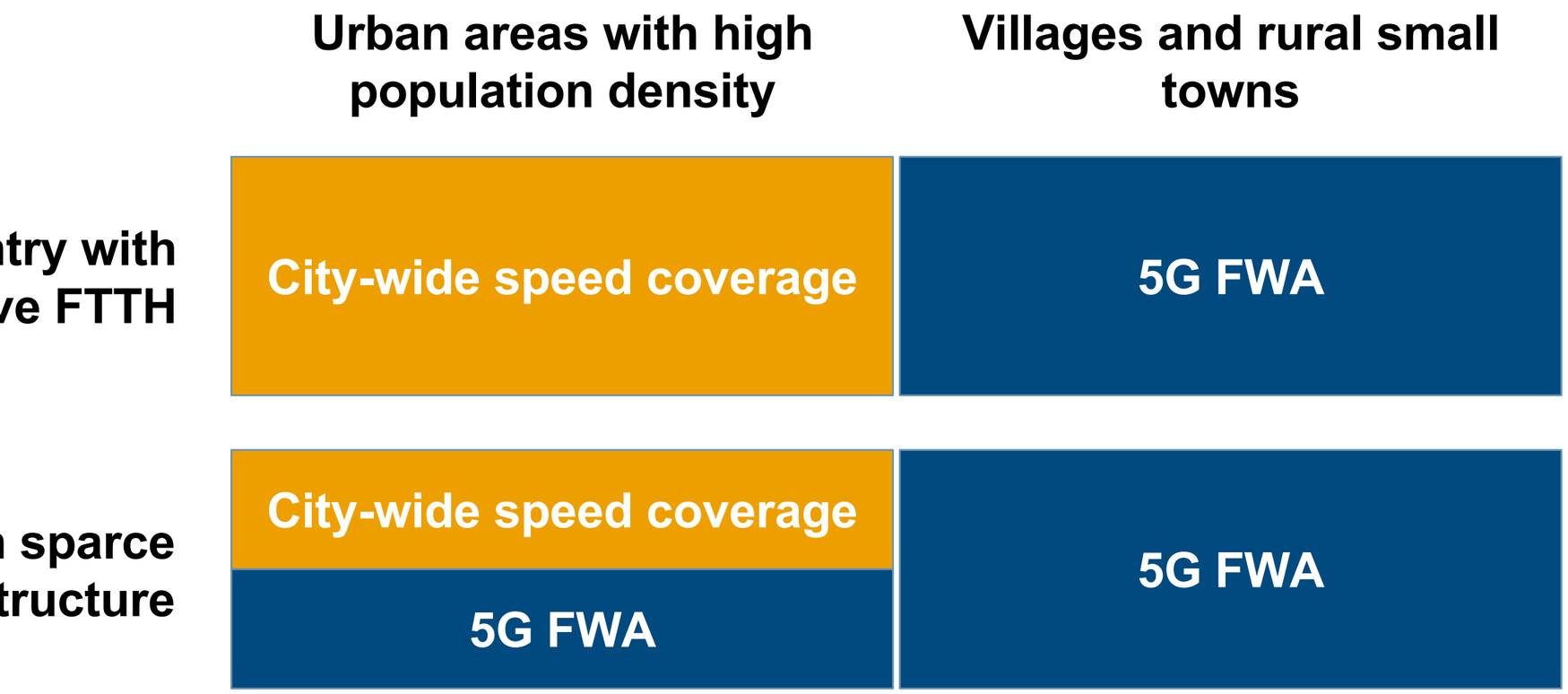
- There are 1.1 to 1.2 billion households worldwide without broadband access and FWA is the fastest growing method of bringing fixed broadband to the unconnected.
- Upper mid-band spectrum has a key role to play in providing fibre-like access via 5G at an affordable price.
- The ITU and UNESCO Broadband Commission for Sustainable Development 2025 Targets make this explicit: *“By 2025, entry-level broadband services should be made affordable in developing countries, at less than 2% of monthly gross national income per capita.”*
- Alternative rural connectivity solutions based on satellite or fibre typically have higher costs and, therefore, outside the affordability of households and business in villages and rural small towns, particularly in middle- and low income countries.

In countries with low FTTH penetration the unlicensed use of mid band spectrum such as the 6 GHz band does not solve the connectivity problem

- In middle and low income countries the access network is essentially provided by mobile operators using 4G and now 5G.
- The notion of using more spectrum for WiFi to distribute traffic around buildings is pointless because the connectivity bottleneck is the connection to the network.
- Using more upper mid-band spectrum for 5G will make a significant contribution to overcoming the connectivity problem.

In middle- and low-income countries the IMT identification for the 6 GHz would deliver socio-economic benefits which would not be the case if the 6 GHz band is used for R-LAN (WiFi) access.

Conclusion: Demand drivers for mid-band spectrum is driven by both urban and rural in developing and developed countries



Without 1.2 to 3 GHz of additional mid-band spectrum the urban - rural digital divide my widen rather than narrow.

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Roadmaps for 5G

Luiz Felippe Zoghbi

Senior Spectrum Policy Manager, GSMA

Importance of Roadmaps

What spectrum will be available and when:

- To plan what spectrum operators need to invest in over the near-to-long term to meet rapidly growing data demand (this should encompass coverage & capacity bands, existing and future bands)

Regulatory certainty:

- e.g. assignment methodologies, renewal procedure

Licensing regime:

- e.g. refarming, pricing, spectrum sharing

Harmonised future spectrum:

- To reduce equipment costs, limit interference and enable roaming

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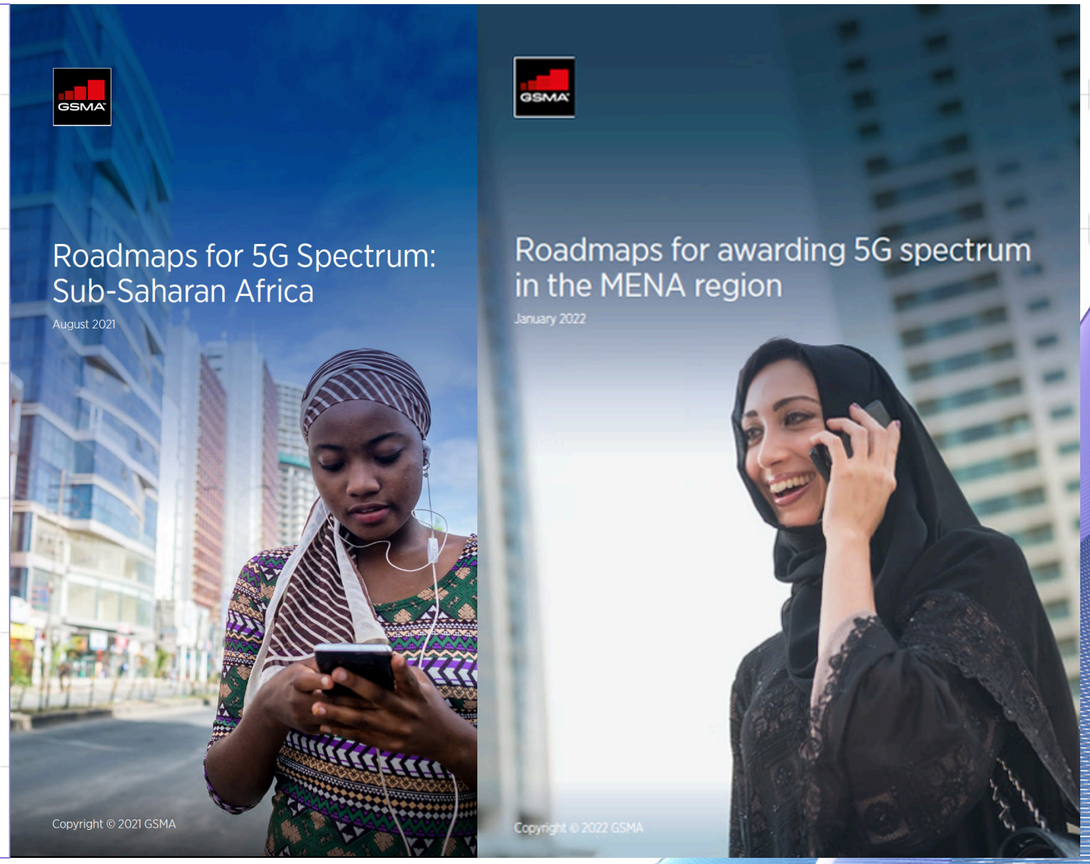
The Roadmap Series

- Details of which spectrum is envisioned for 5G use.
- International best practice in awarding 5G spectrum.
- A categorisation of countries based on the current state of awards to identify which countries are most advanced in their plans for 5G release, and which suffer from significant constraints.
- An overview of how spectrum should be released, including details of the identification, clearance, award and assignment stages.



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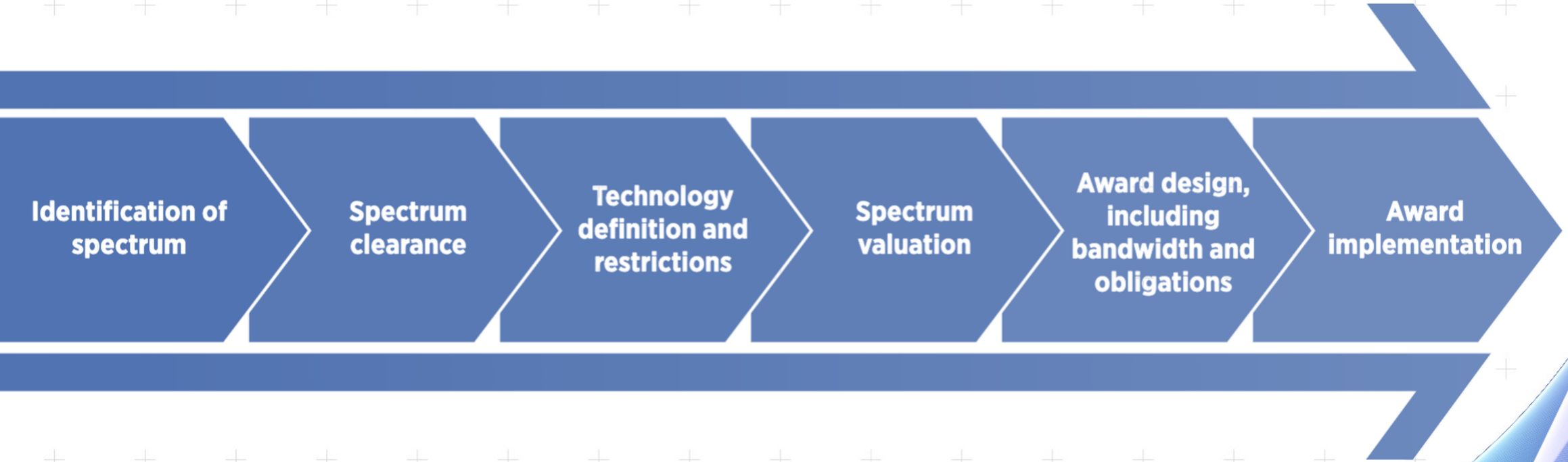
Generic Roadmap



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Conclusions

- All countries studied have existing LTE networks
- However many have not upgraded to LTE-A or LTE-A Pro or have just awarded 4G spectrum
- Countries with limited spectrum awarded to date should aim to release more frequencies. Many of the countries have made substantially less spectrum available than in other countries.
- Before investing in 5G it is crucial existing networks are optimised
- 4G will continue to play key role in mobile networks as 2G and 3G are phased out and 5G introduced
- It is important existing licences are technology neutral to allow operators to refarm current spectrum for LTE expansion if needed based on the market and their network and service planning
- All countries should adopt their Regional band plans to minimise interference issues – in particular cross border
- Those countries where the bands 2300, 2600 and 3500 MHz have been awarded previously for another service should investigate the options and potential to release for 4G and 5G services

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Planning for 5G success

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Executive Director, UCC

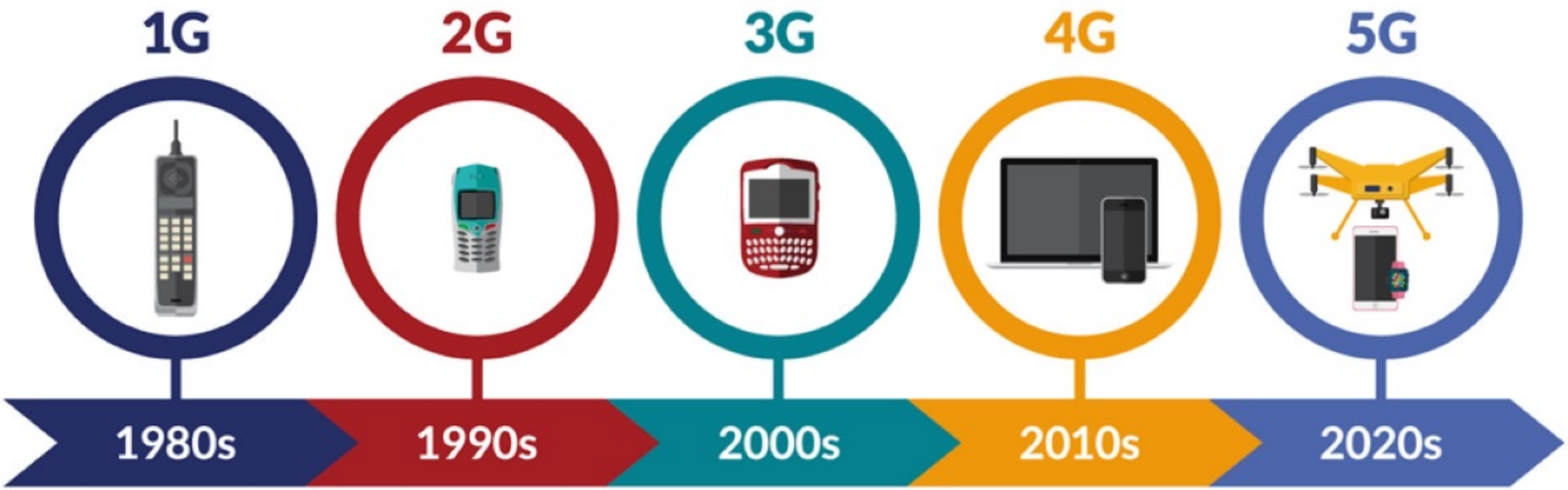
SPECTRUM ROADMAPS FOR A THRIVING 5G ERA

UGANDA'S RADIO FREQUENCY SPECTRUM MASTER PLAN (2021/22 to 2025/26)

Irene Kaggwa Sewakambo
Ag. Executive Director

UGANDA COMMUNICATIONS COMMISSION

INTRODUCTION



Source: Huawei enterprise support

Evolution in technology and new use cases have continued to place constraints on the available radio frequency spectrum, thus necessitating a review of existing allocations and identification of new allocations

What do we seek to achieve with the Master Plan

The objectives of the Master Plan are to:

i. promote certainty and encourage investment through the anticipation and interventions to meet the needs of spectrum users;

ii. facilitate national stakeholders by ensuring that spectrum management decisions respond to market demands;

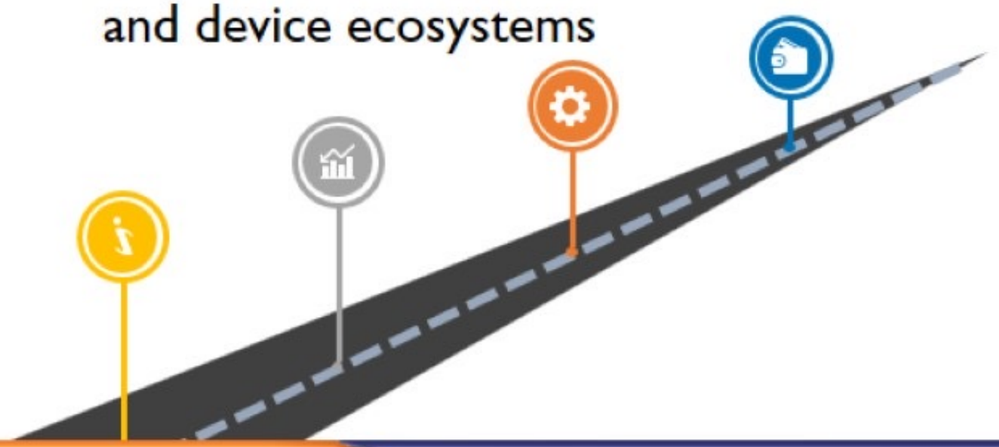
iii. proactively seek opportunities to optimize the benefit of spectrum for its users, maximizing its value to society.

THE JOURNEY TO THE MASTER PLAN

The development of the 5-year spectrum Master Plan involved:

A. Review of the outputs of the World Radiocommunication Conference 2019 (WRC-2019) and the agenda of WRC23

B. Review of regional and international technology innovation trends, spectrum use cases, and developments in the equipment and device ecosystems



C. Consultation of sector stakeholders on:

i. their radio frequency spectrum needs (current and projected demand future),

ii. industrial best/recommended practices,

iii. The approach and plans of Uganda Communications Commission relating to the release of resources for commercial mobile services, license-exempt applications, satellite, broadcasting and wireless backhaul services for the period 2020/21 to 2024/25

iv. International Telecommunications Union (ITU) spectrum allocations and the various standards (national, regional and international) identified by the Commission to ensure harmonized and efficient use of available spectrum resources

Highlights of the Master Plan

- ✓ An overview of the current electronic communications market situation in Uganda;
- ✓ Plans to address the current spectrum uses and future spectrum needs due to emerging technologies in:
  - a) Fixed and mobile wireless broadband needs;
  - b) Private/Industry Vertical Networks;
  - c) Machine-to-Machine communications;
  - d) Satellite Communications Technologies;
  - e) Broadcasting services;
  - f) Government use, and;
  - g) Amateur Radio.

THANK YOU

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Discussion Segment

Moderator: Kamal Tamawa

Policy Director, SSA, GSMA