

6 GHZ 5G/IMT SPECTRUM FORUM

1 MARCH 2022

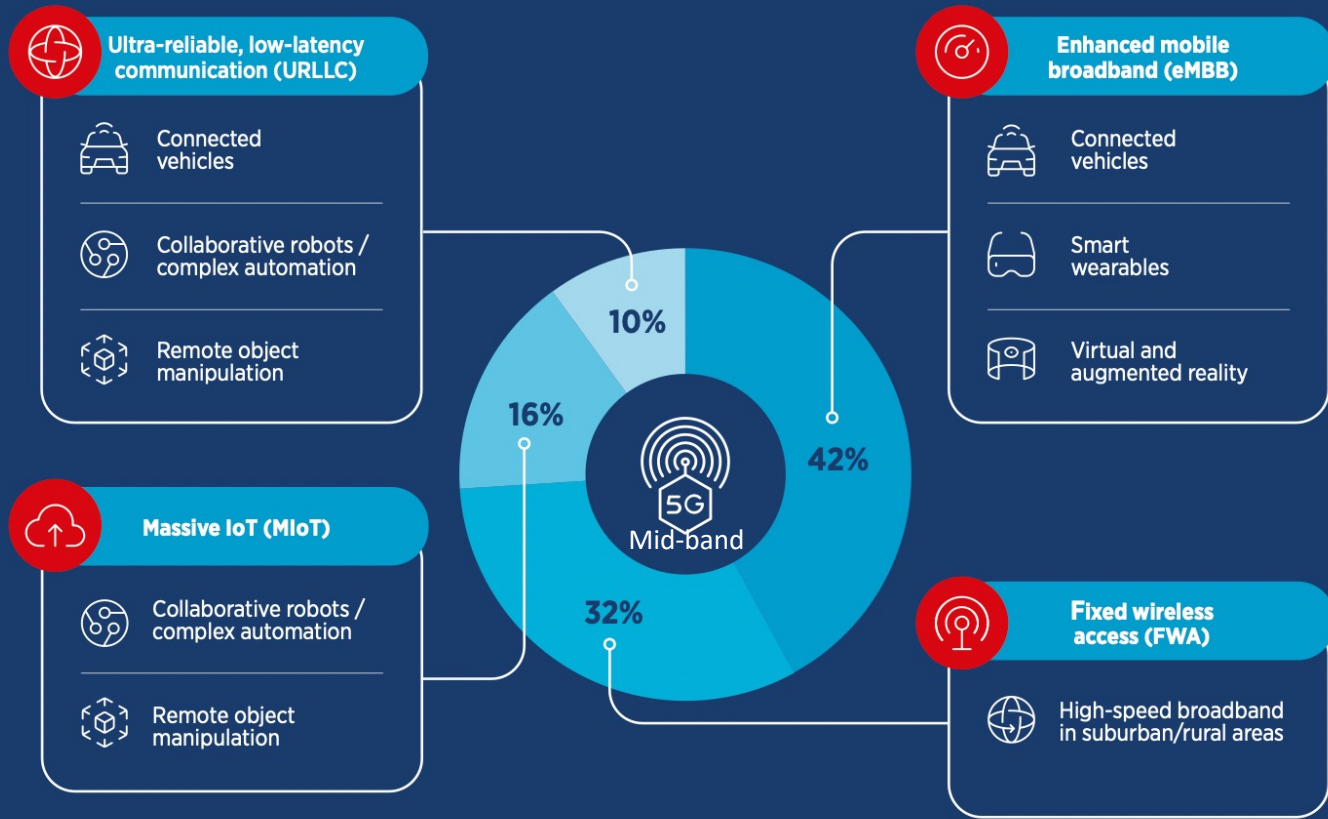
#MWC22



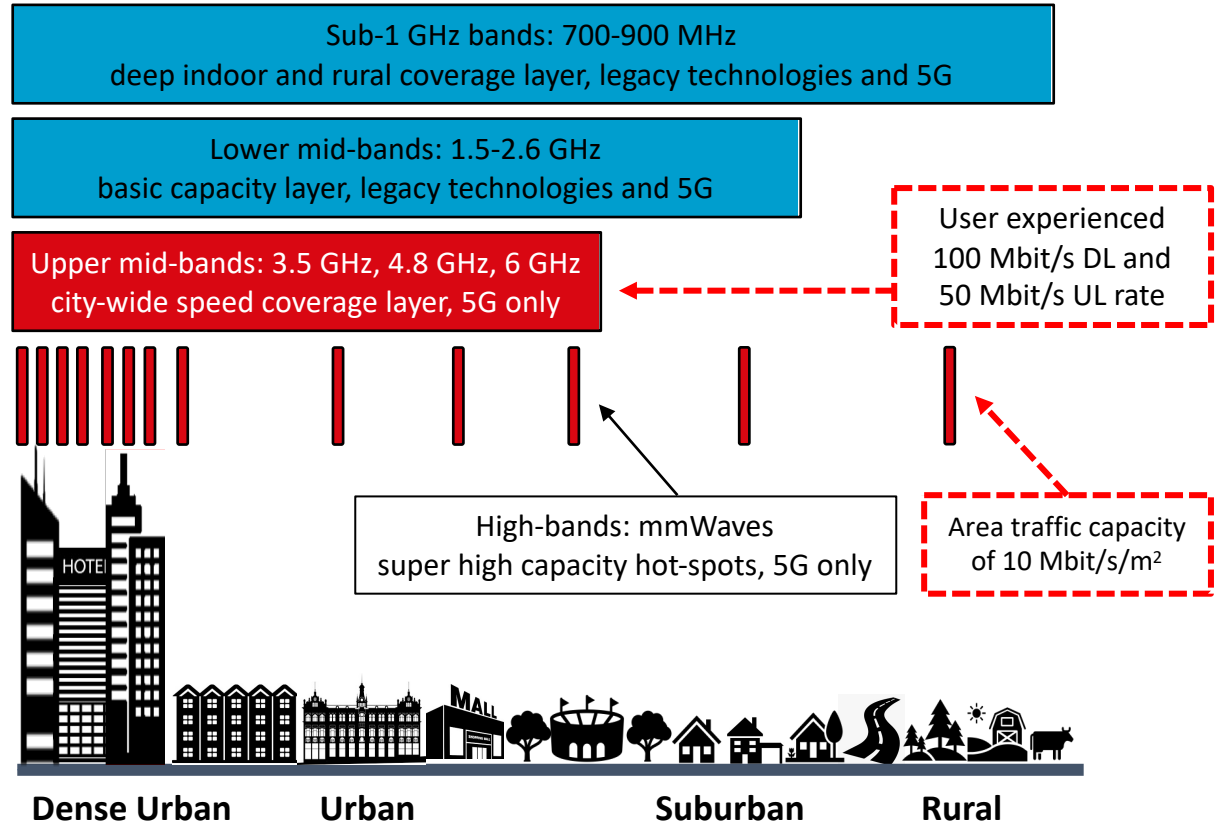
Mid-band Spectrum Needs

Luiz Felipe Zoghbi
Senior Spectrum Policy Manager
GSMA

5G is not an Evolution, but a Revolution



IMT-2020 Requirements and all 5G Spectrum Ranges



The Mid-band Spectrum Needs Report

The vision for 5G is that it should provide the 100 Mbit/s DL and 50 Mbit/s UL user experienced data rate any time, anywhere, while “on the move”.

- 36 studied cities
- Population density
- Available spectrum by 2025
- Inter-site distance
- 5G technology, MIMO upgrades and small cells
- High-bands, indoor small cells and Wi-Fi offload
- Cellular network activity factor



GSMA Vision 2030:

2 GHz of Mid-band Spectrum Needs



Densely populated cities need, on average, a total of 2 GHz of mid-band spectrum.



IMT-2020 requirements will be at risk with less spectrum, and significantly more base stations would be needed without sufficient assignments.

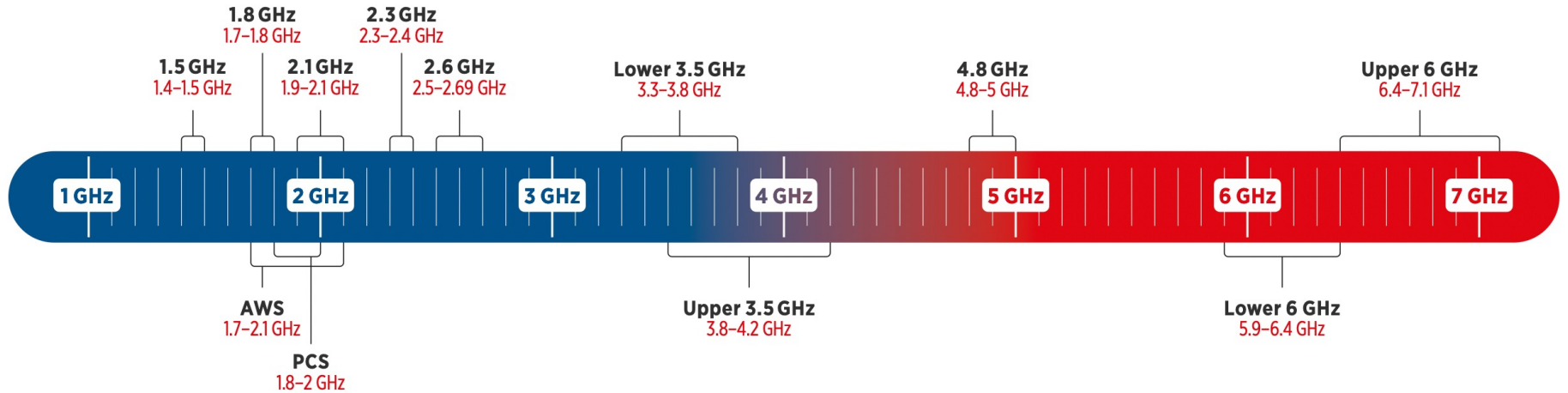


Additional base stations will generate a carbon footprint 1.8-2.9x higher without sufficient spectrum.



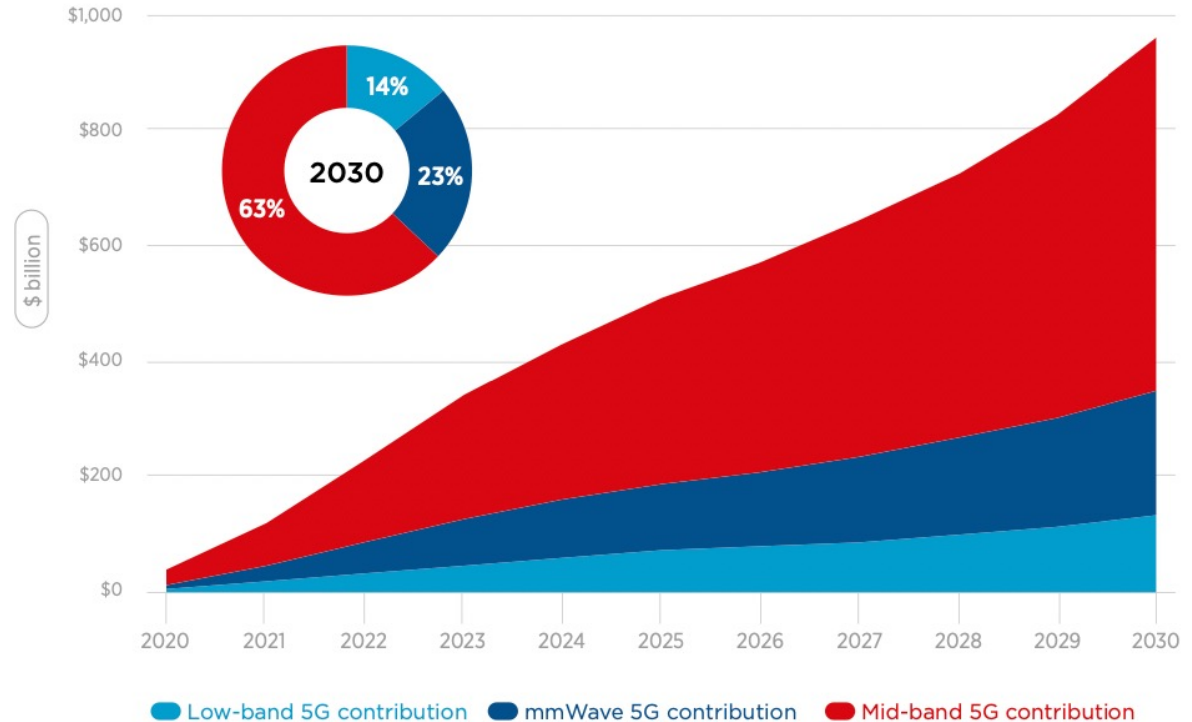
Affordable fixed wireless access will raise demand. The additional spectrum in mid-bands will allow each cell site to support 3.5-6x more homes with 5G FWA.

Mid-band Spectrum



Mid-band Spectrum Socio-economic Benefits

USD610bi in 2030



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The socioeconomic benefits of the 6GHz band: Considering licensed and unlicensed options

DATE

1 March 2022

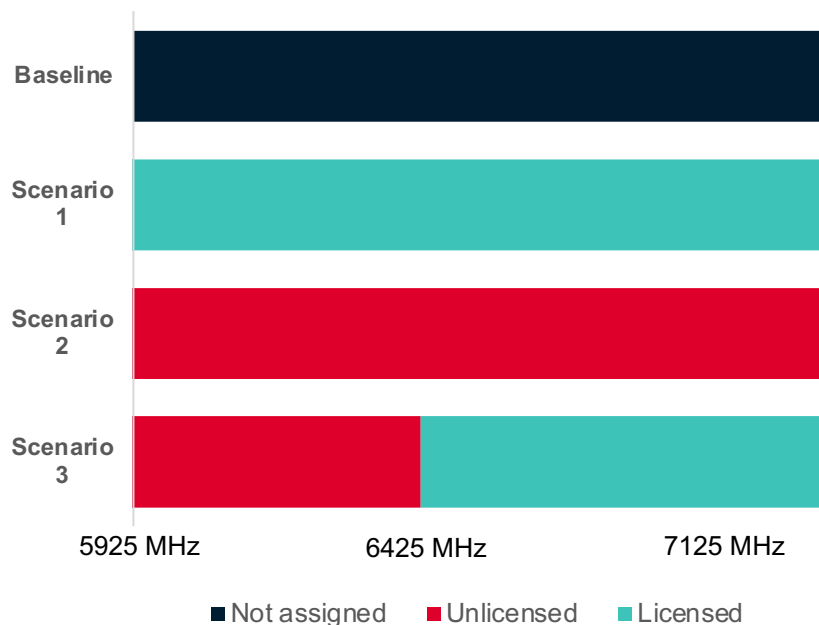
AUTHOR

Kalvin Bahia

GSMA™
Intelligence

1. Introduction

A Cost-Benefit Analysis of the allocation of the 6GHz band



- This study carries out a cost-benefit analysis of different assignment options for the 6 GHz spectrum band.
- We look at expected traffic demand and supply for 5G and Wi-Fi, whereby supply is partly determined by the amount of spectrum available.
- If there is a supply (or capacity) constraint relative to mobile broadband and Wi-Fi traffic demand, this may be alleviated with 6 GHz spectrum and will generate socio-economic benefits by reducing prices and/or increasing network quality.
- Relative to the baseline scenario of unassigned 6 GHz spectrum, we compare the socioeconomic benefits of three scenarios of different allocations of the 6 GHz band.
- The analysis covers the 2021-2035 time period

Key drivers of benefits from 6 GHz spectrum

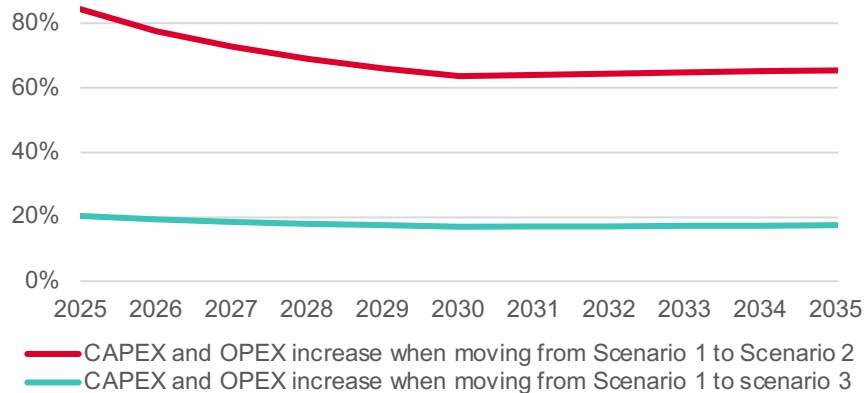
Key variable	Description
Existing spectrum availability for licensed and unlicensed use	The existing and future spectrum allocation to licensed mobile use or unlicensed use (in bands other than 6 GHz) will determine the supply (and capacity) constraints relative to broadband traffic demand, and the requirement for additional spectrum from the 6 GHz band.
Utilisation of high-band spectrum for licensed and unlicensed use	<p>The benefits for unlicensed can also depend on the utilisation of available 60 GHz spectrum (in 57-71GHz bands). Utilisation of high-band spectrum (60 GHz) for Wi-Fi traffic demand will reduce the amount of traffic demand that is reliant on other spectrum bands, and reduce the benefits from 6 GHz spectrum.</p> <p>It should be noted, however, that not using the 60 GHz band would represent an inefficient use of spectrum. Equally, the benefits for licensed use also depend on the utilisation of the mobile licensed high bands. Usage of high bands is always assumed for mobile.</p>
Fixed broadband speeds	The existing and future fixed broadband infrastructure in a market will determine the maximum speeds achievable over a Wi-Fi connection and therefore the addressable traffic demand. In most cases, FBB is the bottleneck.

2. Results

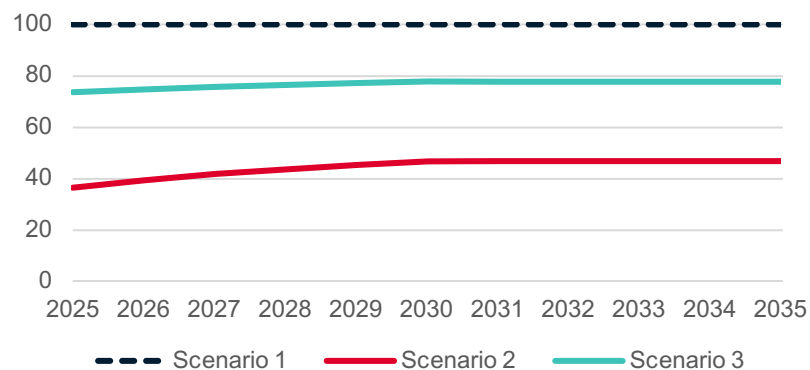
Less spectrum assigned to 5G means lower speeds or higher costs

- With less spectrum, operators could densify networks to meet the 5G download speeds requirement. Increased costs would have a negative impact on 5G adoption.
- Assuming no change in network densification or 5G adoption, download speeds would fall below the 5G performance requirement of 100 Mbps. This could be unavoidable if operators reach the technical limits of network densification.

Average increase in operators' annual capital and operational expenditure in Scenarios 2 and 3 (vs. Scenario 1)



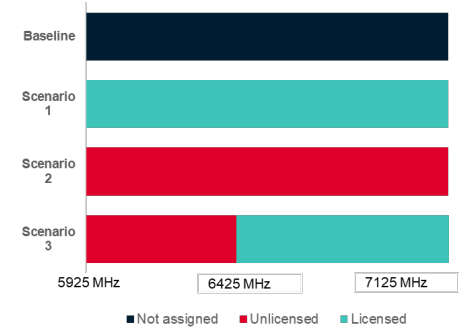
Average 5G download speeds in the three Scenarios (Mbps)



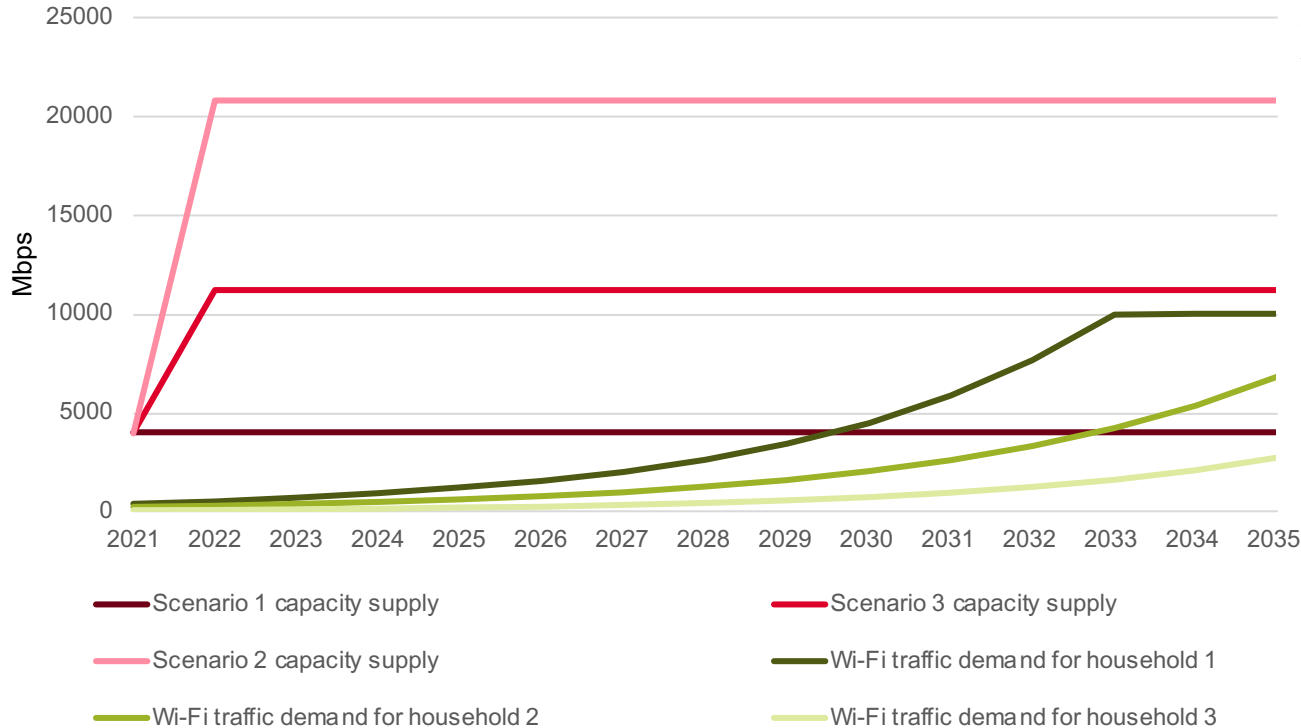
Would assigning less spectrum to unlicensed use create a capacity crunch for Wi-Fi traffic?



The red lines on this chart represent the total spectrum supply for unlicensed use in each Scenario included in the analysis:



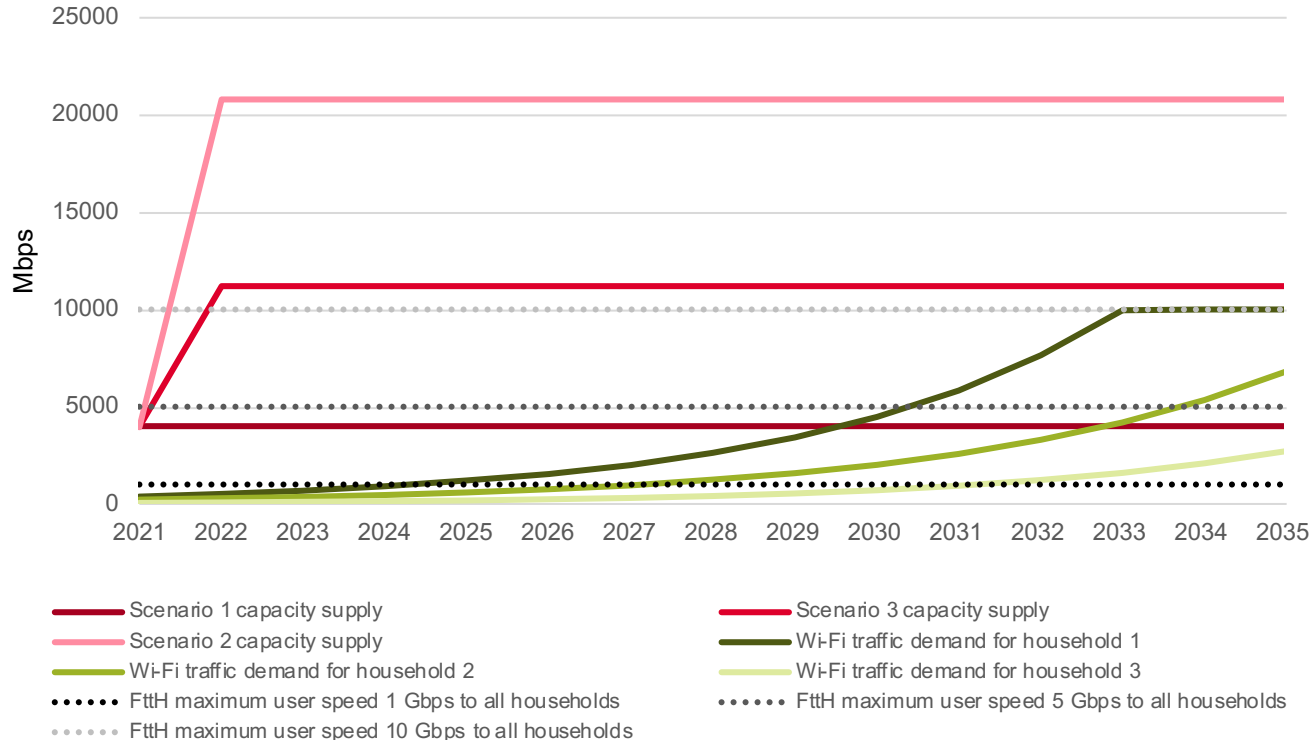
Would assigning less spectrum to unlicensed use create a capacity crunch for Wi-Fi traffic?



The green lines on this chart represent Wi-Fi traffic demand from three illustrative households:

- Household 1 is based on 11 connected devices being concurrently used (the maximum in our study).
- Household 2 is based on six connected devices being used (the average in our study).
- Household 3 is based on three connected devices being used (the minimum in our study).

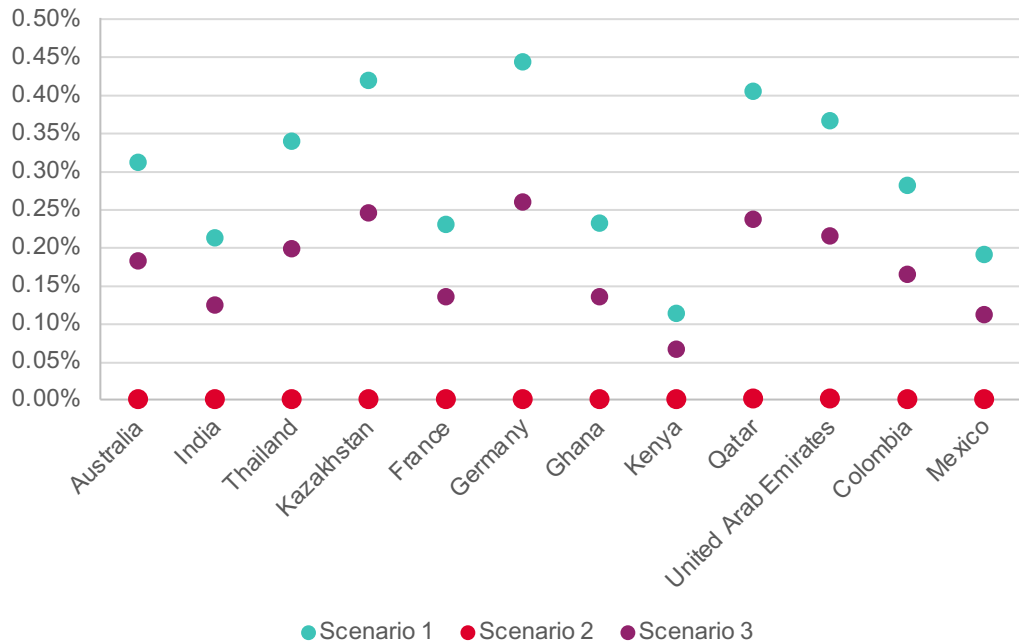
Would assigning less spectrum to unlicensed use create a capacity crunch for Wi-Fi traffic?



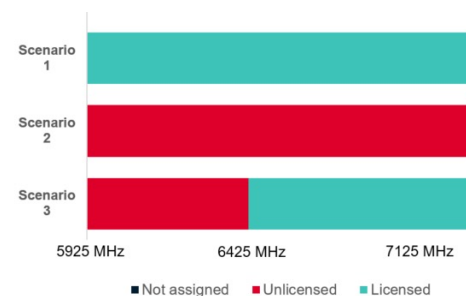
- If FTTH/Cable provides a maximum user speed of 1 Gbps over the period of analysis, then household traffic demand will never surpass the spectrum capacity for Wi-Fi – even without any spectrum from the 6GHz band.
- If FTTH/Cable provides maximum user speeds of 10 Gbps to all households over the period of analysis a capacity crunch without any spectrum assigned to unlicensed use (Scenario 1) depends on the level of household traffic demand.
- If FTTH/Cable provides maximum user speeds of 10 Gbps to all households over the period of analysis, there are no capacity crunches if there is 500 MHz assigned to unlicensed use (Scenario 3).

Scenario 1 delivers the largest benefits when FTTH/Cable speeds are up to 5 Gbps and when the 60 GHz band is utilised for Wi-Fi

Economic impact of scenarios (cumulative benefit 2021-2035 - % of GDP in 2035)

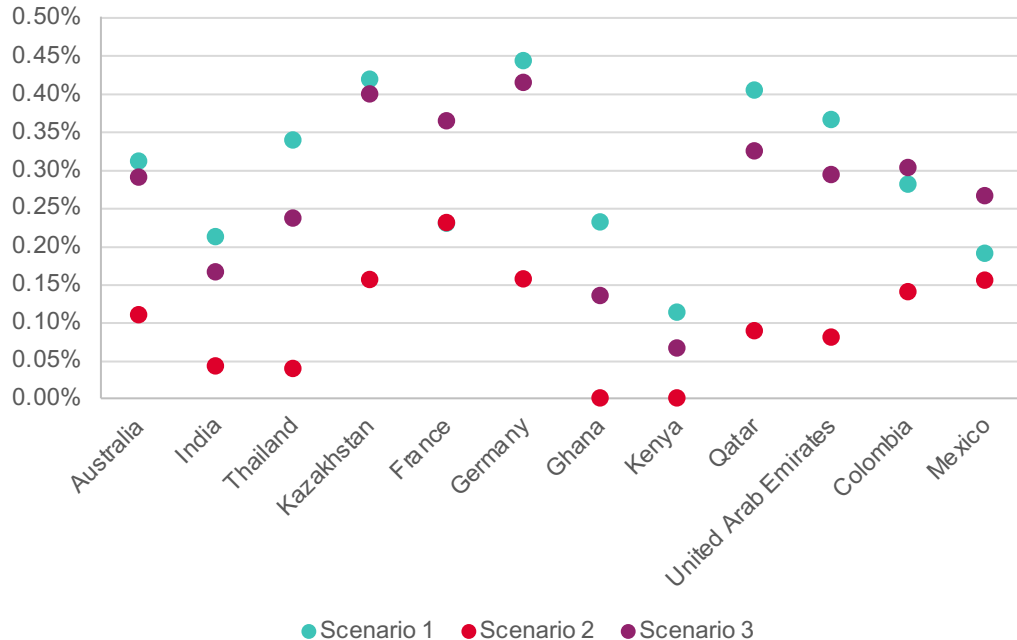


- Scenario 1 will deliver the largest benefits across all countries if fixed broadband technologies do not provide maximum user speeds above 5 Gbps to all users, **AND** if a portion of Wi-Fi traffic is offloaded to the 60 GHz band.

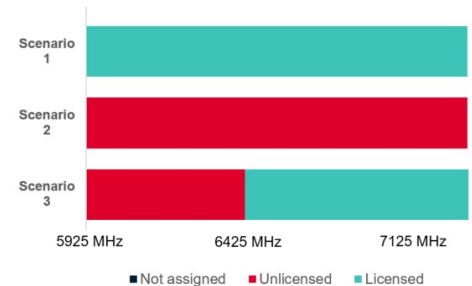


Scenario 1 generally delivers the largest benefits when FTTH/Cable speeds are up to 10 Gbps and when the 60 GHz band is utilised for Wi-Fi

Economic impact of scenarios (cumulative benefit 2021-2035 - % of GDP in 2035)

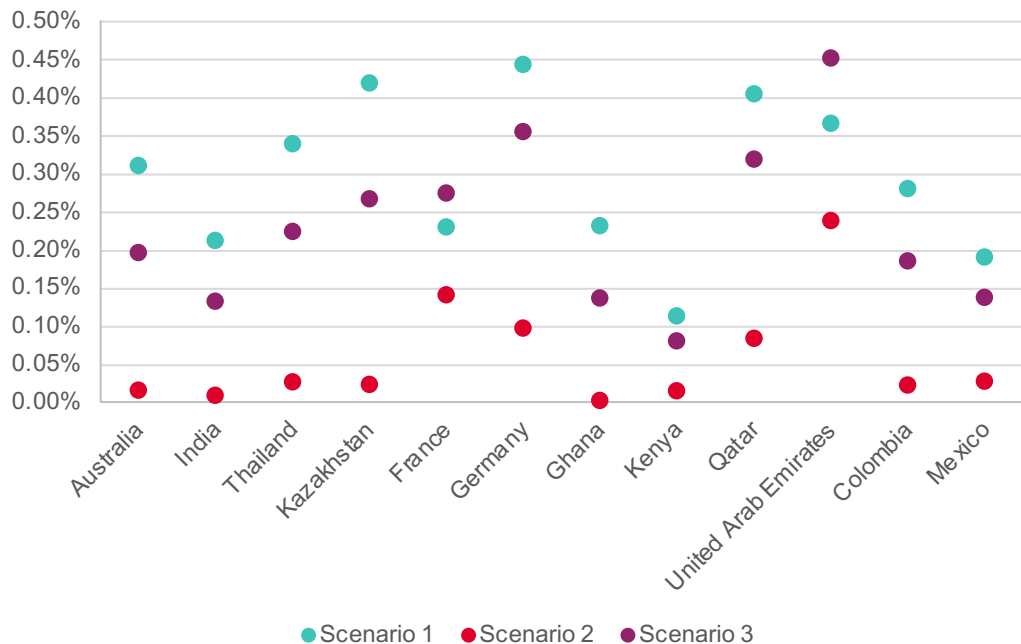


- **Scenario 1** will generally deliver the largest benefits across all countries if fixed broadband technologies do not provide maximum user speeds above 10 Gbps to all users, **AND** if a portion of Wi-Fi traffic is offloaded to the 60 GHz band.
- In some cases, **Scenario 3** will deliver the greatest benefit.

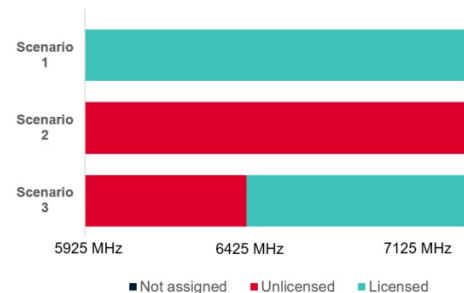


Scenario 1 generally delivers the largest benefits when FTTH/Cable speeds are up to 5 Gbps and when the 60 GHz band is not utilised for Wi-Fi

Economic impact of scenarios (cumulative benefit 2021-2035 - % of GDP in 2035)

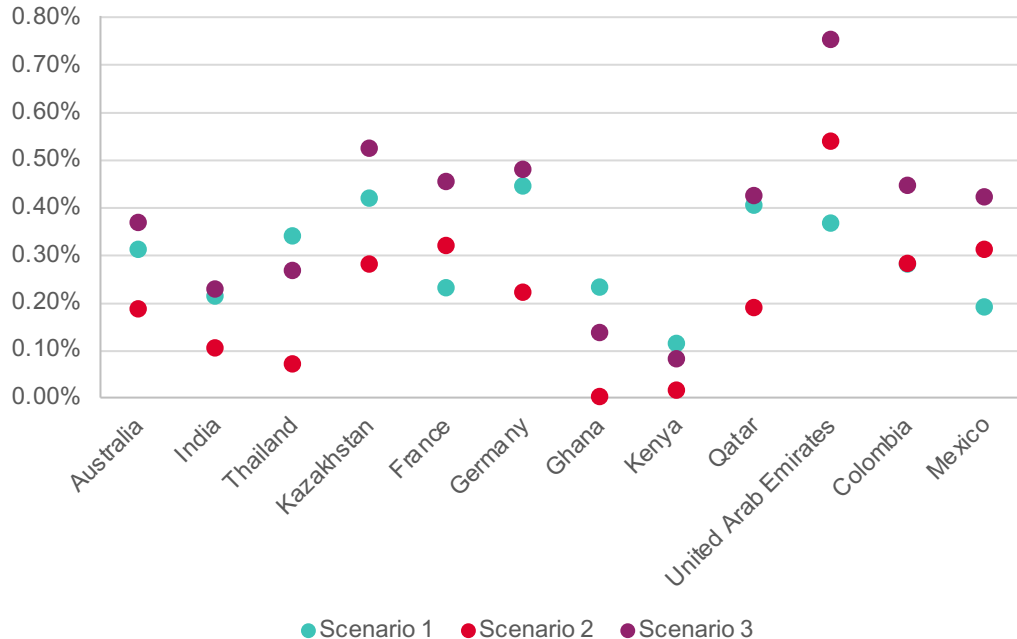


- **Scenario 1** will generally deliver the largest benefits across all countries if fixed broadband technologies do not provide maximum user speeds above 5 Gbps to all users, **AND** if the 60 GHz band is not used by Wi-Fi where available for unlicensed.
- In some cases, **Scenario 3** will deliver the greatest benefit.

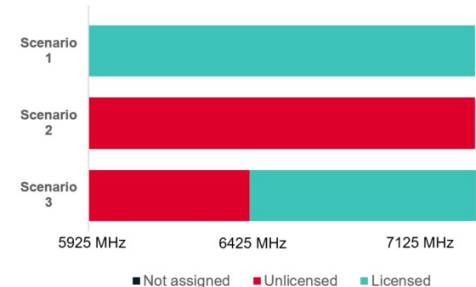


Scenario 3 generally delivers the largest benefits when FTTH/Cable speeds are up to 10 Gbps and when the 60 GHz band is not utilised for Wi-Fi

Economic impact of scenarios (cumulative benefit 2021-2035 - % of GDP in 2035)



- **Scenario 3** will generally deliver the largest benefits across all countries if fixed broadband technologies do not provide maximum available speeds above 10 Gbps, **AND** if the 60 GHz band is not used by Wi-Fi where available for unlicensed.
- In some cases, **Scenario 1** will still deliver the greatest benefit.



3. Conclusions

Conclusions

1

Overall, we find that the optimal assignment policy mainly depends on the expected adoption of 5G and fixed fibre/cable broadband services in each market, along with the speeds that fixed broadband can offer consumers.

2

Scenario 1 (all 6 GHz band assigned to licensed use) will deliver the largest benefits across all countries if fixed broadband technologies do not provide maximum available speeds above 5 Gbps.

3

Scenario 1 will still deliver the largest benefits across most countries if fixed broadband provides maximum use speeds up to 10 Gbps and if a portion of Wi-Fi traffic is offloaded to the 60 GHz band.

4

Scenario 3 (700 MHz assigned to licensed use; 500 MHz assigned to unlicensed used) will deliver the largest benefits if FTTH/B and cable broadband adoption is widespread, they support maximum use speeds of 10 Gbps to all users and the 60 GHz band is not utilised by Wi-Fi.

5

Scenario 2 (all 6 GHz band assigned to unlicensed use) was not found to be the most beneficial allocation in any of the considered analyses.

For further questions, please contact:

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MWC - 6 GHz 5G/IMT Spectrum Forum

Eric Fournier

European harmonisation for RLAN in the 6 GHz

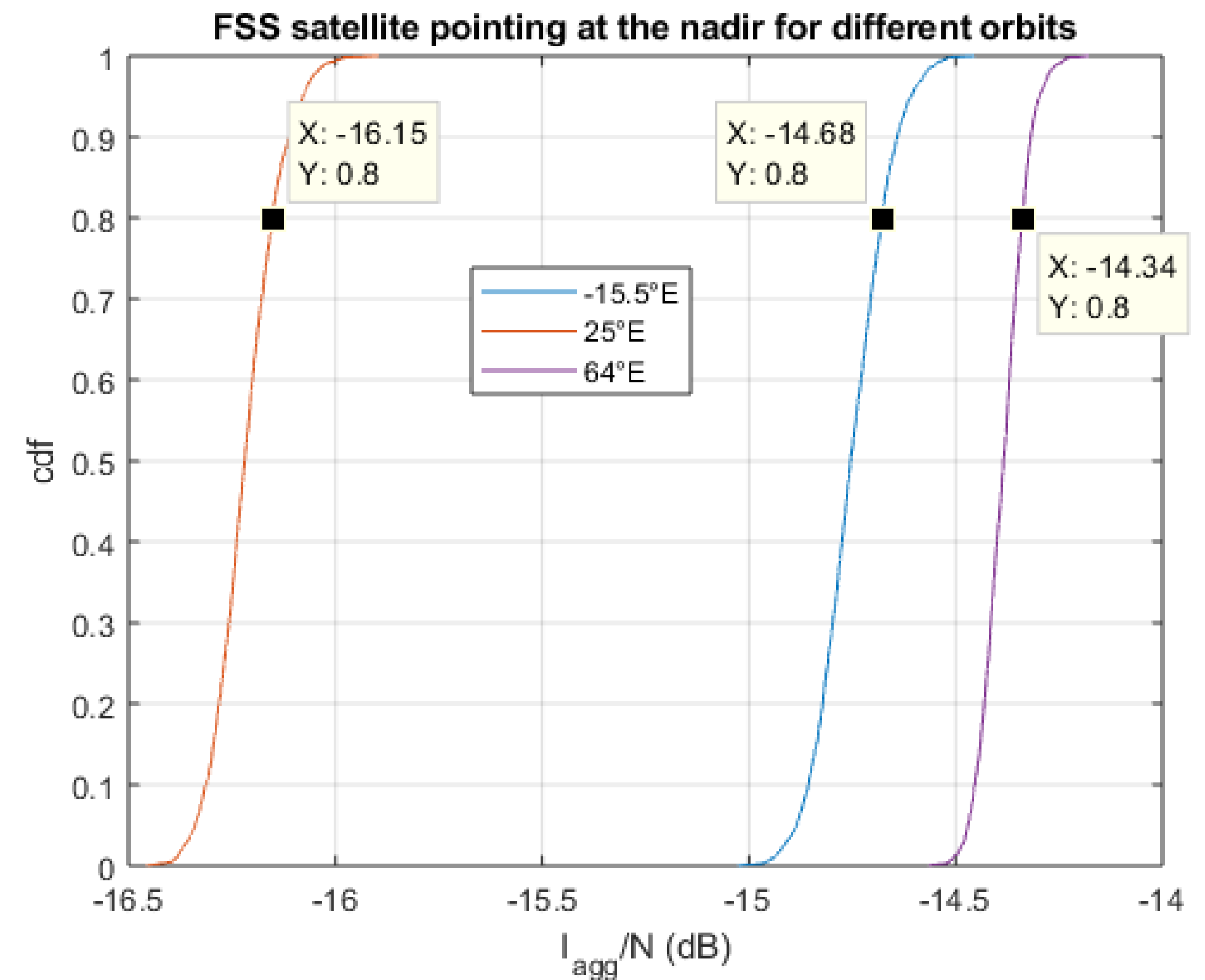
- **Decision (EU) 2021/1067** harmonises 5 945-6 425 MHz frequency band for RLANs
- CEPT initiated studies for the **upper 6 GHz** on possible technical conditions under which RLAN could operate in the band 6425-7125 MHz
 - Target date : May 2024 (after WRC-23)
 - No harmonization measure planned at this stage
- Initial discussion in CEPT (French initiative) to widen the technical conditions in the **lower 6 GHz** to enable **outdoor, 1W/4W RLAN under AFC**
 - Work item expected to be adopted in May 2022
 - **Future opportunities for both RLAN or NR-U deployment** (verticals, local access)

Upper 6 GHz for IMT ?

- WRC-23 Agenda item 1.2 on 6425-7125 MHz in Region 1
- Main issue: **FSS uplink protection**
 - **International obligation** (RR), including AP30B FSS Plan
 - But the **paired downlink bands are not anymore available**
 - 3400-3700 MHz (paired with 6425-6725 MHz) is now 5G/IMT
 - 4500-4800 MHz (paired with 6725-7025 MHz) is not available in Europe
- **Earth Exploration** (sea/ocean surface temperature) without allocation status but needs a solution, maybe with alternative band/allocation
- **Other services**: fixed links, FSS downlink (NGSO Feeder links: few sites) are more « national » issues

FSS uplink protection: technical analysis

- France takes care of **IMT and FSS interests** in this frequency band: « **neutral** » studies
- **Independent simulation** validated with other independent simulations
- Results are showing that the **FSS protection criteria is met**, although the margin is low
- Some worst case (FSS antenna pointing) and best case (antenna characteristics) assumptions are being refined **without changing overall conclusions**



Upper 6 GHz for IMT or RLAN?

- If studies are confirming the possibility of IMT in the upper 6 GHz:
 - Fixed service might be refarmed **at the 2030 horizon**
 - The band would provide a **good solution for large spectrum blocks with good propagation** for 5G extension or 6G launching
 - Bands above 7 GHz could not provide such solution and Europe would be in advance in mobile spectrum access compared to, eg USA
- But there are arguments (**Gigabit society**) for RLAN 320 MHz channels
- What will be WRC-23 decision?
 - Africa and Middle-east are split
 - RCC strongly supporting IMT
- IMT identification would provide opportunity/flexibility for Europe, but final choice between RLAN/IMT would be at a latter point of time

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6 GHz - A Key Resource for 5G Mobile Broadband

Jan-Hendrik Jochum, Deutsche Telekom AG
6GHz 5G/IMT Spectrum Forum
Mobile World Congress, 1 March 2022

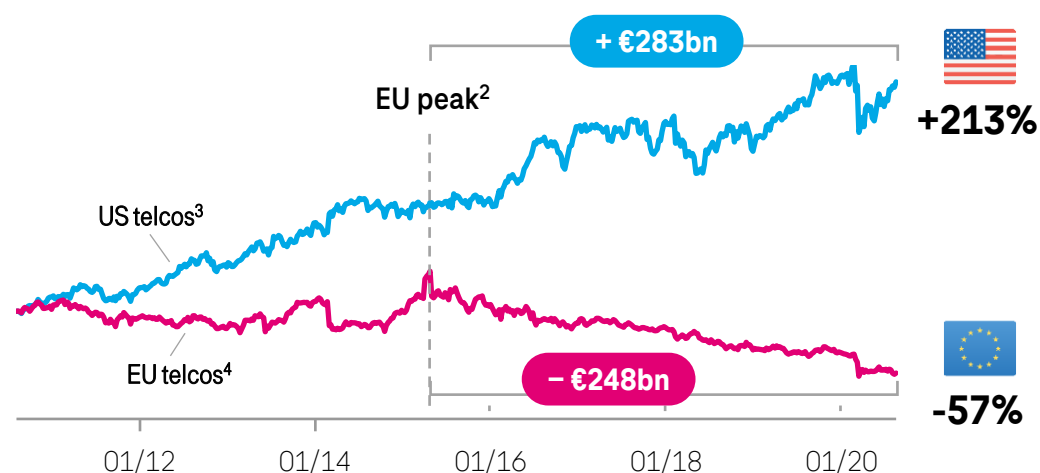


■ ■ ■ LIFE IS FOR SHARING.

Digitization targets vs. European investment challenge

EU and US on different trajectories

Market cap, 2010-2020¹



»» REGULATION

More investment-friendly regulatory environment in the US – no access and price regulation for mobile in the US

»» FRAGMENTATION

Less fragmented market: 3 network operators for >300m people in US vs. >100 MNOs for >400m people in the EU

Source: Capital IQ, Bloomberg, Analysys Mason.

Notes: 1) Market cap from 05.08.2010 til 15.08.2020 (indexed); 2) EU peak 23.04.2015; 3) US telcos: TMUS, Sprint, AT&T, Verizon (VZ), Charter, Altice USA, Comcast; 4) EU Telcos: British Telecom, Liberty Global, Orange, Telefónica, Telecom Italia, Vodafone. 5) McKinsey



5G investment challenges in Europe

Ambitious political targets

All populated areas covered by 5G till 2030 (EU Commission)

BUT

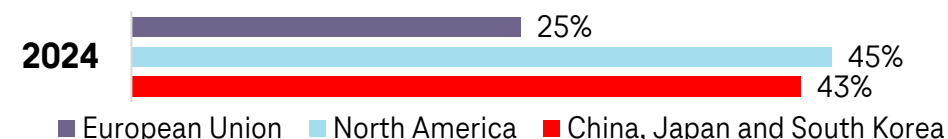
Declining revenues in Europe vs. rising revenues in US

EU: -14% from 2012
US: +46% to 2018⁵

Resulting in an EU 5G investment gap

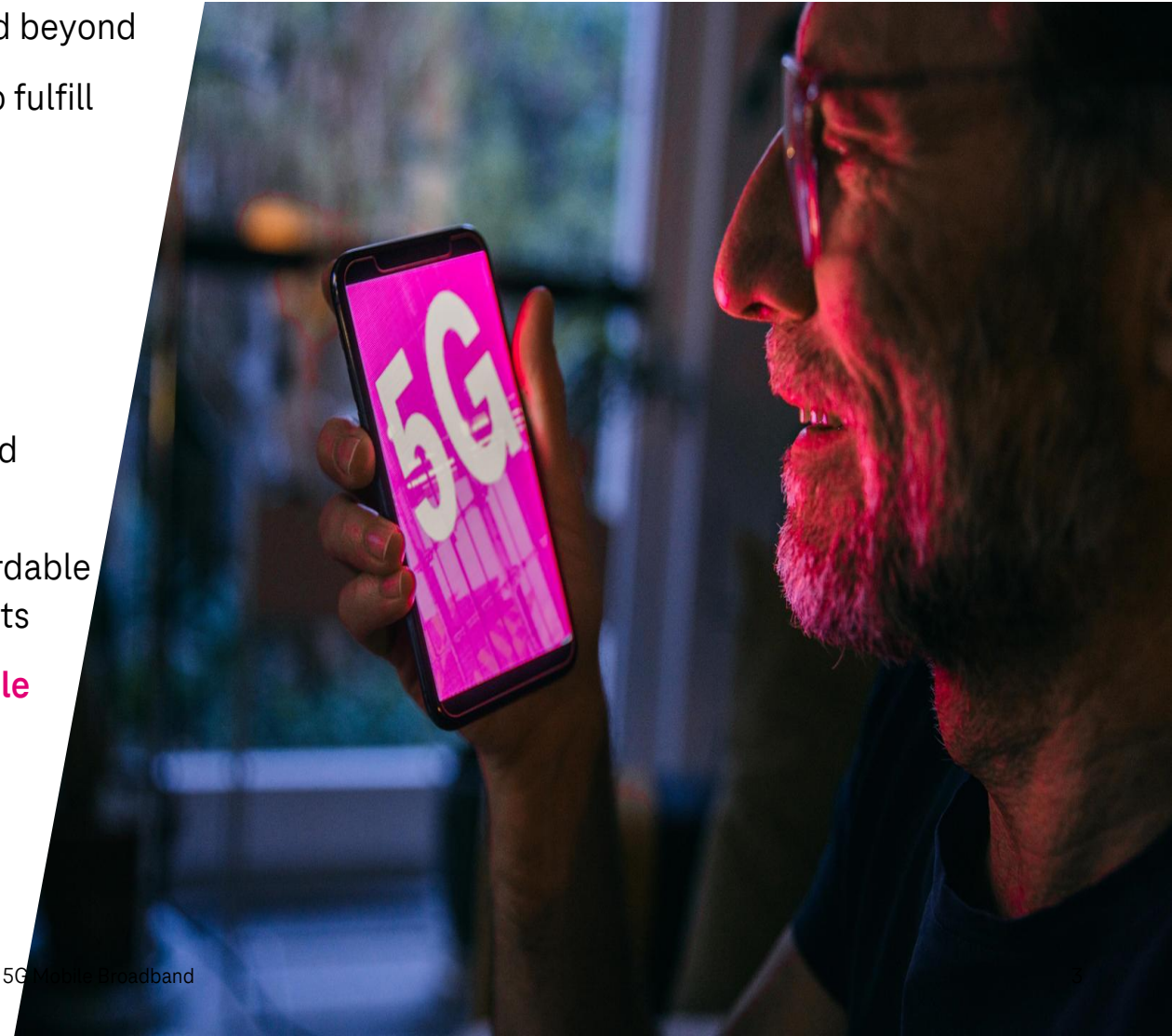
€150bn (BCG)

Leading to lower 5G adoption in Europe



6 GHz is a key resource for 5G mobile broadband

- **Customer data demand** expected to **increase** greatly by 2025 and beyond
- Availability of additional **mid-band spectrum for 5G is essential** to fulfill customer demand in this decade already
- A [study for GSMA](#) clearly shows that **more mid band spectrum is required** to fulfill the IMT-2020 requirements
- **Not all harmonized mobile bands available** in all markets (e.g. 1500 MHz, 2300 MHz)
- **Reservations** for verticals in harmonized bands **create scarcity** and reduce the resource for public 5G services
- Spectrum for balanced coverage and capacity assigned with affordable fees is important for economically sustainable network investments
- In addition to the 3.5 GHz range the **6 GHz band is the only possible mid-band resource** to meet mid-term capacity needs but also to provide wider area coverage. Higher propagation loss compared to 3.5 GHz may be compensated by technology.

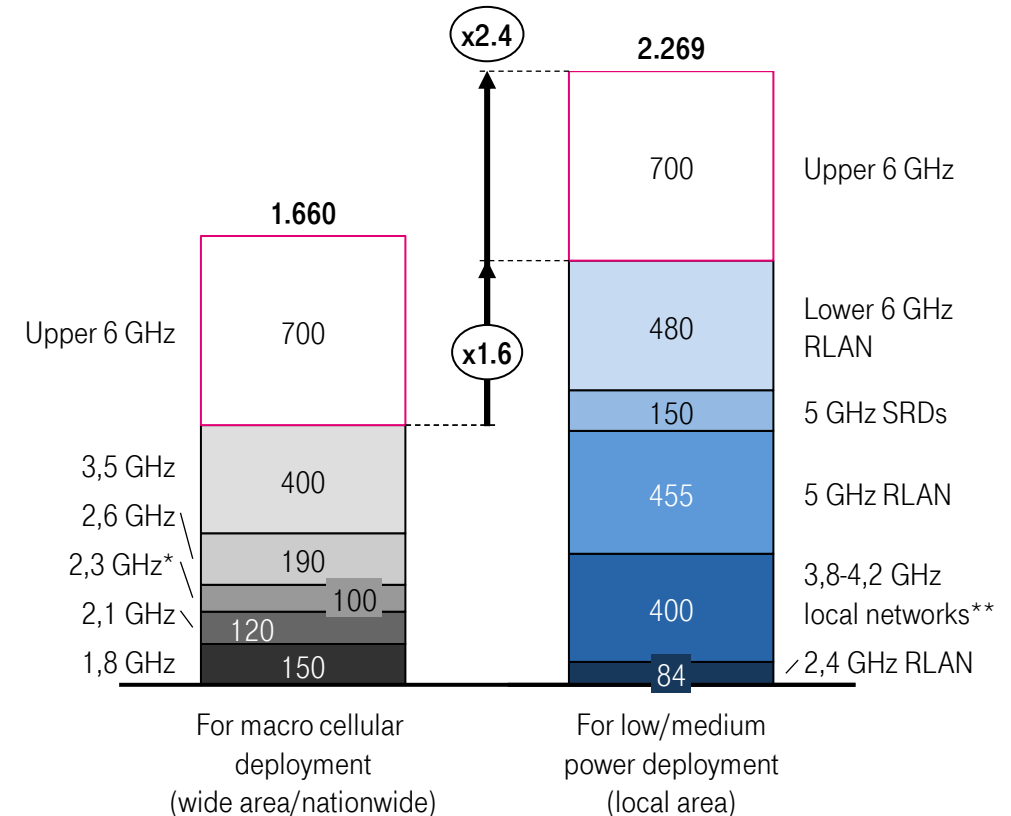


Mid-band spectrum needed for macro cellular 5G deployments - upper 6 GHz is the only possible resource

Mid-band spectrum rationale

- Wide area **mobile networks need more mid-band bandwidth** to address high-capacity, wide area coverage.
- The deployment of macro cellular networks in the upper 6 GHz band is the **only opportunity to support the EU 5G connectivity targets**.
- 6 GHz can perfectly complement the 3.5 GHz** deployment by aligning the cell ranges by technology.
- Other mid-band options** such as 3.8-4.2 GHz are **blocked for macro** due to incumbent use
- Low/medium power cells (such as RLAN, e.g., WiFi) are smaller, thus capturing less users and traffic per cell, not allowing nomadic usage and not contributing to EC's Digital Decade targets.

Wide vs local area mid-band spectrum (MHz)



(*) The band might not become widely available in all Member States

(**) Based on RSC #76 mtg. (Oct. '21)

Implications of not allocating 6 GHz for IMT



Europe's digitization will further fall behind other regions in particular U.S. and China



An allocation of the upper 6 GHz for unlicensed use further **weakens European Telco Industries capability** to deliver VHC networks



Outdoor 5G deployment in Europe will **suffer capacity and thus quality of service**



Spectrum scarcity will **drive spectrum prices**

As consequence, **Mobile operators will not be able to provide the required 5G outdoor capacity** in an economical viable manner

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6 GHz Key to ensure the digital society future

Roberto Rodriguez Dorrego, Telefónica S.A.
6 GHz 5G/IMT Spectrum Forum
Mobile World Congress, 1 March 2022

Telefónica has network deployments in 12 countries

Europe and Latin America

Spain

Germany

United Kingdom (JV VMO2)

Brazil

Latin America:

- Argentina
- Chile
- Colombia
- Ecuador
- Uruguay
- Venezuela



**TOTAL
CUSTOMERS**

345 m

**FTTX HOMES
PASSED**

128 m

**MOBILE
CUSTOMERS**

261 m

Telefonica has fixed and mobile operations

Fixed broadband penetration is limited in many countries. Particularly in Latam, where it hardly reaches 25%.

Fixed broadband speeds today are mostly below 1 Gbps. In Latam, broadband speeds are between 10 Mbps and 100 Mbps. even Germany or UK have still a high percentage below 100 Mbps. Telefonica is deploying fibre in those countries, evolving to fibre speeds up to 1 Gbps.

WiFi services rely on fixed broadband connections. WiFi speeds are limited by the connection, wider channels and technology upgrades have to keep pace with fixed network upgrades

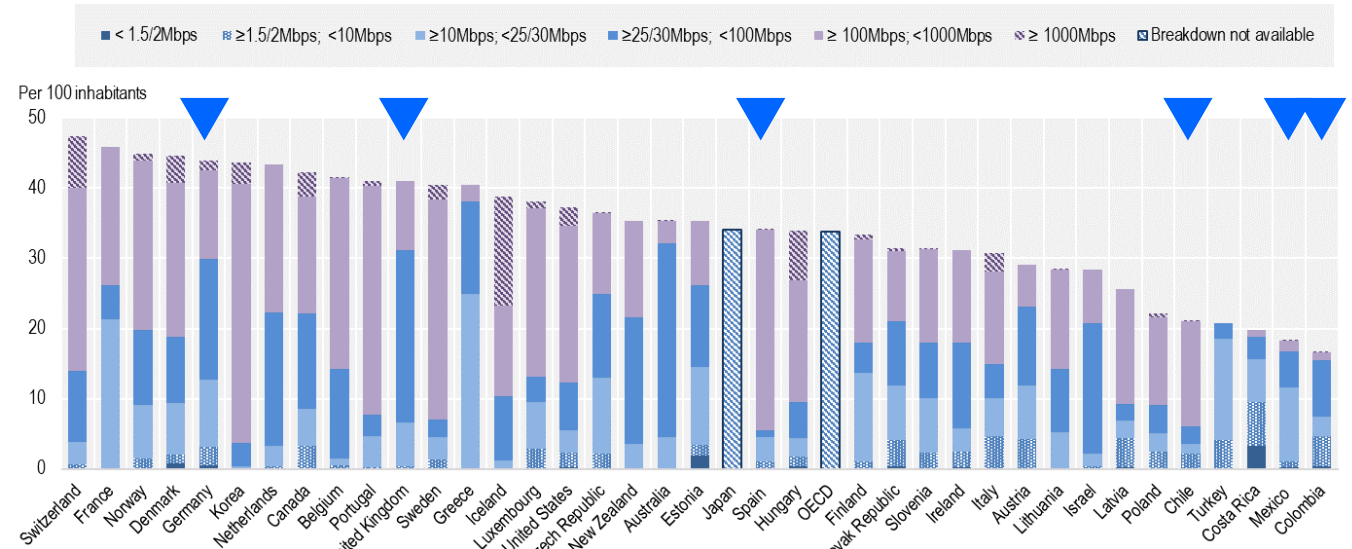
Limited power and localised indoor usage allows for a high frequency reuse and diminishes WiFi spectrum needs, while public mobile networks serving wide areas need more spectrum

Mobile penetration is much higher becoming the main means of broadband connection in many countries

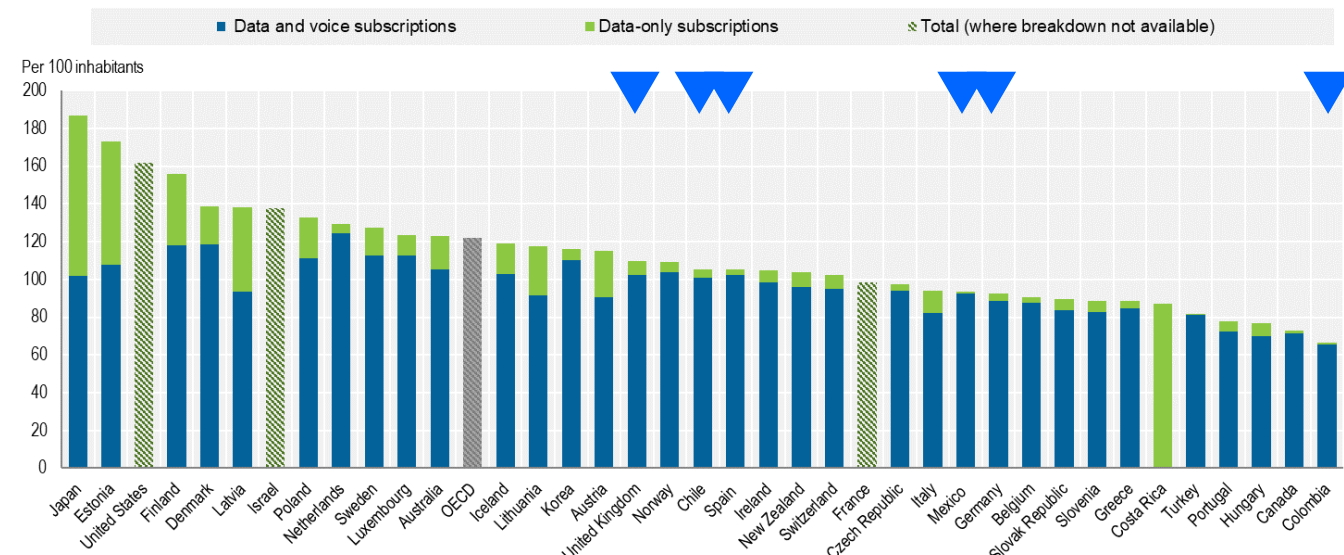
Even for advanced fixed broadband countries, like Spain, and the expected evolution, allocating 500 MHz lower 6 GHz band to unlicensed (WiFi) is enough to ensure high quality home services

Furthermore, when no fixed broadband connection is available, WiFi will be on-loading 5G networks with extra traffic

60 GHz band spectrum would be available for further WiFi capacity



Fixed broadband subscriptions per 100 inhabitants, per speed tiers, OECD June 2021



Mobile broadband subscriptions per 100 inhabitants, by technology, OECD June 2021

6 GHz spectrum is the only foreseeable opportunity to ensure the continued support of 5G services quality in the mid-term

Mobile traffic demand keeps growing, doubling every two years, and innovative services like AR/VR would add to the growth rate in the future fueled by 5G capabilities

Additional mid-band spectrum would become critical in the mid-term to keep 5G services quality up to the citizen's expectations. Mid-band spectrum provides high capacity in a wide area coverage. Coleago report on spectrum needs points out to a need of additional 1 to 2 GHz in mid-bands

Allocating 6 GHz upper 700 MHz to licensed 5G services produces the highest benefits for society in all cases. GSMA report on the "Socioeconomic benefits of the 6 GHz band" considering unlicensed and licensed options concludes that a balanced approach in the band, dedicating the lower 500 MHz to unlicensed services and the upper 700 MHz to licensed 5G services, produces the highest benefits to society. In some scenarios, the optimal solution is to allocate the 1200 MHz to licensed 5G

6 GHz band is the only real possibility for significant additional mid-band spectrum for 5G services (700 MHz) towards 2030. 6 GHz identification for IMT at WRC-23 is key to ensure availability when needed

A lack of sufficient 6 GHz spectrum, assigned timely with affordable fees, will lead to 5G network capacity limitations in main cities in the mid-term, and would endanger economically sustainable network investments

Telefonica urge administrations to ensure the upper band (6425 to 7125 MHz) will be available for public mobile networks towards 2030 to enable the digital society future



Telefónica

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NOKIA

6GHz fueling the 5G-Advanced* World

*5G-Advanced World : 5G and its evolution

A vendor's perspective

Ulrich Dropmann, Head of Standardization and Industry Environment, Nokia

MWC22, March 1st, 2022, Barcelona

6GHz 5G/IMT Spectrum Forum

6GHz and 5G-Advanced : Growth engine of 2nd half of this decade



2GHz of mid-bands for 5G and 5G-Advanced needed
Products 2025
Standard 2023/2024



Mobile primary allocation globally
3GPP Band
Existing (C-Band) BS-Grid
WRC-23 opportunity
Licenses from 2024/2025
700MHz bandwidth



Facts and figures for 6 GHz

Global support

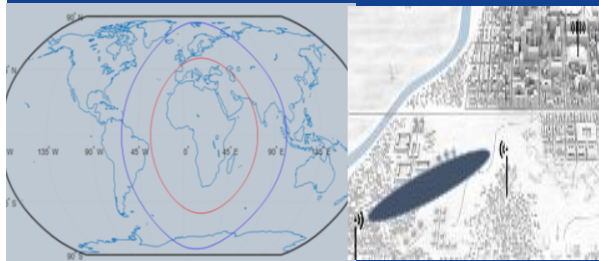
6425-7125 MHz
completed June 22



Coexistence with
Satellite/Fixed links to be
finalized in ITU 12/22:

-> good **protection
margin**

-> opportunities for
spectrum sharing



In countries of need,
additional 500MHz@L6GHz
sufficient for Wi-Fi growth
Home / Office

RLAN should also rely on
60GHz



Re-use existing C-Band
macro-cell grid

High capacity citywide /
urban and suburban
coverage

2025 onward



NOKIA



6GHz fueling a 5G-Advanced World, 6GHz 5G/IMT Spectrum Forum, March 1st, 2022, Barcelona -
Dropmann, Nokia - Public

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