# 6GHZ IMT OPPORTUNITY FOR SOCIETY

## The mid-bands spectrum needs in Europe and the 6GHz band opportunity (6425-7125MHz)

WEBINAR | 18 JANUARY 2021 | 10:00-12:00 CET

Hosted by

ERICSSON GSMA HUAWEI NOKIA ZTE

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The mid-bands spectrum needs in Europe and the 6GHz band opportunity (6425-7125MHz)

WEBINAR

18 JANUARY 2021 | 10:00-12:00 CET

# WELCOME

The deployment of 5G will bring large benefits to mobile services and users over the coming years. Allocating spectrum in the 6425–7125MHz band for 5G-NR and its evolution is a critical building block making it economically feasible to offer 5G services at a price point that is affordable to all income groups.

Starting with the existing trends and anticipating further evolution in the longer term, this webinar on the topic elaborates on the importance of making more spectrum available for IMT as an essential means to achieve the 5G vision in developed and developing markets. It considers the fact that the 6GHz mid-band spectrum represents a very strong candidate band for this purpose.

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The mid-bands spectrum needs in Europe and the 6GHz band opportunity (6425-7125MHz)

WEBINAR

18 JANUARY 2021 | 10:00-12:00 CET

# Webinar **Agenda**

## Moderator

Alessandro Casagni
*Director, Wireless Regulatory Policy EMEA, Huawei*

## 10:00 - Keynote Introduction

Stefan Zehle
*Co-Founder & CEO, Coleago Consulting*

Glyn Carter
*Senior Spectrum Advisor, GSMA*

## 10:30 - Regulators corner

Baxton Sirewu
*Director Technical Services Engineer, Post and Telecommunications Regulator (POTRAZ), Zimbabwe*

Chris Woolford
*Director of International Spectrum Policy Ofcom, United Kingdom*

Sergey Rudko
*RCC Co-Coordinator on AI 1.2 and AI 1.3 of WRC-23*

Jan Engelberg
*Senior Advisor, Finnish Transport and Communications Agency Traficom. Finland*

Prof. Antonio Sassano
*Chairman of Fondazione Ugo Bordoni, Italy*

Šarūnas Oberauskas
*Advisor of Spectrum Engineering Division, Communications Regulatory Authority (RRT), Lithuania*

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## 11:00 - Industry corner

Maarit Palovirta
*Director, Regulatory Affairs, ETNO*

Eiman Mohyeldin
*Senior Specialist Spectrum Regulation, Nokia (on behalf of co-hosting vendors)*

Glyn Carter
*Senior Spectrum Advisor, GSMA*

## 11:20 - Views from audience and Q&A

## 11:55 - Wrap-up

(Moderator) Alessandro Casagni
*Director, Wireless Regulatory Policy EMEA, Huawei*

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# KEYNOTE PRESENTATION

**Stefan Zehle**
Co-Founder & CEO
Coleago Consulting

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January 2021

# Demand for IMT spectrum in the 2025-2030 timeframe

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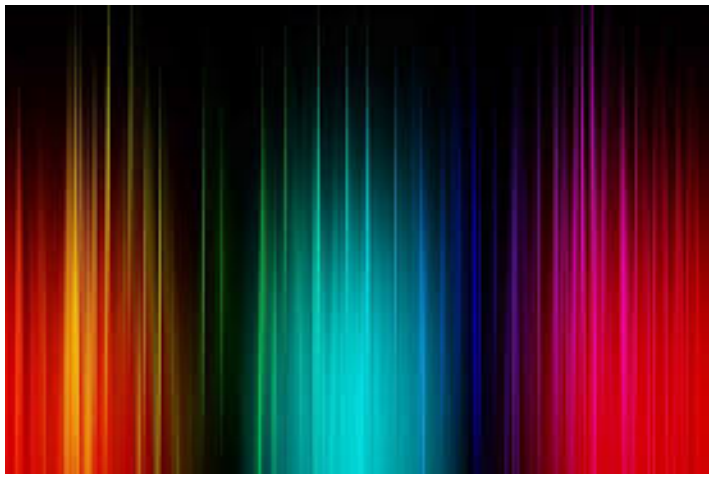
# Agenda

1. Examining the need for IMT spectrum to realise the 5G vision
2. Demand for spectrum in eleven cities
3. Cost saving from additional mid-band spectrum to achieve the EU 100 Mbit/s connectivity target

# Examining the need for IMT spectrum to realise the 5G vision

- The deployment of 5G will bring large benefits to **mobile services** and users over the coming years.
- We examine whether there is a **need for more spectrum for IMT to achieve the 5G vision**.
- Specifically we examine the mobile operators' demand of additional **mid-band spectrum up to 7GHz:**
  - The Report provides an estimate for the **mobile operators' future need for additional spectrum to meet the IMT-2020 requirements in their outdoor base station networks** and serve the various 5G use cases.
  - The Report also provides an **estimate for the cost savings associated with the use of FWA instead of FTTH to bring 100 Mbit/s connectivity to rural households** when additional mid-bands spectrum is made available.



# 5G is not simply a continuation of the mobile business as we know it

**Extremely high data rates, very high traffic volumes, high traffic density, rapid mobility, city wide coverage**

**Enhanced Mobile Broadband**
Smartphone, 8k 250fps video, AR/VR, cloud based gaming, venues, body cams

**Fibre like data rates, extremely high traffic volumes**

**Fixed Wireless Access**
Home, business, retail, nomadic, cameras

**Very large number of devices, very low device cost, low energy, high density, country wide coverage**

**Massive Machine Type Communications**
Sensors, meters, tracking, fleet management

**Very low latency, very high availability and reliability**

**Critical Machine Type Communications**
Self-driving car, industrial applications, manufacturing

**The 5G vision is for a ubiquitous fibre-like user experience** and connectivity for a wide range of new uses coupled with new features, such as:

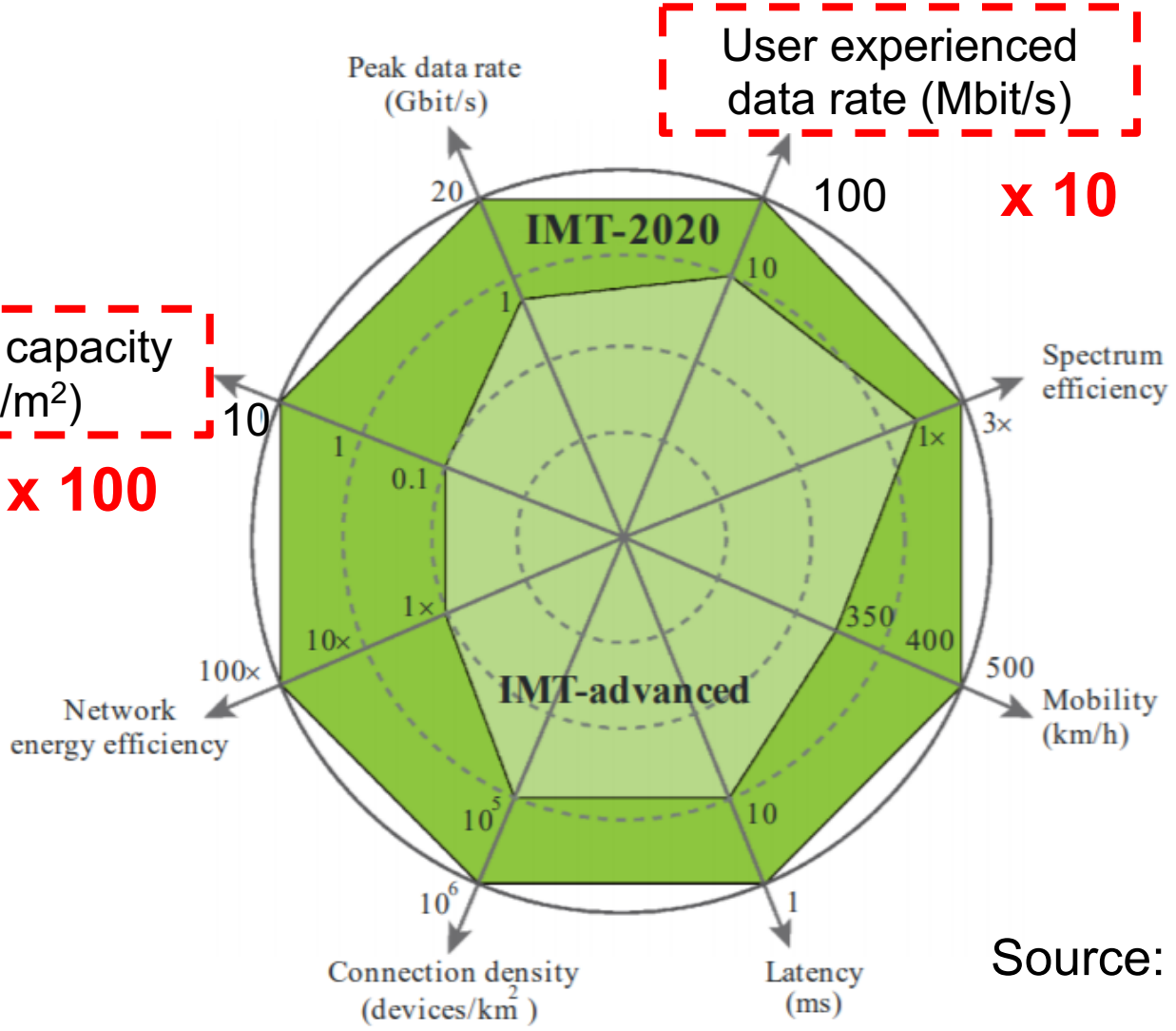
- an expectation of a near guaranteed data rate, seamless,
- low latency communication,
- smart city and other IoT,
- self-driving vehicles,
- network slicing

# IMT 2020 requirements drive the need for spectrum

While several of 5G capabilities are inherent in 5G technology, to ensure a consistently high **user experienced data rate** and a high **area traffic capacity** more spectrum is required.

***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".***

## Enhancement of key capabilities from IMT-Advanced to IMT-2020




Source: ITU

# Spectrum need is driven by the bandwidth required to deliver a near guaranteed fibre like experience rather than traffic volume – Mbit/s rather than Gbytes

Sub-1GHz band 700-900 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**

# Agenda

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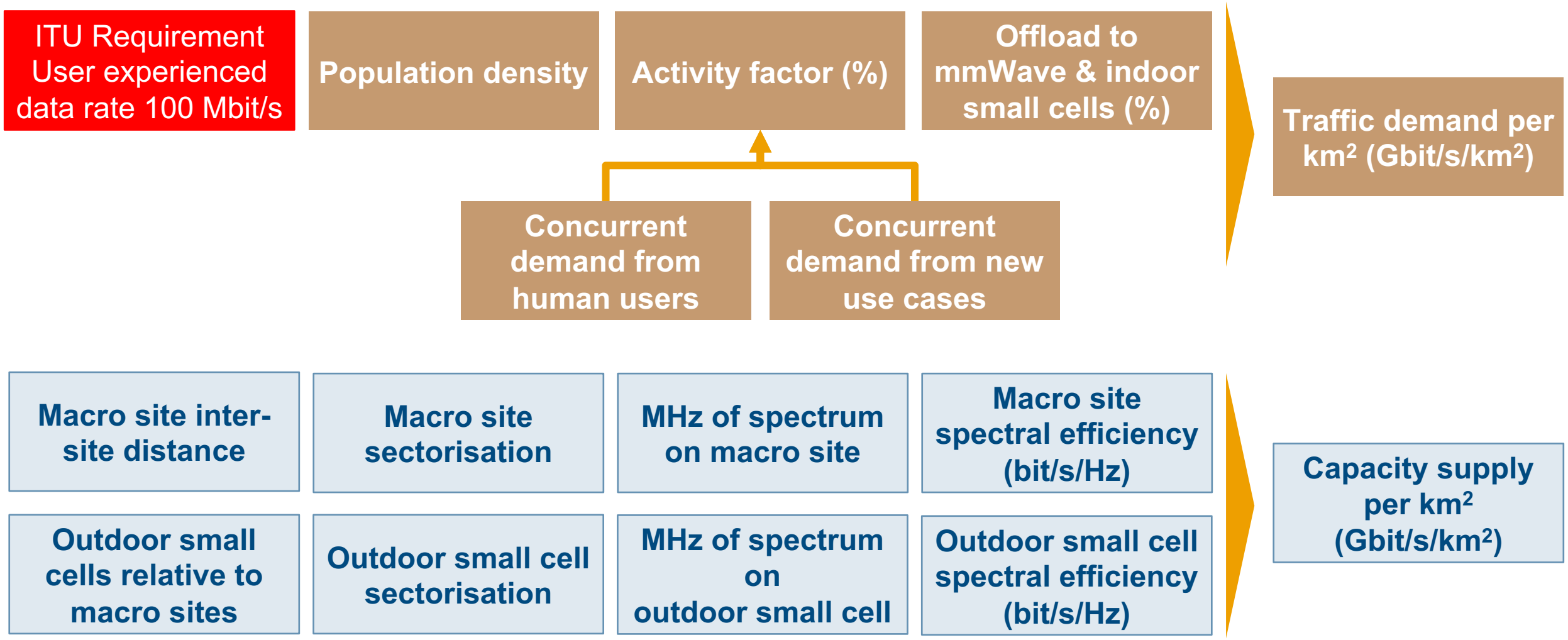
2. Demand for spectrum in eleven cities
3. Cost saving from additional mid-band spectrum to achieve the EU 100 Mbit/s connectivity target

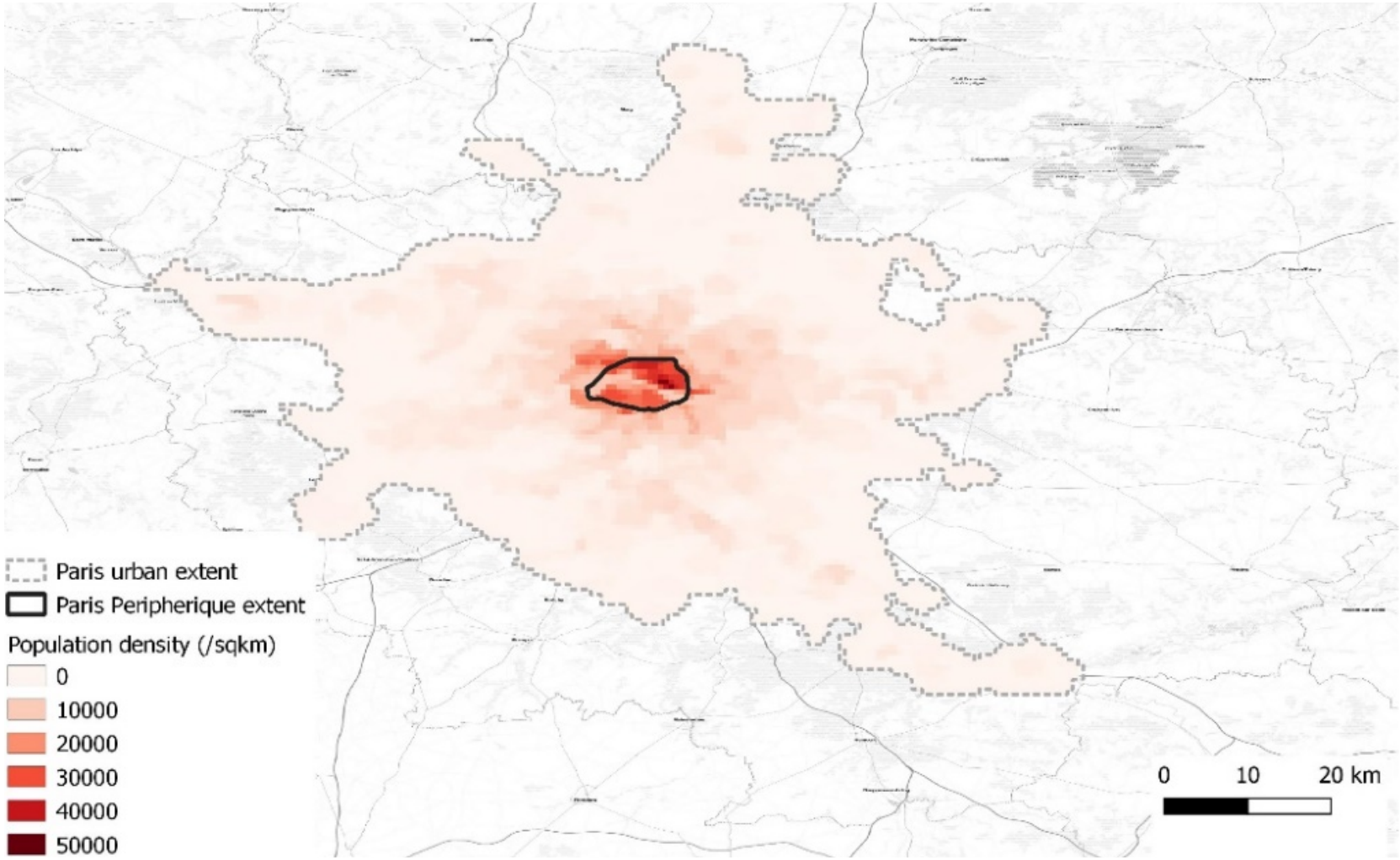
# The required 100 Mbit/s DL and 50 Mbit/s UL user experienced data rate is the key driver to assess the need for additional mid-band spectrum



# Identifying the high density area, example Paris

Population density

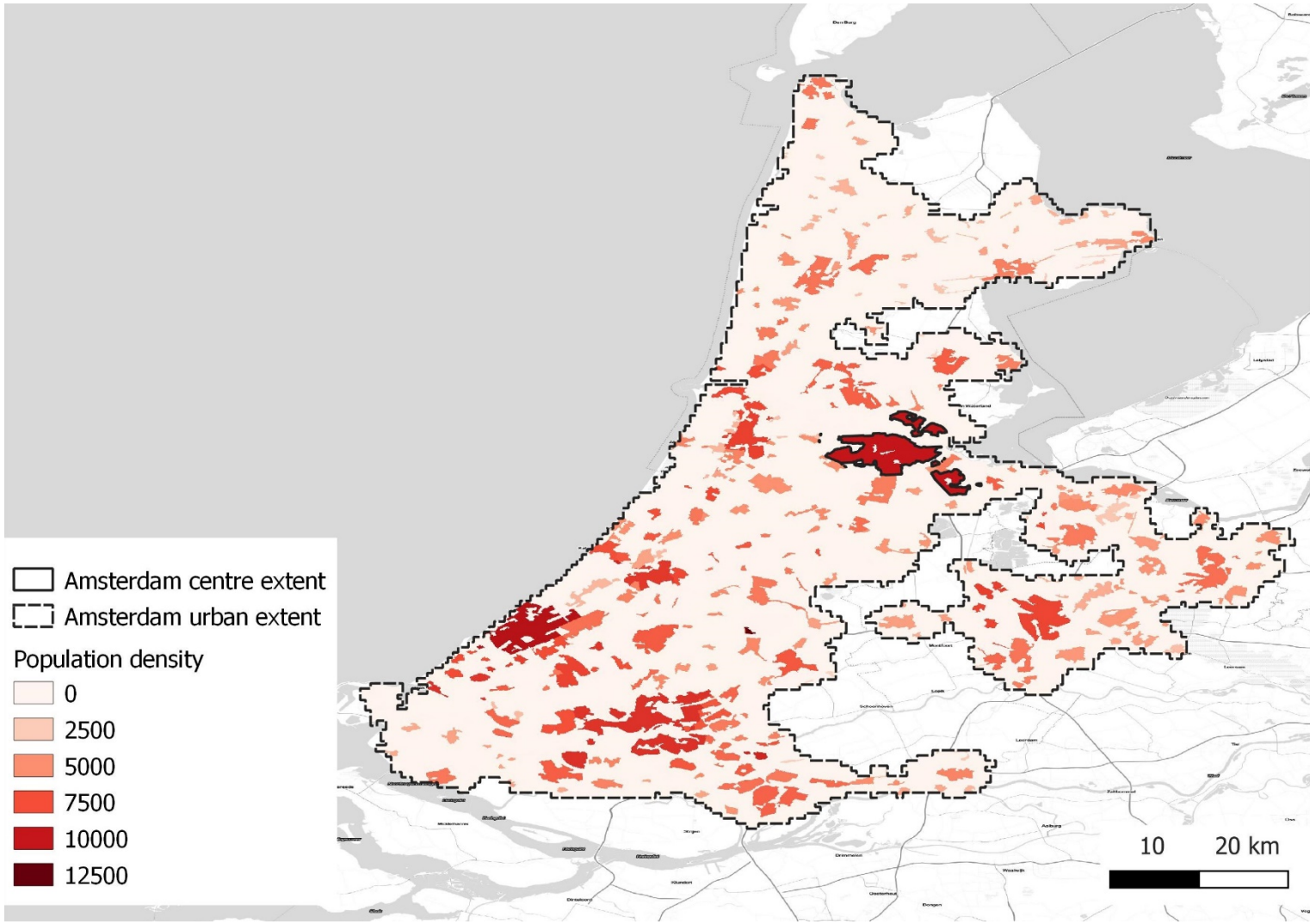
- A contour of 17,500 people/km$^2$ has been used to identify the central region.
- The central region, which corresponds to the area inside the Boulevard Périphérique. represent an area of 85.3 km$^2$ with an average population density of 25,018 people/km$^2$, i.e. a population of 2.1 million in the identified areas.



# Identifying the high density area, example Amsterdam – The Hague Area

Population density

- A contour of 7,500 people/km$^2$ has been used to identify the high density areas of Amsterdam – The Hague region with several distinct high population density areas.
- These high density areas aggregate to an area of 72.3 km$^2$ with an average population density of 9,788 people/km$^2$ with a population of circa 0.7 million.



# Population density in high density urban areas in Europe

| City / Urban Area | High density area ($km^2$) | Population in high density area | Population density in high density area ($pop/km^2$) |
|---|---|---|---|
| Paris | 85.3 | 2,134,035 | 25,018 |
| Lyon | 72.6 | 769,242 | 10,595 |
| Marseille | 43.2 | 390,489 | 9,035 |
| Berlin | 85.6 | 1,191,421 | 13,917 |
| Hamburg | 23.6 | 304,065 | 12,884 |
| Munich | 47.2 | 517,045 | 10,952 |
| Rome | 68.6 | 1,086,670 | 15,839 |
| Milan | 61.9 | 942,746 | 15,226 |
| Madrid | 113.1 | 2,741,249 | 24,246 |
| Barcelona | 110.0 | 2,030,121 | 18,456 |
| Amsterdam – The Hague | 72.3 | 707,220 | 9,788 |

# The activity factor represents concurrent demand in a cell by human users and new uses



## Concurrent demand for 100 Mbit/s

- Not all users would require 100 Mbit/s at the same time. We need an assumption with regards to the concurrent or simultaneous demand for capacity during the busy period.
- In our model this is captured in the form of an “activity factor” to represent concurrent use in a cell
  - from human users with smartphones and
  - other devices, and new use cases such as connected cars, sensors, and cameras.

## Using population density as a proxy

- It is reasonable to use population density as a proxy for demand from human users with smartphones and other devices as well as new use cases because many new use cases occur where people are.
- Traffic from new use cases occurs in additional to traffic generated by human users. In other words it adds to the human activity factor.

# The activity factor will increase: As usage increases, so will concurrent use



## Smartphone usage is heading towards fixed usage

- In Finland average monthly mobile data usage per Finn is already 34 Gbytes and growing.
  Source: Traficom, Finish Transport and Communications Agency, 2.11.2019
- Looking specifically at 5G users in South Korea, monthly data usage is three times higher than 4G usage. Source MITC, Dec 2019
  - This is driven by the fact that the majority of 5G plans offer unlimited data usage and do not throttle speed above a certain limit, as is the case in fixed broadband networks.

## Increased use means people are using more data for longer periods

- The higher the usage, the more concurrent use there will be. This is evident from FTTH, xDSL, and cable broadband which have a busy period lasting several hours rather than the peaky traffic pattern associated with today's mobile use.
- Unlimited data plans are becoming common for 5G mobile.
  - This translates into a higher activity factor for human users, i.e. more people use their devices in the same period in the same cell.
- The activity factor for human users is anticipated to reach 20%.

# High-bands and indoor small cells absorb some of the concurrent bandwidth demand



## Depending on the city 10% to 30% of demand may be served by high-bands (mmWave)

- In very high density traffic areas, high bands will be used to deliver the required area traffic capacity of 10Mbit/s/$m^2$.
- In those areas, high bands sites will carry some of the traffic and this will reduce traffic demanded from sites with mid-bands.

## We assume 10% of traffic will be offloaded to indoor upper mid-band small cells

- In some locations upper mind-bands small cells are expected to be installed indoors to provide speed coverage.
- We assume that 10% traffic will be offloaded to upper mid-band indoor cells.

# Variables in the area traffic capacity (supply) side calculation of the model

Supply Side

| Band | Category | Average Inter-Site Distance (m) | No. of sectors | Aver. DL / UL spectral efficiency (bit/s/Hz) | Baseline spectrum available |
|---|---|---|---|---|---|
| 700, 800, 900 | Macro site; Low bands | 400 | 3 | 1.8 / 1.8 | 190 MHz |
| 1800, 2100, 2600 | Macro site; Lower mid-bands | 400 | 3 | 2.2 / 2.5 | 460 MHz |
| 3500 | Macro site; Upper mid-bands | 400 | 3 | 6.0 / 4.1 | 400 MHz |
| Additional mid-bands | Macro site; Mid-bands | 400 | 3 | 6.0 / 4.1 | Spectrum demand model output |
| 3500 | Small cell; Upper mid-bands | n/a* | 1 | 3.7 / 2.6 | 400 MHz |
| Additional mid-bands | Small cell; Mid-bands | n/a* | 1 | 3.7 / 2.6 | Spectrum demand model output |

* For small cells this does not assume contiguous coverage because small cells are deployed to fill in speed coverage holes rather than providing contiguous coverage. Hence the inter-site distance is irrelevant.

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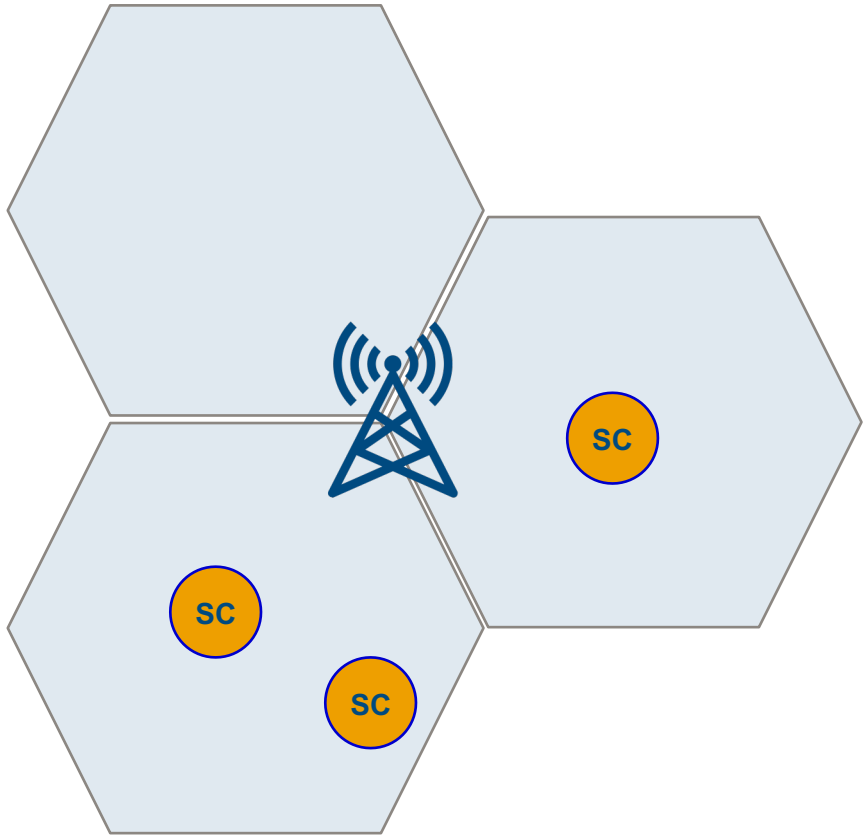
# Outdoor small cells



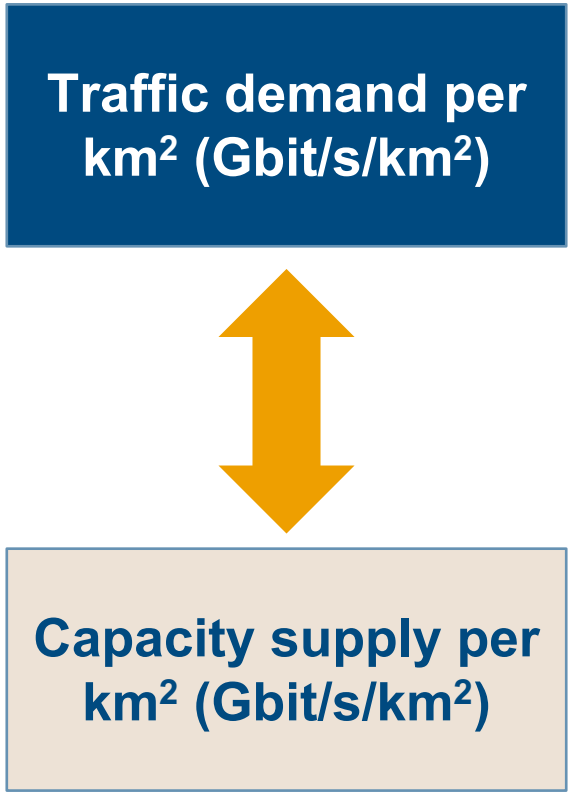
- Outdoor small cells will not provide contiguous coverage but will be deployed to fill in “speed coverage holes” using upper-mid band spectrum.
- These speed coverage holes are locations where, for example due to blockage by buildings, upper mid-bands used at macro sites do not provide coverage.
- Outdoor small cells provide consistency of area traffic capacity by in-filling any speed coverage holes at the macro layer.
- We assumed for typical city a ratio of three outdoor small cells per macro site.



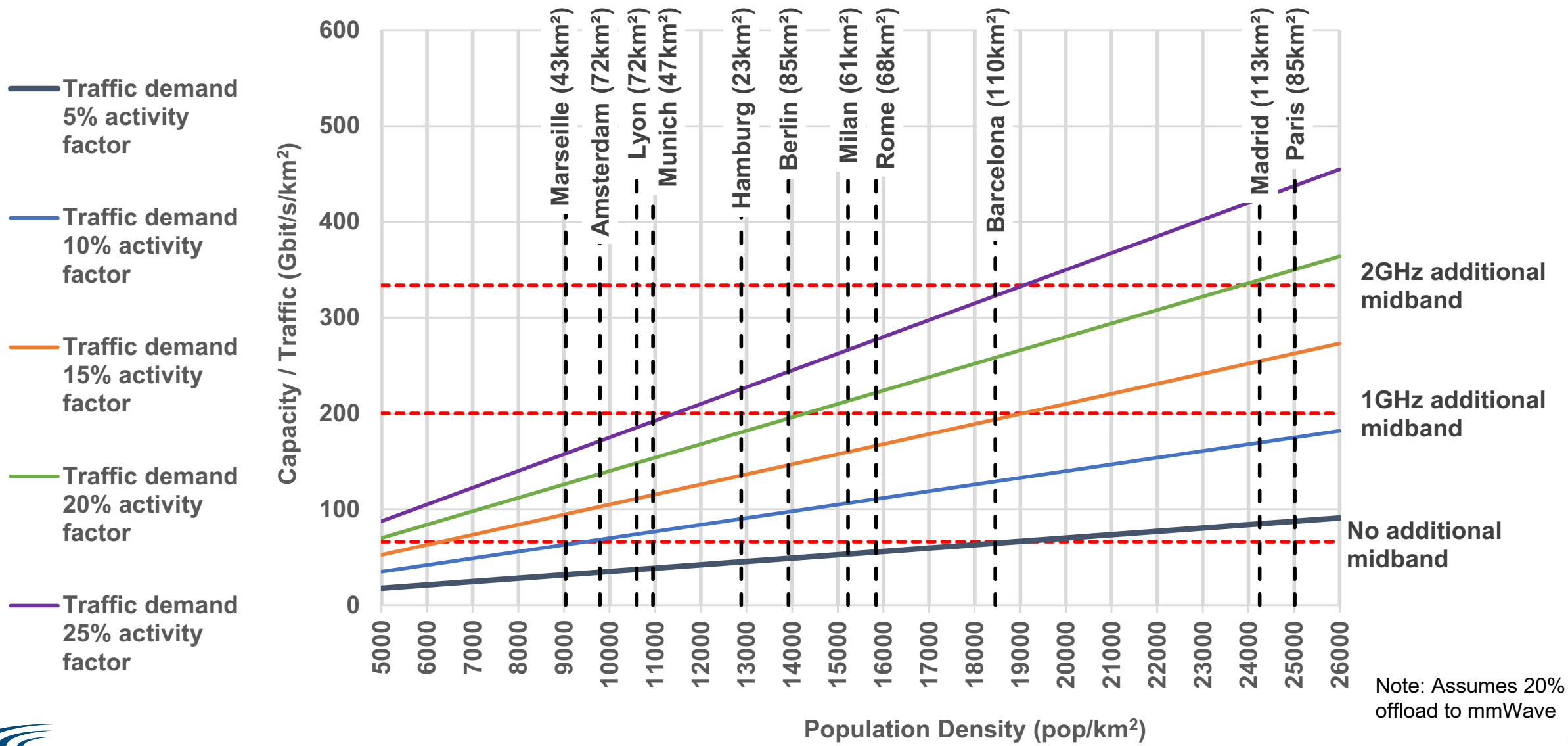
# Demand for area traffic density and supply of area traffic capacity cities

## To illustrate the output, we have applied the model to 11 cities

- We look at a situation in the 2025-2030 time frame when 5G will be mature.
- We assume all the available spectrum is used across all available sites.
  - This removes issues around differences in numbers of mobile operators, co-location, and the amount of spectrum held by individual operators.



# Area traffic capacity vs. demand and spectrum need




Note: Assumes 20% offload to mmWave

# Additional mid-bands spectrum need (MHz) to meet DL requirement

| City | Activity factor 10% | | | Activity factor 15% | | | Activity factor 20% | | | Activity factor 25% | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | High bands offload | | | High bands offload | | | High bands offload | | | High bands offload | | |
| | 30% | 20% | 10% | 30% | 20% | 10% | 30% | 20% | 10% | 30% | 20% | 10% |
| Paris | 620 | 810 | 1000 | 1180 | 1460 | 1740 | 1740 | 2120 | 2490 | 2310 | 2770 | 3240 |
| Lyon | 0 | 50 | 130 | 210 | 330 | 450 | 450 | 610 | 770 | 690 | 890 | 1080 |
| Marseille | 0 | 0 | 40 | 110 | 210 | 310 | 310 | 440 | 580 | 510 | 680 | 850 |
| Berlin | 120 | 230 | 330 | 440 | 590 | 750 | 750 | 960 | 1160 | 1060 | 1320 | 1580 |
| Hamburg | 80 | 170 | 270 | 370 | 510 | 660 | 660 | 850 | 1040 | 940 | 1190 | 1430 |
| Munich | 0 | 70 | 150 | 240 | 360 | 480 | 480 | 650 | 810 | 730 | 930 | 1140 |
| Rome | 210 | 330 | 450 | 560 | 740 | 920 | 920 | 1160 | 1390 | 1280 | 1570 | 1870 |
| Milan | 180 | 300 | 410 | 520 | 690 | 870 | 870 | 1090 | 1320 | 1210 | 1490 | 1780 |
| Madrid | 590 | 770 | 950 | 1130 | 1400 | 1680 | 1680 | 2040 | 2400 | 2220 | 2670 | 3130 |
| Barcelona | 330 | 460 | 600 | 740 | 950 | 1160 | 1160 | 1430 | 1710 | 1570 | 1920 | 2260 |
| Amsterdam | 0 | 10 | 80 | 160 | 270 | 380 | 380 | 520 | 670 | 600 | 780 | 960 |

| Spectrum need | < 10 MHz | 10 to 500 MHz | 500 - 1000 MHz | 1000-2000 MHz | > 2000 MHz |
|---|---|---|---|---|---|

Note: Figures are rounded down to the nearest 10 MHz

# Fulfilling the 50 Mbit/s uplink requirement

## The 50 Mbit/s uplink requirement

- We also examined the impact of fulfilling the 50 Mbit/s uplink requirement defined by the ITU-R using the same methodology as for the downlink.
- The growing uplink requirements, notably from applications other than smartphones, drives additional spectrum requirements.


## DL to UL ratio in TDD spectrum

- There is some uncertainty over how the DL:UL ratio may change over time. For example, some applications such as cameras will be UL only.
- In the longer term the total DL and UL area traffic demand must be served using additional upper mid-band spectrum and adjusting the DL:UL split in synchronised TDD bands proportionate to relative demand.

# Additional mid-bands spectrum need (MHz) to meet combined DL and UL requirement

| City | Activity factor 10% | | | Activity factor 15% | | | Activity factor 20% | | | Activity factor 25% | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | High bands offload | | | High bands offload | | | High bands offload | | | High bands offload | | |
| | 30% | 20% | 10% | 30% | 20% | 10% | 30% | 20% | 10% | 30% | 20% | 10% |
| Paris | 870 | 1110 | 1350 | 1590 | 1960 | 2320 | 2320 | 2800 | 3290 | 3040 | 3650 | 4250 |
| Lyon | 50 | 130 | 240 | 340 | 490 | 640 | 640 | 850 | 1050 | 950 | 1210 | 1460 |
| Marseille | 10 | 40 | 110 | 200 | 330 | 460 | 460 | 640 | 810 | 730 | 940 | 1160 |
| Berlin | 220 | 360 | 490 | 630 | 830 | 1030 | 1030 | 1300 | 1570 | 1430 | 1770 | 2110 |
| Hamburg | 160 | 290 | 410 | 540 | 720 | 910 | 910 | 1160 | 1410 | 1280 | 1600 | 1910 |
| Munich | 50 | 160 | 260 | 370 | 530 | 690 | 690 | 900 | 1110 | 1000 | 1270 | 1530 |
| Rome | 330 | 490 | 640 | 790 | 1020 | 1250 | 1250 | 1560 | 1870 | 1710 | 2100 | 2480 |
| Milan | 300 | 450 | 590 | 740 | 960 | 1180 | 1180 | 1480 | 1770 | 1620 | 1990 | 2360 |
| Madrid | 820 | 1060 | 1290 | 1530 | 1880 | 2230 | 2230 | 2700 | 3170 | 2930 | 3520 | 4100 |
| Barcelona | 490 | 660 | 840 | 1020 | 1290 | 1560 | 1560 | 1910 | 2270 | 2090 | 2540 | 2980 |
| Amsterdam | 30 | 80 | 170 | 270 | 410 | 550 | 550 | 740 | 930 | 840 | 1070 | 1310 |

| Spectrum need | < 10 MHz | 10 to 500 MHz | 500 - 1000 MHz | 1000-2000 MHz | > 2000 MHz |
|---|---|---|---|---|---|

Note: Figures are rounded down to the nearest 10 MHz

# A reasonableness check

## City average area traffic density

- In most cities in our sample with a 20% activity factor this results in area traffic density is less 300 Gbit/s/km$^2$ or
- Let's compare this to the ITU-R IMT-2020 area traffic requirement of 10 Mbit/s/m$^2$ translating it into Gbit/s/km$^2$.
  - Multiply by 1,000,000 to get from m$^2$ to km$^2$ and divide by 1,000 to get from Mbit/s to Gbit/s gives 10,000 Gbit/s/m$^2$.
- Our 300 Gbit/s/km$^2$ on average across the whole city is only 3% of the local peak. Hence our numbers are modest.

## Peak area traffic density – mobile users

London Route Master Bus

| | |
|---|---|
| Area 2.5x10 m (m$^2$) | 25 |
| Capacity (passengers) | 80 |
| % using video | 10% |
| 4K video speed (Mbit/s) | 20 |
| Area traffic demand Mbit/s/m$^2$ | 6.4 |

# The benefit of additional spectrum in urban areas with less than 9,000 pops / km$^2$

## Small cell investment is needed, but can be reduced

- In urban areas with a population density below 9,000 people per km$^2$, mobile operators will also have to densify the network with small cells to deliver the 5G downlink and uplink user experienced data rates.

## Additional spectrum delivers and environmental benefit

- Additional upper mid-band spectrum would reduce the need for cell site densification, thus delivering an environmental benefit.

# Agenda

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2. Demand for spectrum in eleven cities
3. Cost saving from additional mid-band spectrum to achieve the EU 100 Mbit/s connectivity target

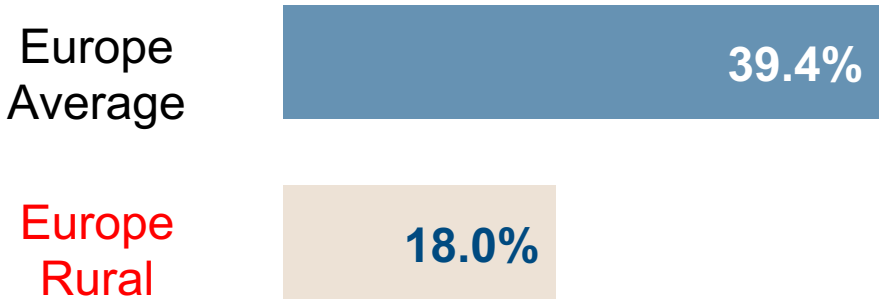
# The European Commission's strategy on Connectivity for a European Gigabit Society sets a target of have 100 Mbit/s connectivity available to 100% of households

## The 2025 is still far from realised

- EU 28  connected by fibre 88.1 million, equivalent to a coverage rate of 39.4%.
- To fulfill the objective of 100 Mbit/s connectivity to 100% of homes by 2025, a further 135 million homes will need to be reached.
- The investment required to achieve this is estimated at €123 bn, assuming that 100% of homes passed with 50% actually connected.

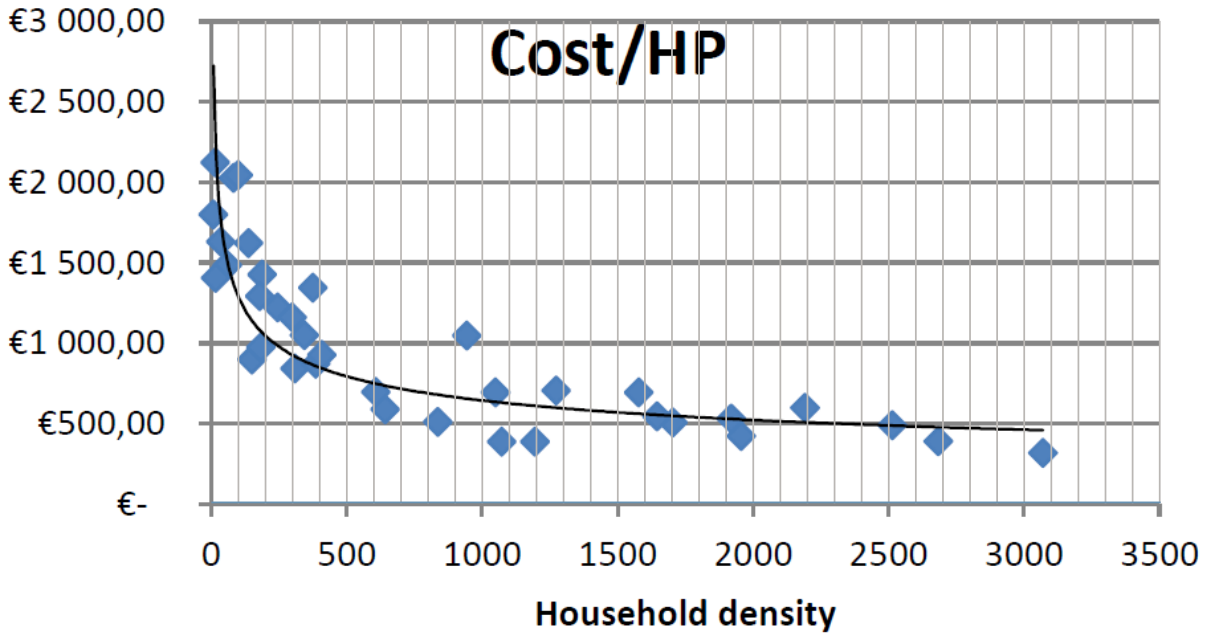
## Achieving the 100 Mbit/s target in rural is particularly challenging

- In mid-2019, rural FTTH coverage was only 18%

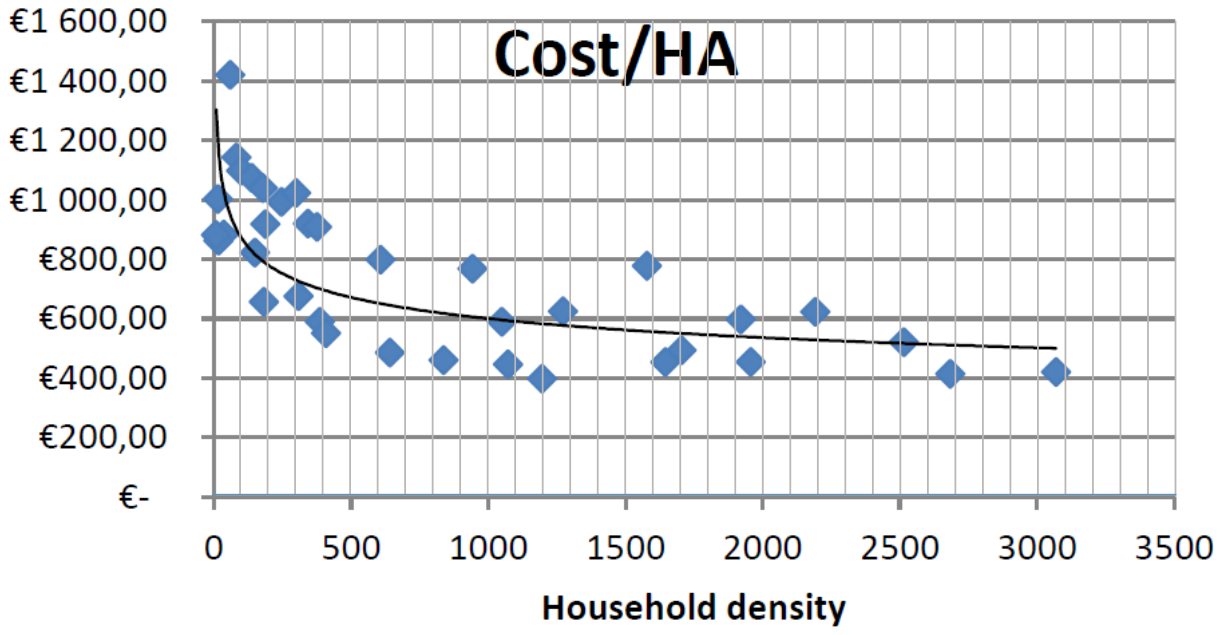



# The lack of rural broadband access is due to the poor economics of connecting homes and business premises in areas with a low population density

## Fibre cost per home passed




## Fibre activation cost per home




Source: The Cost of Meeting Europe's Future Network Needs, FTTH Council Europe, 3/2017

- The average cost of connecting a rural household with FTTH amounts to circa €2,000.

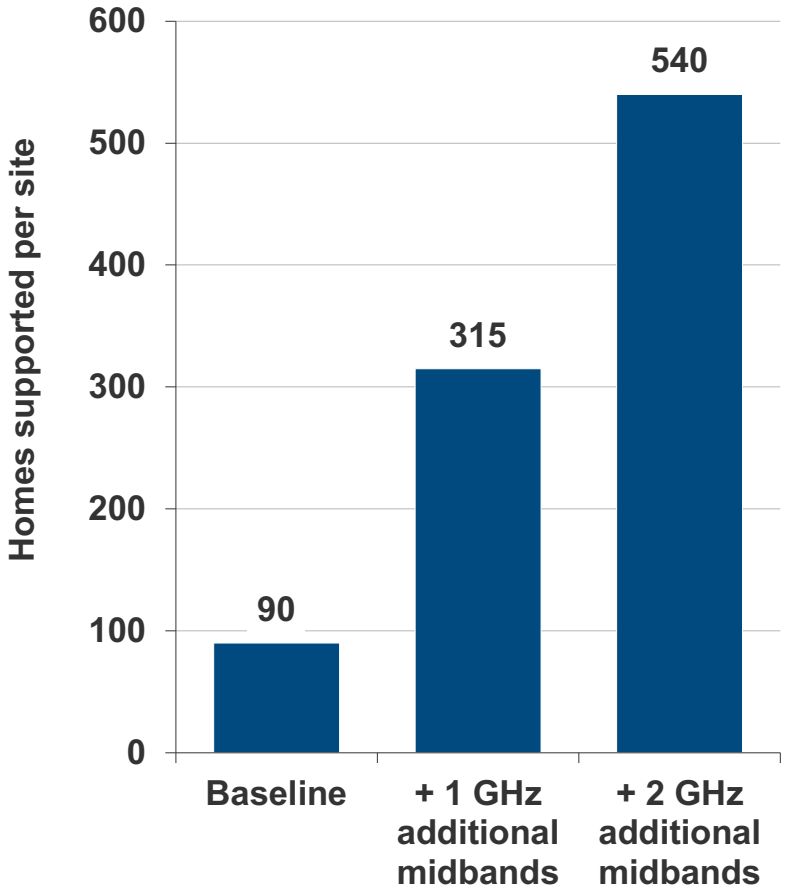
# The more spectrum is available the better the business case for rural 5G FWA

- With an additional 2,000 MHz of mid-bands spectrum one site can provide a data rate of 100 Mbit/s for 540 households.
- If the speed requirement is increased to 300 Mbit/s this drops to 180 households and a 1 Gbit/s service could be provided to 54 households from a single site.

## FWA households supported depending on speed and spectrum

| Households supported | 100 Mbit/s | 150 Mbit/s | 300 Mbit/s | 1Gbit/s |
|---|---|---|---|---|
| Baseline (400 MHz) | 90 | 60 | 30 | 9 |
| Baseline + 1GHz additional | 315 | 210 | 105 | 32 |
| Baseline+ 2GHz additional | 540 | 360 | 180 | 54 |

## Number of premises supported per 5G FWA site @ 100 Mbit/s



# The range of upper mid-band spectrum is not an issue: Example, Gordes in France

**Using upper mind-band spectrum for FWA, a single mast can cover an entire village.**

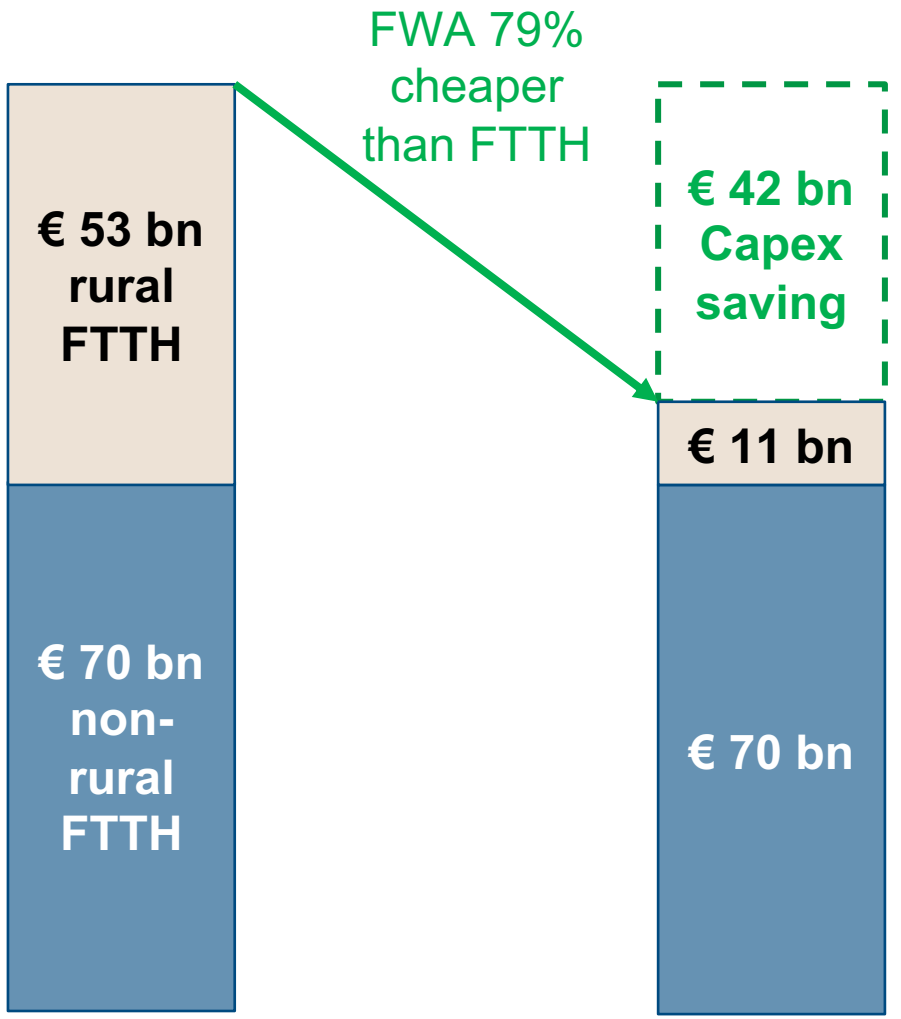
# Using FWA instead of FTTH to bring 100 Mbit/s connectivity to rural homes can reducing capital expenditure by 79%

- The table shows the savings if FWA instead of FTTH is used to bring 100 Mbit/s connectivity to rural households.

| Cost saving FWA vs FTTH | Base Line | Plus 1 GHz | Plus 2 GHz |
|---|---|---|---|
| Cost per household covered @ 100 Mbit/s | 56% | 75% | 79% |
| Cost per household covered @ 150 Mbit/s | 33% | 63% | 68% |
| Cost per household covered @ 300 Mbit/s | -33% | 26% | 36% |
| Cost per household covered  1 Gbit/s | -344% | -146% | -113% |

# Using additional mid-bands spectrum for FWA would reduce the cost to deliver the EU 100 Mbit/s connectivity target by €42 billion

- The total investment required to cover 100% of households in the EU with FTTH is estimated at €123 billion.
- An estimated €53 bn this investment needs to be made in rural areas.
- For an additional 2GHz of spectrum, an investment saving of 79% on €53 billion amounts to €42 bn.
- 5G IMT has a capital expenditure avoidance value of €42 bn, for FWA alone, i.e. not counting the capex avoidance value for mobile 5G.
  - If only 1 GHz of additional mid-bands spectrum is made available, the saving is €40 bn.



# Further information

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The mid-bands spectrum needs in Europe and the 6GHz band opportunity (6425-7125MHz)

WEBINAR

18 JANUARY 2021 | 10:00-12:00 CET

# KEYNOTE PRESENTATION

**Glyn Carter**
Senior Spectrum Advisor
GSMA

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ERICSSON GSMA HUAWEI NOKIA ZTE

# The importance of 6 GHz for IMT

**Glyn Carter**
Senior Special Advisor
GSMA

# Affordable Capacity

6 GHz can provide solutions to long-standing problems

**Coverage**

90%

of the world's population is covered by Mobile Broadband

Mobile Broadband now connects around

4BN

PEOPLE TO THE INTERNET

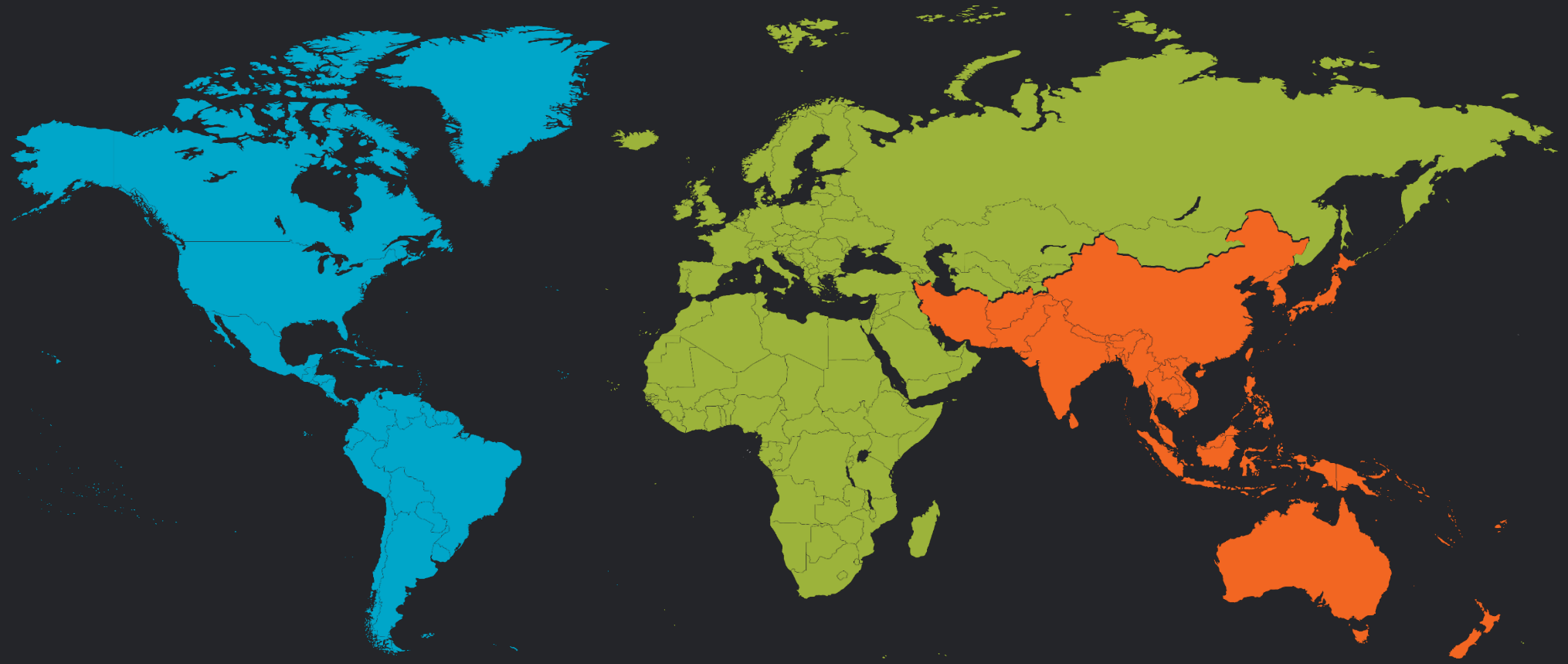
**Usage Gap**

4BN MORE PEOPLE ARE NOT CONNECTED BUT

3.3BN

LIVE WITHIN MOBILE BROADBAND COVERAGE

# WRC-23 IMT Agenda Items



| Bands | 470-960 MHz | 3300-3400MHz | 3600-3800MHz | 4800-4990 MHz | 6425-7025 MHz | 7025-7125 MHz | 10-10.5 GHz |
|---|---|---|---|---|---|---|---|
| Region 1 | AI 1.5 (IMT) | AI 1.2 (IMT) | AI 1.3 (MS) | AI 1.1 (IMT) | AI 1.2 (IMT) | AI 1.2 (IMT) | |
| Region 2 | | AI 1.2 (IMT) | AI 1.2 (IMT) | AI 1.1 (IMT) | | AI 1.2 (IMT) | AI 1.2 (IMT) |
| Region 3 | | | | AI 1.1 (IMT) | | AI 1.2 (IMT) | |

# WRC-23 IMT Agenda Items Overview

**Global Industry Analysis:**
GSMA questionnaire responses show support for 6425-7125 MHz as **high priority for future IMT in all three Regions**

- **Harmonisation is key**
- **Economies of scale are expected**
- **WRC-23 can help towards this**

| Bands | 470-960 MHz | 3300-3400MHz | 3600-3800MHz | 4800-4990 MHz | 6425-7025 MHz | 7025-7125 MHz | 10-10.5 GHz |
|---|---|---|---|---|---|---|---|
| Region 1 | AI 1.5 (IMT) | AI 1.2 (IMT) | AI 1.3 (MS) | AI 1.1 (IMT) | AI 1.2 (IMT) | AI 1.2 (IMT) | |
| Region 2 | | AI 1.2 (IMT) | AI 1.2 (IMT) | AI 1.1 (IMT) | | AI 1.2 (IMT) | AI 1.2 (IMT) |
| Region 3 | | | | AI 1.1 (IMT) | | AI 1.2 (IMT) | |

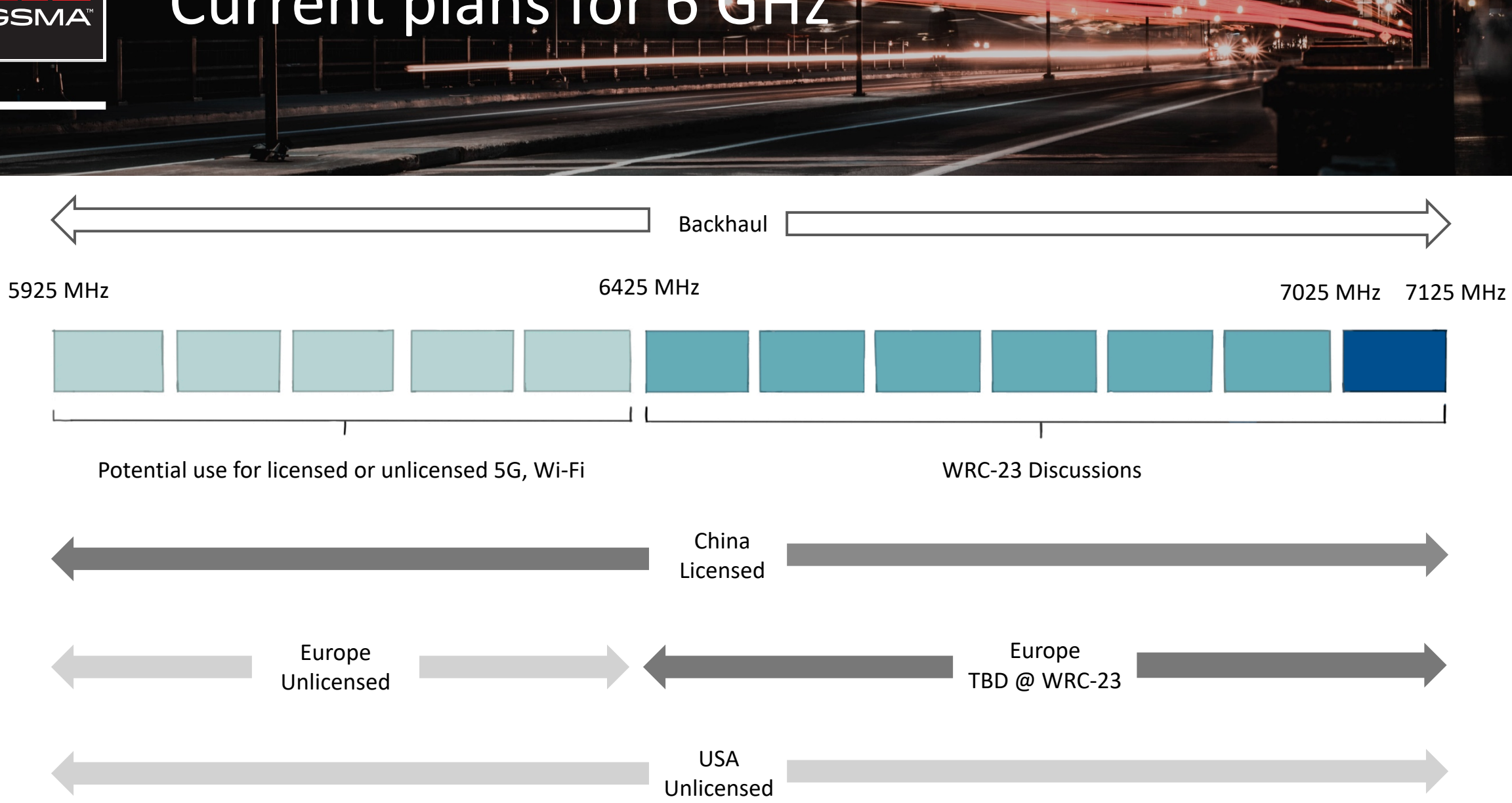
# IMT spectrum demand

## Additional mid-band spectrum needed for mobile operators in 2025-2030 timeframe


A total of around 2-3 GHz of mid-band spectrum would enable mobile operators to deliver the ITU-R IMT-2020 requirements in cities in an economically feasible manner

https://www.gsma.com/gsmaeurope/resources/imt-spectrum-demand/

# Current plans for 6 GHz



# Conclusions

## Market assessment should lead approach

| | |
|---|---|
| 5 925-6 425 MHz | • Follow developments and protect backhaul<br>• Consider market conditions and developments<br>• If required, consider for unlicensed use |
| 6 425-7 125 MHz | • Ensure 5G has sufficient bandwidth for lower network density/costs<br>• Look at market metrics: more 5G means more 6 GHz will be needed<br>• Consider options for 5G expansion spectrum: 3.5 GHz and 6 GHz |
| Approach | • Consider the protection of backhaul for any way forward<br>• Avoid decisions that cannot be reversed<br>• Look at core network availability and 3.5 GHz availability<br>• Safeguard the top 700 MHz for 5G; consider the lower band |

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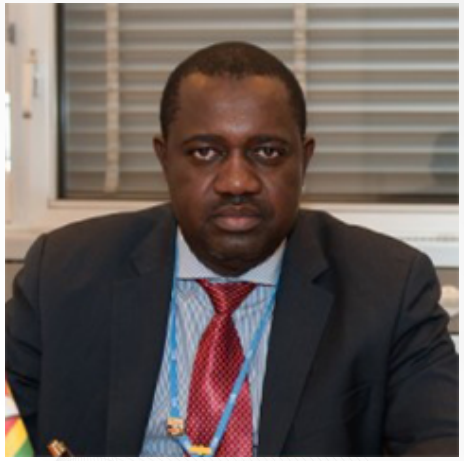
# REGULATORS CORNER



**Baxton Sirewu**
Director Technical Services
Engineer
Post and Telecommunications
Regulator (POTRAZ), Zimbabwe

# 6GHz IMT:
# "Understanding the Opportunities for Society: An African Perspective"

Baxton SIREWU
sirewu@potraz.gov.zw

# Background

- The ongoing Covid-19 Pandemic has demonstrated just how imperative broadband connectivity is in today's world wherein working and learning from home have taken center stage as key elements of the new world order.
- The new reality has brought the fore the infrastructure deficit between and within developing countries; let alone between developed and developing countries;
  - Children in rural areas have not attended school since the onset of the pandemic
  - Clinics and hospitals are in dire need of broadband connectivity
  - The 4IR is proving to be a pipe dream
- There is therefore an urgent need for ubiquitous broadband coverage in Africa lest the widening digital divide mutates into much more complex divides including learning and health care divides and national productivity;
- While copper, fibre and some other forms of broadband cannot be discounted there is no doubt that IMT is mainstream in Africa; regulators therefore need to feed that mainstream ecosystem with appropriate resources for equitable access and inclusive development. Africa needs more coverage spectrum for 5G.
- WRC-19 Agreed to AI 1.2 to Study the upper 6GHz bands for **IMT** (**Res. 245**)

# Africa activity under AI1.2

- 1st African Preparatory Meeting for WRC-23 took place in August 2020 (APM23-1)
- APM23-1 approved the work plan for WRC-23 and established 7 ATU WRC-23 Working Groups
- WG1A has responsibility for IMT Agenda Items including AI1.2

# KEY CONCIDERATION FOR ATU

- Protection of incumbent services – ATU fully supports is participating in studies relating to WRC-23 agenda item 1.2
- Maximisation of harmonisation:
  - Global/Regional Economies of Scale
  - International Roaming
  - Ease cross-boarder interference management
  - Reduced design complexity of equipment & Device
  - Attainment of a Unified Digital Market (attractive to investment and innovation)
- Early release of additional mid-band spectrum for both urban and rural 5G network expansion.

# How Africa can benefit from 6 GHz

- the band is globally allocated to the mobile service on a primary basis.
- Compensate for the gap in mid-band spectrum
- Offer sufficient bandwidth for network densities with affordable cost

- Connectivity in cities with reasonable coverage and statisfiy 5G use cases

- Expected use in Africa: Mobile Broadband and Fixed Wireless Access

# THANK YOU

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# REGULATORS CORNER

**Sergey Rudko**
RCC co-coordinator on AI 1.2 and AI 1.3 of WRC-23

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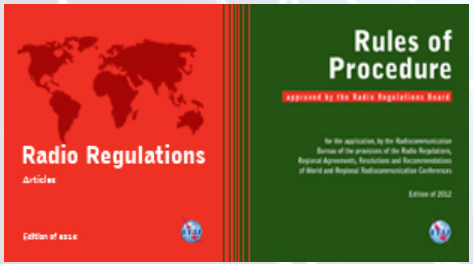
# REGIONAL COMMONWEALTH IN THE FIELD OF COMMUNICATIONS

The ITU-R has started its preparatory work towards WRC-23 agenda Item 1.2 assessing the feasibility of allocating 6425–7125 MHz for IMT in accordance with Resolution 245 (WRC-19)

Some mid-bands have been considered at previous WRCs (in particular, in the range from 3 to 6 GHz by WRC-07, 12 and 15) and for some of the bands relevant solutions have been made for their identification for IMT. However, the decisions did not fully satisfy all countries, in particular the RCC countries due to number of limitations with respect to compatibility with the services operating in countries.


At WRC-19, the RCC countries proposed to consider the frequency band 6525-7100 MHz, taking into account that in the 3 GHz range some difficulties for the implementation of IMT due to the wide use of Fixed-Satellite Service in the RCC countries.




Therefore, the RCC countries consider the 6 GHz band as one of the Key-band for the launch and development of 5G in the RCC region.

# PRELIMINARY POSITION OF THE RCC ADMINISTRATIONS ON AGENDA ITEM 1.2 WRC (6 425-7 125 MHz)


**6425−6525 MHz (Region 1)**

The RCC Administrations are in favour of the protection for a fixed satellite service.

**6525−7025 MHz (Region 1)**

The RCC Administrations are in favour of the identification of all or part of the frequency band 6 525−7 025 MHz for IMT systems, taking into account the results of the compatibility studies. Identifying all or part of the frequency band 6525−7025 MHz for IMT systems shall not impose additional regulatory and/or technical constraints on stations of services having primary allocations in this frequency band.

**7025−7100 MHz globally**

The RCC Administrations are in favour of the identification of the frequency band 7 025−7 100 MHz for IMT systems, taking into account the results of the compatibility studies between IMT systems and satellite receiving stations of FSS, EESS (passive) and SOS. Identifying all or part of the frequency band 7025−7100 MHz for IMT systems shall not impose additional regulatory and/or technical constraints on stations of services having primary allocations in this frequency band.

**7100−7125 MHz globally**

The RCC Administrations are in favour of the protection of incumbent radio services in the same and adjacent frequency bands (including space stations in SOS and EESS (passive)) from interference based on the results of compatibility studies. Identifying all or part of the frequency band 7 100−7 125 MHz for IMT systems shall not impose additional regulatory and/or technical constraints on stations of EESS (passive) and SOS.

# 6425-7125 MHZ FREQUENCY BAND IN RCC

Currently the RCC countries are conducting study for further harmonization of 6 GHz frequency bands.

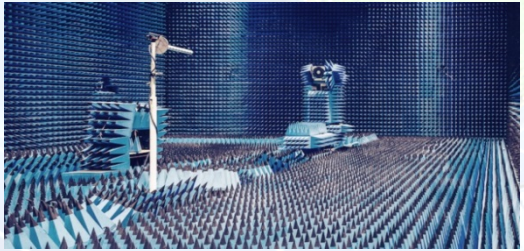
RCC will prepare proposals for WRC-23 for the IMT identification of the frequency band 6425-7125 MHz under AI 1.2, taking into account the conditions ensuring the compatibility of IMT systems with other radio systems using this frequency range.

RCC countries are also in liaison with 3GPP: RCC is preparing regulatory requirements for IMT licensed use in 6 GHz to assist 3GPP NR-licensed

In the RCC countries in the 6425-7125 MHz band the following usage:

| Service / systems | Sharing opportunities |
|---|---|
| FS microwave links | 1050 links (ECC Report 173). FS links are located mostly outside cities in the middle and northern parts of Russia: coordination may be required |
| FSS (GSO) | Current usage in 6425-6525 MHz; limited usage in 6525-6725 MHz; limited usage in 6725-7025 MHz (UL), paired with with 4500-4800 MHz (DL) which is considered for 5G in Russia (as part of 4400-4990 MHz) |
| FSS (NGSO) | Limited number of stations |
| SOS (FN 5.459) | Space Operation Service (TTC): current and future usage to be protected |
| EESS (passive) (FN 5.458) | Future use of passive microwave sensors over the oceans is considered by the national space agency |
| RAS | Limited number of stations |

In accordance with questionnaire on 5G spectrum plans in RCC countries (Sep.2020), Russia has identified 6425-7125 MHz band



In the Russian Federation, full-scale tests of 6 GHz IMT equipment are planned, included in the Regulator's work plan for 2021

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# REGULATORS CORNER

**Prof. Antonio Sassano**
Chairman
Fondazione Ugo Bordoni, Italy

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# *6GHz Band: Licensed, Unlicensed or … Locally Licensed*

***Antonio Sassano***
***Fondazione «Ugo Bordoni»***

*January 18, 2020*

# Focus: 5G and Internet of Things

## 5G is more than high speed and low latency

- **Real revolution:** *widespread diffusion of* **IOT e M2M**
- **20 bn** *of* **connected objects** *in* **2020** *(exponential growth)*
- ***Services and Processes enabled by their «own» objects*** *(few examples):*
  - ***Mobility, Tourism(AR)*** *and* ***Public Services*** *in* ***Smart Cities***
  - ***Autonomous and assisted guided vehicles***
  - ***Object Tracking*** *in* ***logistics*** *(ports, distribution, delivery)*
  - ***Sensors*** *in new* ***precision agricolture***
  - *Control of* ***CyberPhisical Systems*** *(railway, energy, utilities)*

*Every* **Service** *will be enabled by a* **network of connected objects,** *crucial to provide a superior* **QoS to users** *(**sensors, smart-tags , edge-computing, cloud,..**)*

*Every* **Service** *will become a* **Service-Network**

# Spectrum and Service-Networks: licensed, unlicensed or .. local?

- *Service-Network require (a lot of)* ***wireless connections*** *(**Spectrum**)*
  - *The «objects» are billions and mobile (**fixed networks are not enough**)*
  - *A **huge number of transmitters and «objects»** needed* ➡ ***Huge investments!***
  - ***Huge investments** ask for **long term network stability and stable spectrum*** ➡ ***licensed!!***
  - ***Local spectrum: small areas but … many service-networks («thick» use of spectrum)***
- *Verticals **require exclusive use***
  - *Automotive Industry (USA, Germany)*
  - *Energy, Smart-Grids*
  - *Automation and Manifacturing (Industry 4.0)*
  - ***«Local incumbents»***
    - *Ports, Roads, Logistics, Hospitals, ..*

> *«There is need for more private networks as 5G is **becoming the central nervous system** of the factory of the future. Its role could be compared to that played by **electricity in the automation of factories***

***Andreas Muller, Head of Communications and Network Technology at BOSCH***

> *«Feedback from **industry verticals** suggests that it may be useful **not to have public neworks** in these industrial areas, therefore they **require local use of spectrum**»*

***Frank Kruger, Head of the Digital Society and Infrastructure directorate at Germany's Federal Ministry of Transport and Digital Infrastructure***

- *Administrations are «very sensitive»*
  - ***Strategic Sectors in National Economies** (**Cybersecurity**)*
  - ***BNetz Auction: 100 MHz** of «local spectrum» reserved in **3.7-3.8 GHz Band***
  - ***OFCOM:** Use and secondary re-use (market) in **local areas 3.8-4.2 GHz Band***

# ***Local Licensed Spectrum: final questions***

- ***Is Unlicensed*** spectrum ***secure and safe enough*** for **service-networks ?**
- Are the ***investments in "objects"*** (*meter, auto, e-health*) ***protected*** if the **enabling spectrum** is ***managed by someone else ?***
- Can the ***evaluation*** of future **spectrum needs** ignore ***Local*** use ***?***
  - ✓ ***How many different service-networks*** will ask for **reserved and protected** local spectrum in the **same area** (a Railway Station, a City Center) **?**
  - ✓ Does this further ***increase the need*** of *new spectrum* ***(thick use)*** **?**

***.. and finally***

- **Is the upper 6GHz Band *(6425-7125 MHz)***
  ***sufficient*** **for a Local and Nationwide Licensed Use ?**


# *6GHz Band: Licensed, Unlicensed or … Local Licensed*

## *Thanks for your attention!*

***Antonio Sassano***
***Fondazione «Ugo Bordoni»***

*January 18, 2020*

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# REGULATORS CORNER

**Chris Woolford**
Director, International Spectrum Policy
Ofcom, United Kingdom

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# Meeting the needs of users in the 6 GHz band

Chris Woolford

Director, International Spectrum Policy

January 2021

# Different spectrum bands will be required to meet differing needs

- We are making spectrum bands, with different characteristics, available for use by a variety of players to deploy the connectivity solutions that meet their requirements.
- We have been engaging with different businesses and organisations to better understand their evolving needs.


**Auction**: Spectrum mostly authorised on a nationwide basis. MNOs can offer slices of their network to meet business requirements.

**Sharing**: Low cost licences enabling localised access to spectrum. Can be used for private networks and to extend coverage.

**Exempt and light licence:** Access to spectrum with low barriers is an important enabler of innovation. Wi-Fi technology is currently common across many businesses.

# Ofcom Statement on 5925 – 6425 MHz in summer 2020

- Statement published in July 2020
  - followed a consultation issued in January 2020
  - 38 responses received to the consultation

- Statement confirmed 5925 – 6425 MHz being made available for WiFi and other related wireless technologies
  - enabling indoor and very low power outdoor use
  - permits up to 250mW indoor and 25mW outdoor

- Ofcom emphasised the benefits of global harmonisation
  - we are engaging in international discussions
  - we have sought to promote the benefits of a simple regulatory regime

# 6425 – 7125 MHz

- Ofcom's consultation and statement focused on 5925-6425 MHz
  - But some respondents noted that similar technical challenges would exist above 6425 MHz

- 6425-7125 MHz will be discussed at WRC-23 under Agenda Item 1.2 (for Region 1) which is considering bands for IMT identification
  - European preparations currently at an early stage
  - Being taken forward by ECC CPG as part of the European preparatory process for WRC-23

- We are engaging internationally and monitoring developments in other countries and regions

# 6GHZ IMT OPPORTUNITY FOR SOCIETY

The mid-bands spectrum needs in Europe and the 6GHz band opportunity (6425-7125MHz)

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# REGULATORS CORNER

**Jan Engelberg**
Senior Advisor
Finnish Transport and Communications Agency Traficom, Finland

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# REGULATORS CORNER

**Šarūnas Oberauskas**
Advisor of Spectrum Engineering Division
Communications Regulatory Authority (RRT), Lithuania

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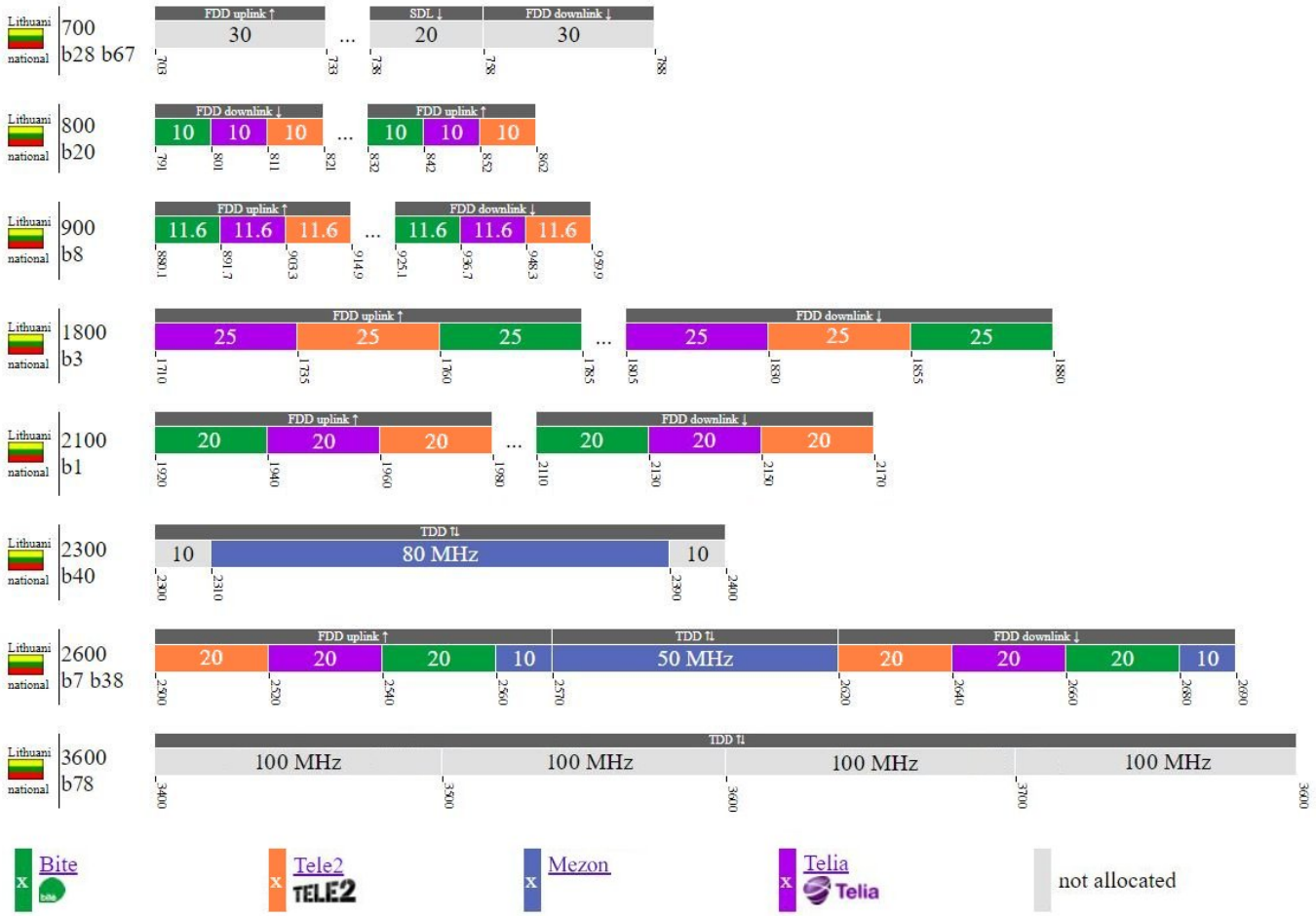
# LOW- & MID- BANDS IN LITHUANIA

Šarūnas Oberauskas
Advisor of Spectrum Engineering Division

# SPECTRUM OVERVIEW AND 4G/LTE COVERAGE

## Spectrum allocations to MNOs

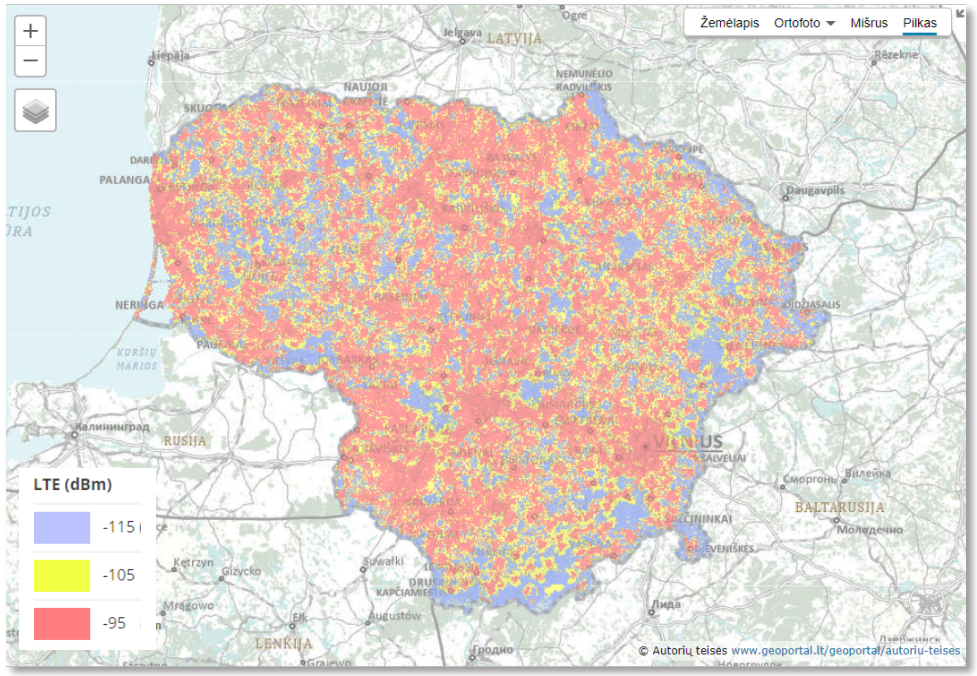



## LTE network coverage (% of territory)

-115 dBm (97-99%), -105 dBm (75-80%), -95 dBm (40-45%)

-115 dBm (97-99%), -105 dBm (75-80%), -95 dBm (45-50%)

-115 dBm (97-99%), -105 dBm (80-85%), -95 dBm (50-55%)



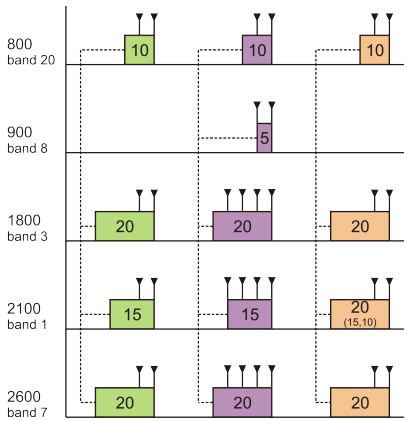

https://www.rrt.lt/judriojo-rysio-tinklu-tiketinos-aprepties-zonos

# 4G/LTE THROUGHPUT (THEORETICAL)

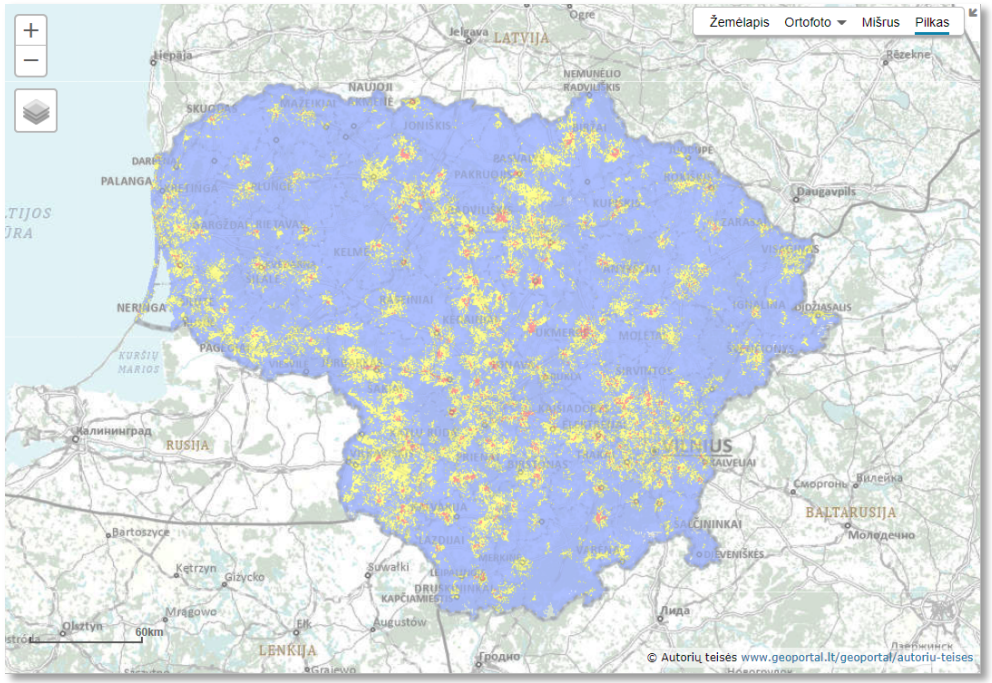
## Assumptions

- Propagation ITU-R P.525 + diffraction (Deygout 1994)
- Rx at 1.5 m, antenna gain -3 dBi, body loss 4 dB
- CA
- MIMO 4x4
- 256 QAM

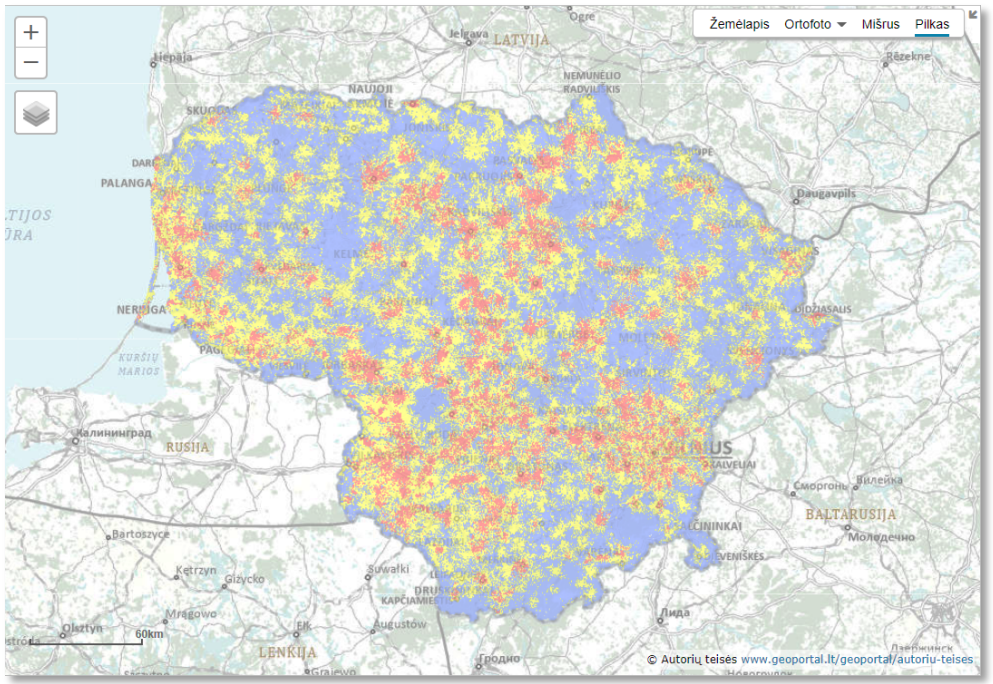
## LTE MIMO & CA
(current implementation)




network load 50%



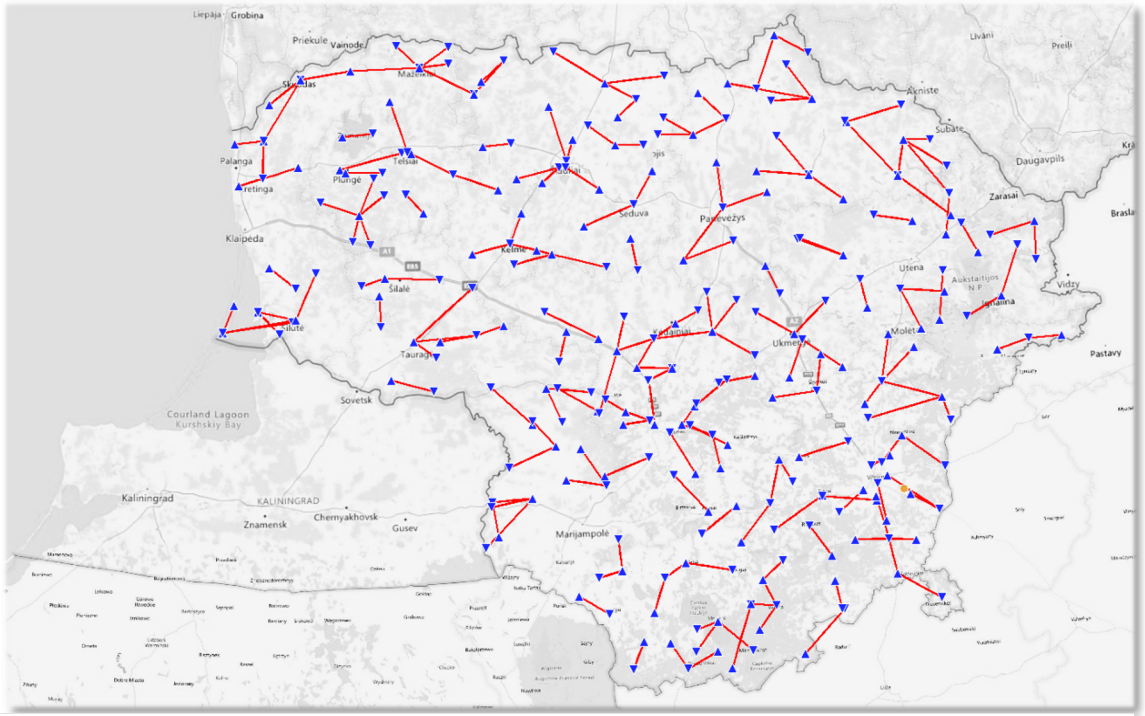

network load 10%

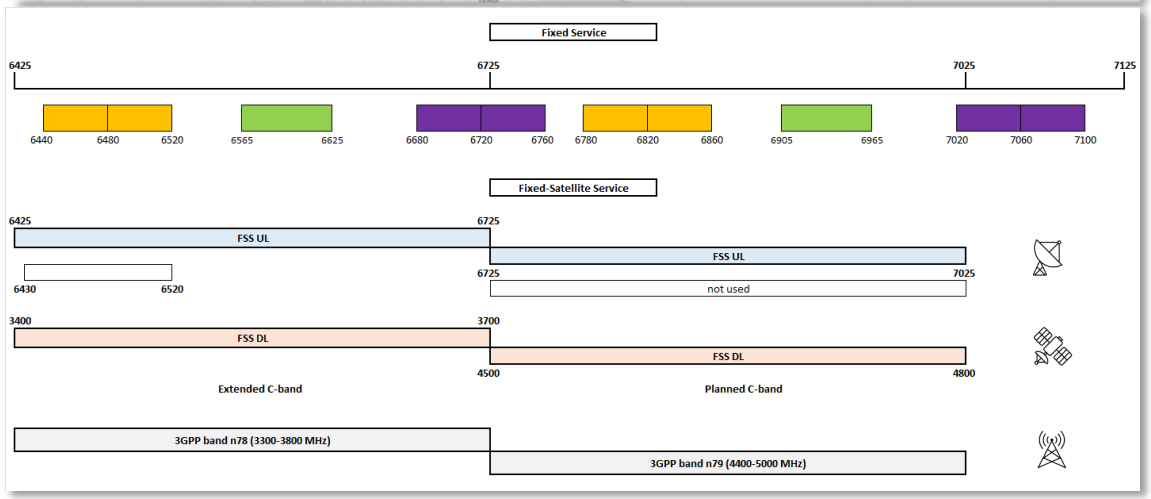



5-30 Mb/s | 30-100 Mb/s | >100 Mb/s

https://www.rrt.lt/judriojo-rysio-tinklu-teoriniai-spartos-skaiciavimai

# 6425-7125 MHz FREQUENCY BAND

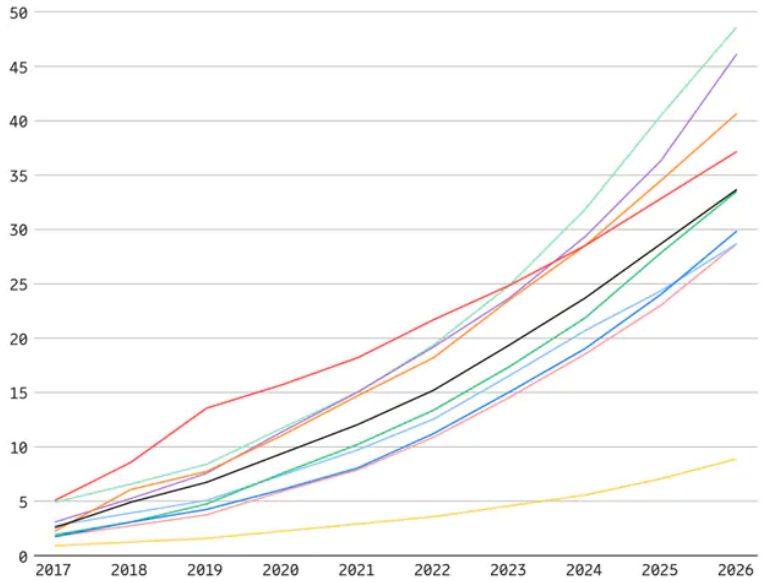



- FS (201 MW links)
- FSS (1 Earth station (E-s)), allotment and Plan of 6725-7025 MHz not used, no information on Earth stations (s-E) in 6700-7075 MHz)
- Licenses up till 2031

- Coexistence
  - Fixed service (e.g. possible migration)
  - Fixed-Satellite service (uplink)

## Mobile data traffic per smartphone (GB per month)




| Regions | 2020 | 2026 | CAGR 2020–2026 |
|---|---|---|---|
| North America | 11.8 | 49 | 27% |
| Western Europe | 11.3 | 46 | 26% |
| North East Asia | 11.1 | 41 | 24% |
| India | 15.7 | 37 | 15% |
| Global average | 9.4 | 34 | 24% |
| South East Asia and Oceania | 7.6 | 33 | 28% |
| Middle East and North Africa | 6.0 | 30 | 30% |
| Central and Eastern Europe | 7.3 | 29 | 26% |
| Latin America | 5.8 | 29 | 30% |
| Sub-Saharan Africa | 2.2 | 8.9 | 26% |

Source: Ericsson Mobility Report data and forecasts
https://www.ericsson.com/en/mobility-report/dataforecasts

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# OPPORTUNITIES


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# INDUSTRY CORNER

**Maarit Palovirta**
Director, Regulatory Affairs
ETNO

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# 6 GHz IMT Opportunity for Europe

18 January 2021

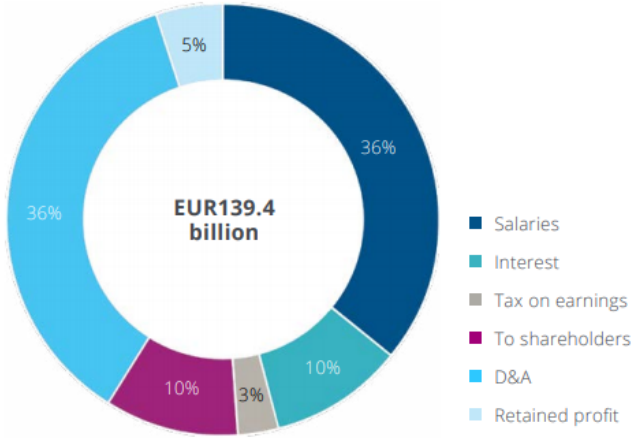
Webinar on 6 GHz IMT opportunity for Society

Maarit Palovirta, ETNO

@ETNOAssociation #ThinkDigital #ETNODigital

# About ETNO

- ETNO's 32 members and 8 observers from Europe and beyond are the backbone of Europe's digital progress
- ETNO members deploy over 70% of the total network investment in Europe
- Data shows they generate a yearly €139.4bn value added for society in the EU




State of Digital Communications 2019, Analysys Mason for ETNO

# 6 GHz Status in Europe

- Lower 6 GHz (5945-6425 MHz) is being harmonized for WAS/RLAN in EU
  - Low Power Indoor devices, max 200 mW e.i.r.p.
  - Very Low Power devices, max 25 mW e.i.r.p.
- Upper 6 GHz (6425-7125 MHz) is under study for IMT for WRC-23 in Region 1
- Main current use is FS and FSS. Operators have fixed links in the band in many countries.

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# 6 GHz IMT Opportunity for Europe

- New mid-band IMT spectrum is needed in mid-long term
  - Especially for urban capacity + coverage
  - Ever increasing demand is driven by existing and new use cases, e.g. media, smart city, transport, automation
- In Europe 6425-7125 MHz offers an excellent opportunity to meet this demand
- Exclusive licenses enable feasible transmission power and protection of existing use where needed

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# INDUSTRY CORNER

**Eiman Mohyeldin**
Senior Specialist Spectrum Regulation
Nokia *(on behalf of the co-hosting vendors)*

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# 6GHz IMT OPPORTUNITY FOR SOCIETY

## 6425-7125 MHz for 5G in Europe

ERICSSON HUAWEI NOKIA ZTE

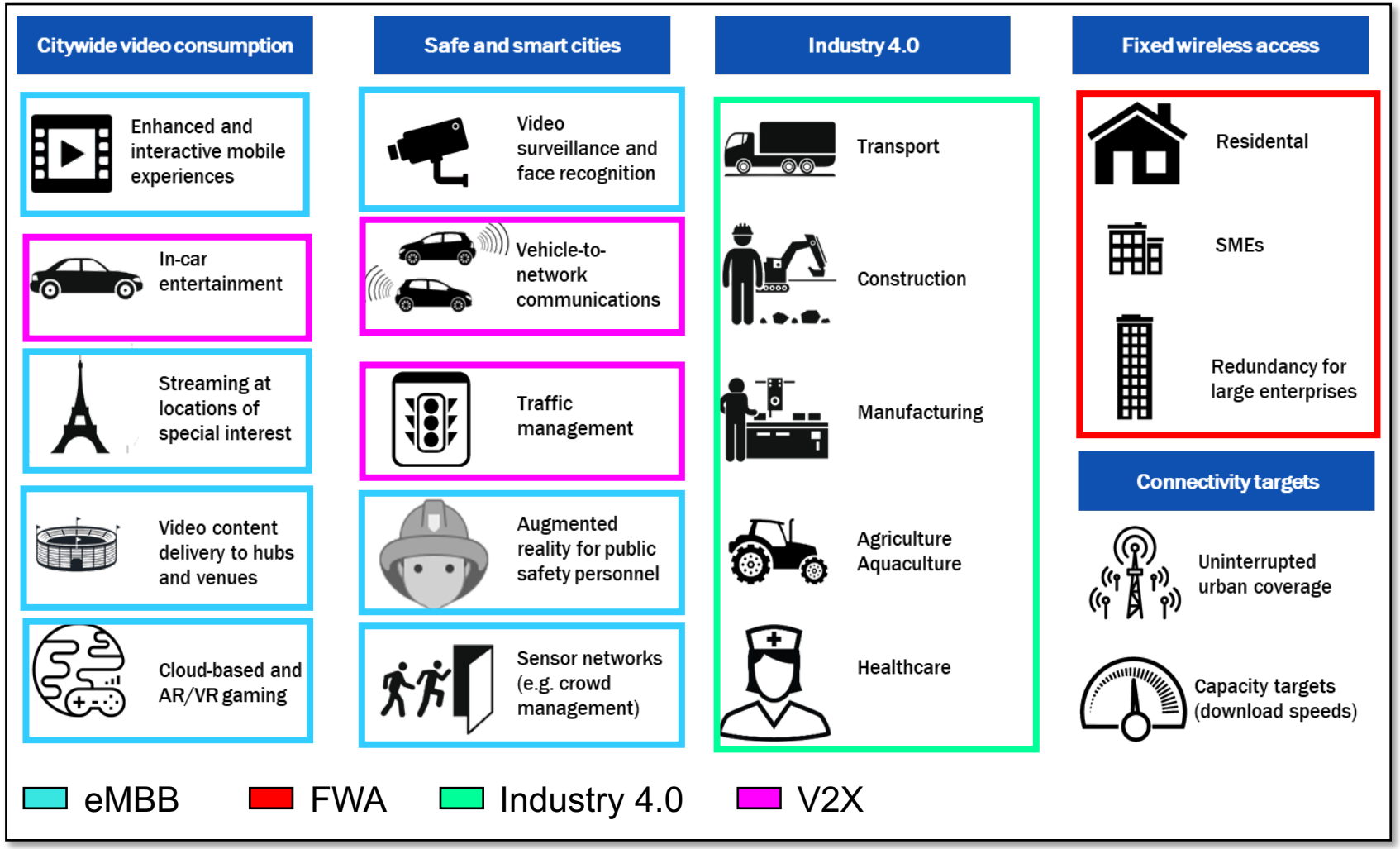
18th January 2021

# Why 6 GHz?

- Additional mid-bands spectrum will be needed by 2025-2030 in European markets to address the IMT-2020 user experience requirements (100Mbit/s in DL and 50Mbit/s in UL) in the most populated European cities – depending on the specific assumptions (e.g. end user activity factor, high bands offloading, …)
- The 6GHz band is ideally suited to meet 5G future capacity needs:
    - Globally allocated already to the mobile service on a primary basis
    - Good balance between coverage and capacity
    - Similar possibilities in terms of coverage to 3.5 GHz
    - Large contiguous blocks available supporting 5G services
    - Potential for wide economies of scale

The 6GHz band has potential in terms of providing coverage and capacity with a healthy ecosystem, leading to satisfy
the projected citizens' connectivity needs.

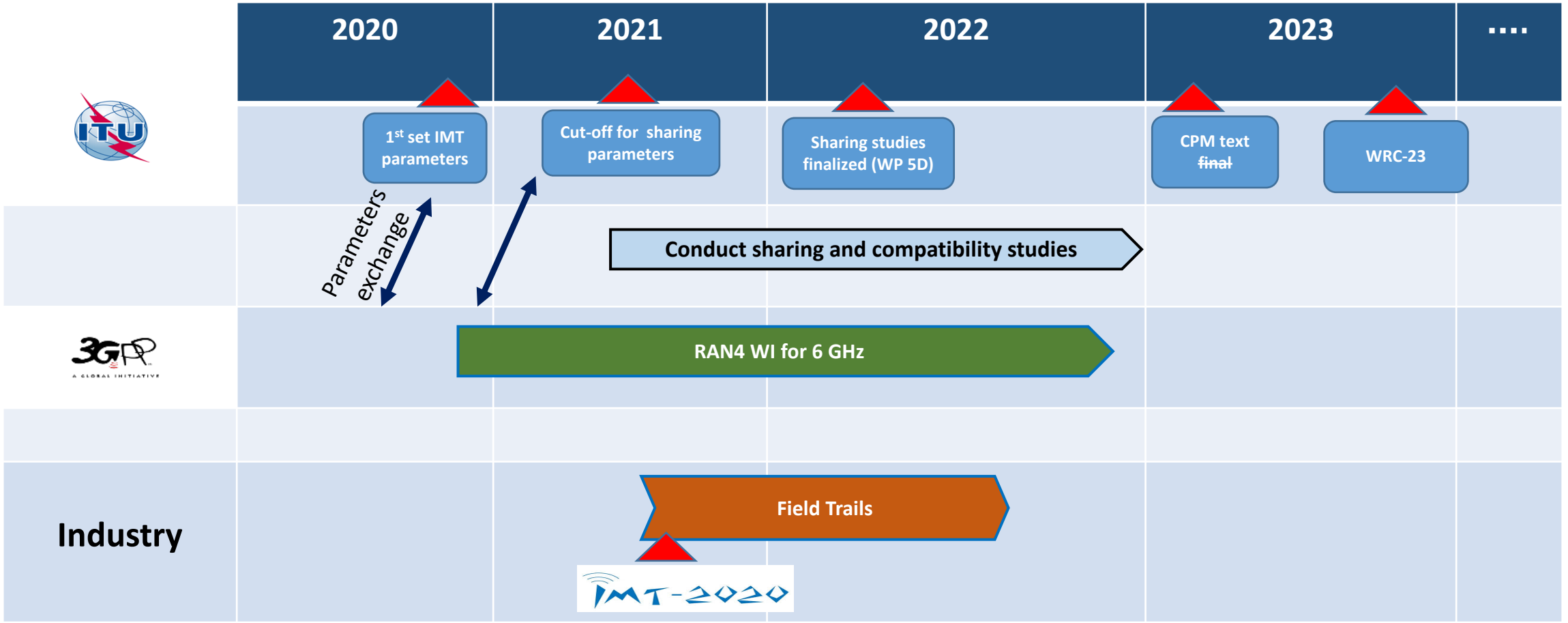
# High capacity citywide (urban/suburban) coverage




*Source: Analysis Mason, "The 6 GHz opportunity", 2019*

- Important to assess the needs of the city of the future.
- Each use case contributes to the spectrum needs
- Number of use cases requiring predictable QoS and reliability
- Mid-bands spectrum is key to address citywide contiguous coverage , high capacity and cost effectively
- The same spectrum can be used outside urban areas (e.g. for FWA, smart manufacturing, transport paths...)

# 6GHz Ecosystem Ready for 5G

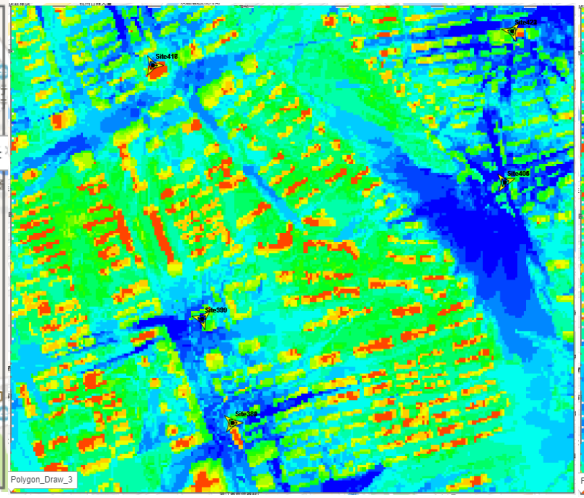



- RCC Commission on Spectrum and Satellite Orbits liaised with 3GPP (RP-201438) expressing their intent to submit a proposal to WRC-23 for use of 6425-7125 MHz for IMT systems
- 3GPP work item for “Introduction of 6GHz NR licensed bands” (RP-202114) covering 6425-7125 MHz and 5925-7125 MHz

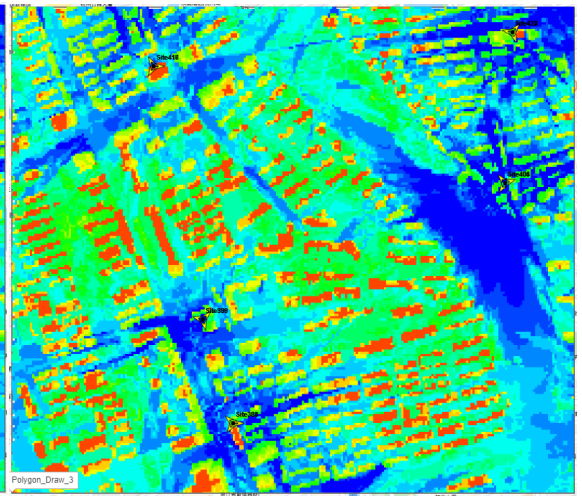
# IMT (5G-NR) provides similar area coverage in the 6 and 3.5 GHz bands

**Coverage simulation with Ray-tracing model in dense urban area**

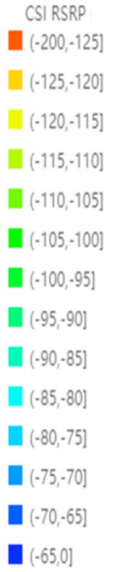

1km*1km, Hangzhou CBD area

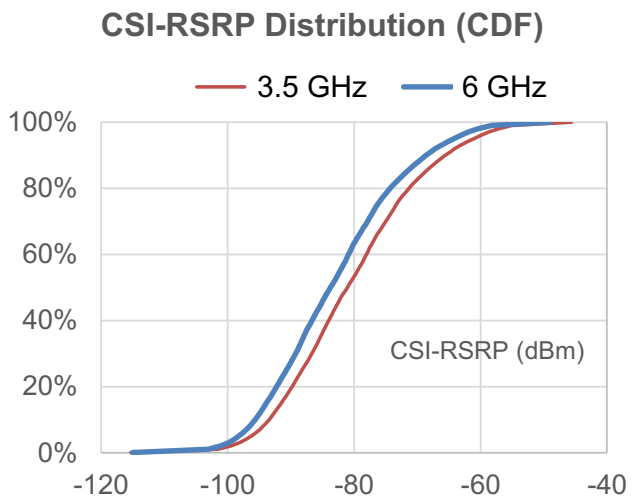


Downlink RSRP@3.5GHz



Downlink RSRP@6GHz




**3400-3800 might not be sufficient in the longer run:**
**The 6GHz band could be a good complement to address the forecasted capacity needs.**

**There is a small gap between**
**6GHz and 3.5GHz coverage (DL and UL);**
**It could be compensated with new BS architectures and UE capability enhancements.**

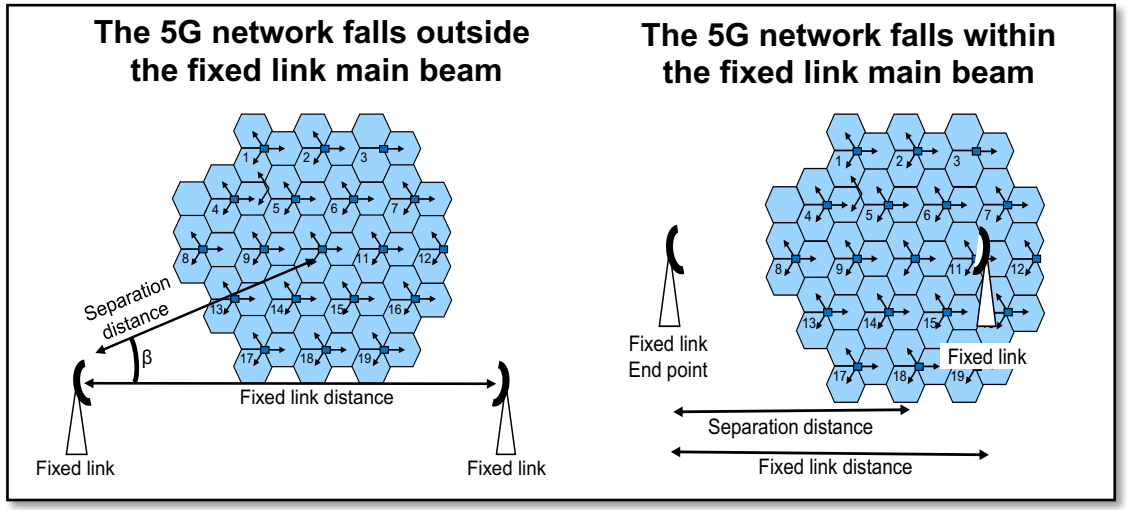
# Sharing with Incumbent : Fixed Service

## FS Typical applications

- **Long distance** P-P links / backbone links (12-65 km)
- **Mainly in rural** / remote areas (at least one hop )
- At **known locations** with **known characteristics**
- Mainly supporting **mobile and broadcasting** networks
- Mostly **link-by-link assignments** (block assignments in few cases)

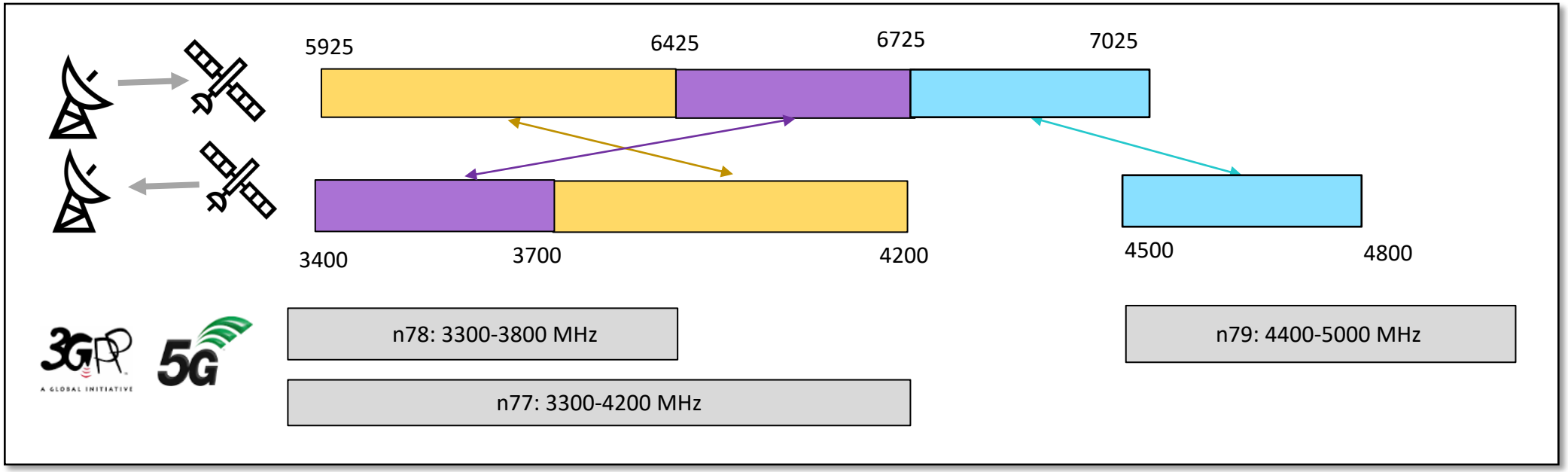
## IMT – FS coexistence: Toolbox

- **Coordination** (spectrum sharing)
  - on a case-by-case basis by network planning:



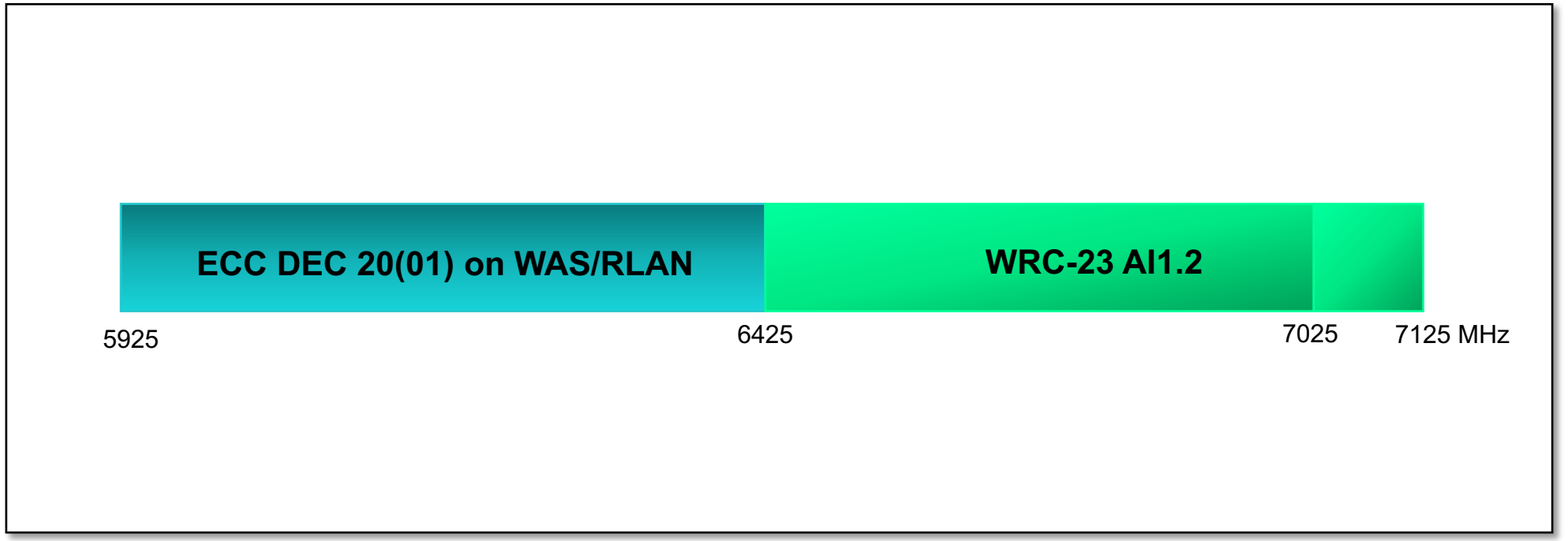

  - The coordination zone depends on the antenna positions, parameters and FS protection criteria (co-channel and LoS operation ssumed)
- As an alternative, depending on operators preference, migration of fixed links to other frequency bands could be a possibility

# Sharing with Incumbent : fixed satellite services




- FSS UL protection is a global issue and thus agreement on protection at ITU level is important
- 3GPP ecosystem available for the 3.3-4.2 GHz and 4.4-5.0 GHz ranges
- Observations for studies towards WRC-23
  - Coexistence may be facilitated by the adoption of Active Antenna Systems with beamforming (Massive MIMO)
  - Sharing studies need to apply and use recent developed and accurate clutter loss, building entry loss and propagation models

# The 6 GHz in Europe: a balanced approach




**WRC-23 is a great opportunity**
**to ensure spectrum harmonization for IMT**
**and balance the spectrum needs in Europe among different applications**

# Thank you!

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# 6GHZ IMT OPPORTUNITY FOR SOCIETY

The mid-bands spectrum needs in Europe and the 6GHz band opportunity (6425-7125MHz)

WEBINAR

18 JANUARY 2021 | 10:00-12:00 CET

# INDUSTRY CORNER


**Glyn Carter**

Senior Spectrum Advisor

GSMA


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# 6GHz Band for IMT - Industry Statement

- The International Mobile Telecommunications (**IMT**) system is the efficient way to provide broadband wireless connectivity on a **worldwide** scale and greatly contribute to global **economic** growth and **social** development;
- The **IMT** technology development and deployment continue contributing to creating a large amount of **new jobs and GDP growth**;
- **5G** is a pillar of **digital transformation**, enhancing mobile broadband and enabling new use cases;
- **5G connectivity** is essential for the development of **new information technologies**, such as IoT, cloud computing, big data, artificial intelligence, etc.;
- The user **mobile data consumption** is increasing and will keep growing rapidly and not only by human users;
- **More spectrum** is needed for 5G to meet the future network **capacity and coverage demand** for citywide use cases;
- in particular, the **6GHz** frequency band is a **strong candidate** to offer seamless high capacity citywide with licensed spectrum;
- The **WRC-23** preparatory work has started in the ITU-R in relation to the possible IMT identification of the 6GHz band, the standardization work in **3GPP** is on its way**.**

**We therefore recommend policy makers and stakeholders**
**to carefully assess the opportunity of IMT identification at the WRC-23 within the 6GHz band**
**which will be important to establish the large scale ecosystem for this band.**

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# VIEWS FROM AUDIENCE AND Q&A

Please click on the tab labelled **'Q&A Session'** on the left-hand side of your screen and enter the session.

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# WRAP-UP

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# NEXT STEPS AND ACTIONS

## Where to go to get replay

Replay link for this webinar can be accessed by the same site used for registration:

6ghzopportunity.com

## Where to go to get more information

- Webinar 1
  - September 2020
  - Event website
- Webinar 2
  - Focus on the Latin American and the Caribbean region
  - December 2020
  - Event website

## Next 6GHz focused webinars

- Webinar 4
  - Focus on the Asia Pacific Region
  - Tuesday, 19th 2021
- Webinar 5
  - Focus on the future availability of mid-bands in the Regional Commonwealth in the Field of Communications (RCC)
- Webinar 6
  - Focus on Middle East countries (ASMG)

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