WRC-23 Agenda Item 1.2 – Focused Discussion on U6 GHz

IAFI WRC23 Workshop,

12 September 2022

Agenda

1 Focus on utilisation & demand for U 6 GHz

2 Relevance to India - National Policy consideration

3 Current Status of U 6 GHz Position Globally

4 Technical & Regulatory Deep Dive

5 Discussion & Recommendation

1. Recap on Agenda Item 1.2 – Focus on Upper 6 GHz

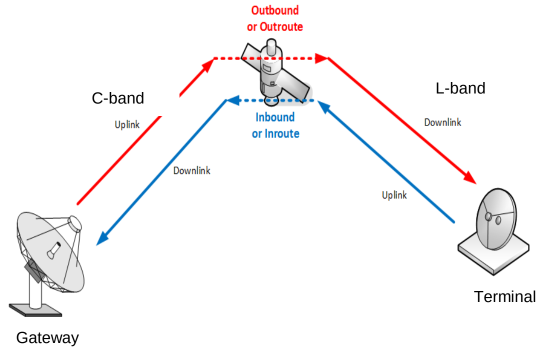
The identification of satellite spectrum for IMT has far reaching implications and therefore this agenda item has sparked the interests of various stakeholders

AI Description

- To consider identification of the following frequency bands for IMT, including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution 245 (WRC 19):
  - 3300 – 3400 MHz (Region 1 & 2)
  - 3600 – 3800 MHz (Region 2)
  - 6425 – 7025 MHz (Region 1)
  - 7025 – 7125 MHz (Globally)
  - 10.0 – 10.5 GHz (Region 2)

Impact

- Harmful interference to satellite receivers & inability to utilise national allotments (App30B) are our primary concerns



Inmarsat Position

- No introduction of IMT in the upper 6 GHz as this would cause harmful interference to MSS that are used to deliver essential and critical comms
- Protection of Appendix 30B allotments to enable growth of domestic satellite markets
- Maximise social and economic value derived from the scarce spectrum resource by enabling (compatible) WiFi technology introduction in the upper 6GHz

Stakeholder Ecosystem

IMT Community | WiFi Community | Satellite Operators | Technology Companies | ICT Ministries & Regulators | Aeronautical Authorities | National Safety & Defence

2. Relevance for India

AI 1.2 presents a unique opportunity to secure the sustainable growth of the satellite & Space market and catalyze digital transformation in India

Domestic Satellite Program

India is **accelerating** the development of its **space program**– aiming to **launch** a series of VHTS **satellites**. Future satellite launches will likely leverage India's **APP 30B** allotment

Enabling Broadband Deployment

Studies have shown that in a 5G era more than **70%** of mobile traffic will be **offloaded** to **WiFi** networks. Hence, availability of U6 GHz on an unlicensed basis is crucial.

Accelerate Digital Transformation

IoT technology is a key enabler for **digital transformation**. Satellite networks provide the national **connectivity fabric** spanning remote areas not covered by terrestrial networks

Robust Networks for Disaster Relief

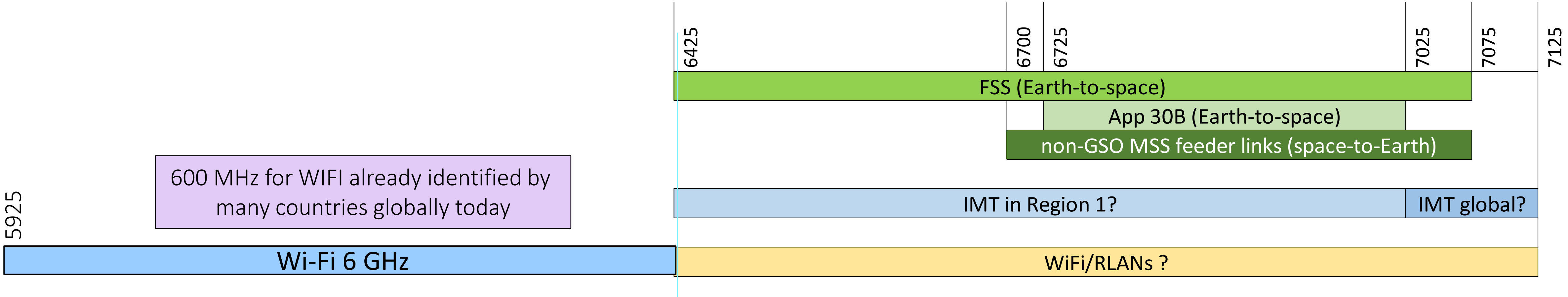
Satellite networks are the **only viable** communication option during periods of national **unrest** and **natural disasters** – numerous **floods,** Earthquakes are a prime examples of how satellite networks were employed for **essential** and **critical** communications

The forefront of Technology Adoption and Innovation

Next-generation **AR/VR** technologies will require the **entire 6 GHz** frequency band. These technologies will fundamentally **transform** key sectors such as **education**, **medicine** & **media** for the benefit of Indians.

3. Current Use of U6 GHz

What are the long-term uses of 5 925 - 6 425 - 7 125 MHz?



6425-7075 MHz – FSS E-S

- For geostationary uplinks used by large numbers of GSO FSS networks covering all regions, includes Inmarsat use
- *Studies required on*
  1. *Interference from IMT to satellite receivers*
  2. *Interference from FSS earth stations to IMT stations*

6725-7025 MHz - Appendix 30B

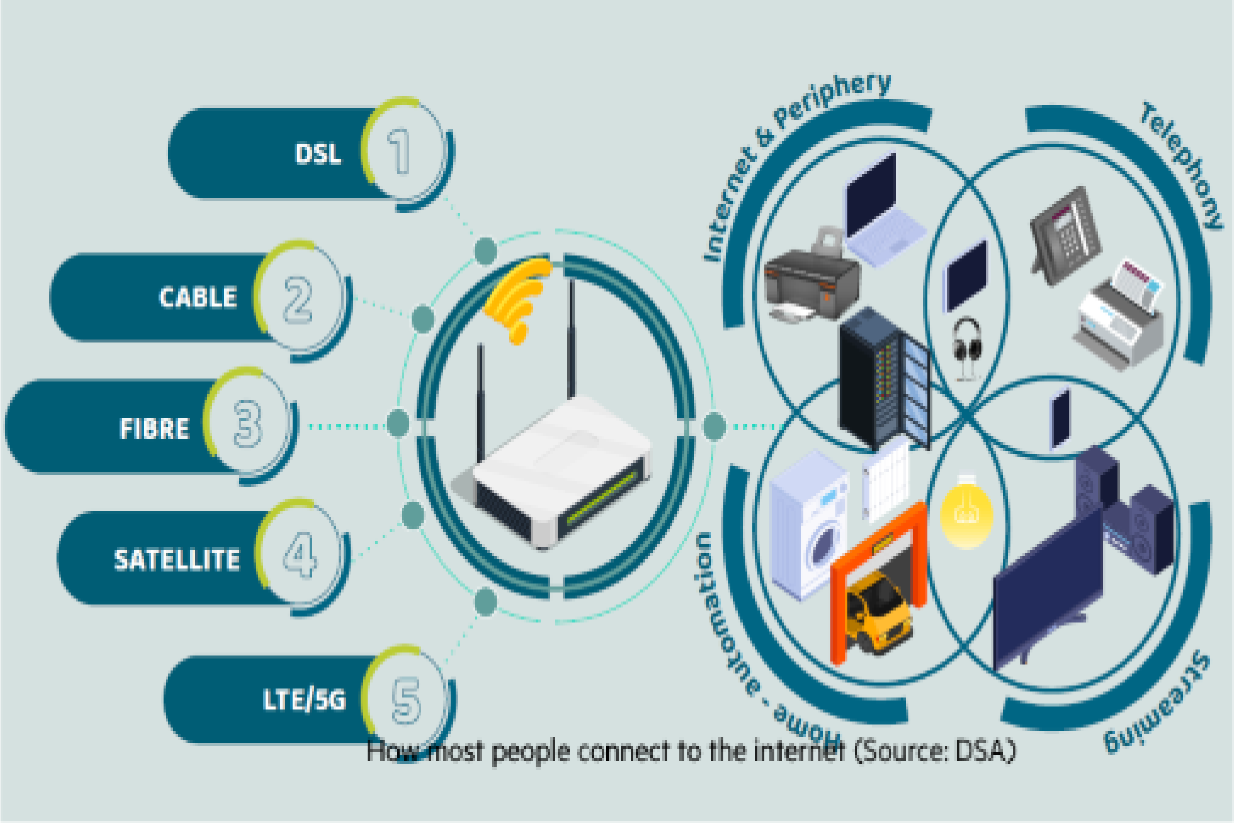
- Allocated to the FSS globally and used for FSS as per the provisions of Appendix 30B.
- Objective: to "...guarantee in practice, for all countries, equitable access to the geostationary-satellite orbit..."
- Provides administrations with a preserved orbital slot and frequency allotments.
- *Studies required on interference from IMT to planned national allotments*

6700-7075 MHz - NGSO MSS DL

- Gateway earth stations deployed around the world for NGSO MSS systems (e.g., GlobalStar, OmniSpace, EchoStar Helios)
- Providing voice, data, and Internet of Things globally
- *Studies required on Interference from IMT to receiving earth stations*

3. Where and How People use Broadband

- Broadband is brought to people's and company's doorsteps through a variety of access technologies.
  - DSL, cable, fiber, satellite, FWA (LTE/5G)
- Indoors, however, the broadband connectivity technology of choice is Wi-Fi.
- More than 90% of data traffic originates or terminates indoors.
- More than 90% of data traffic is transferred over Wi-Fi, and Wi-Fi traffic doubles every three years*.

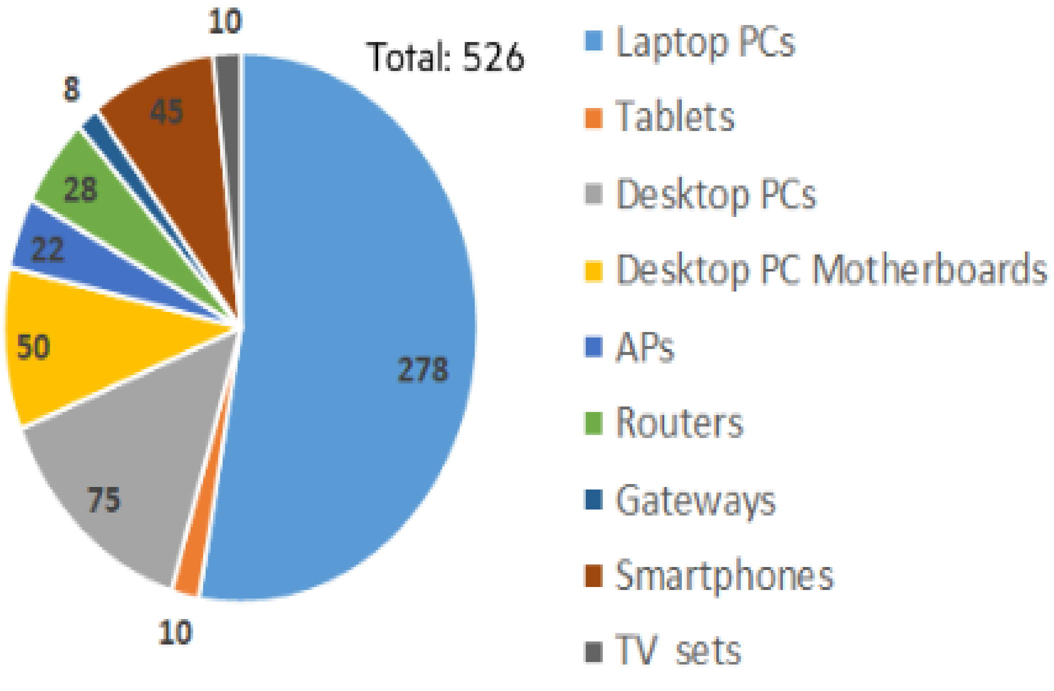


How most people connect to the internet (Source: DSA)

- People spend ~90% of their time indoors. Outdoor broadband usage is typically for short periods.

3. Current Situation on 6GHz Band

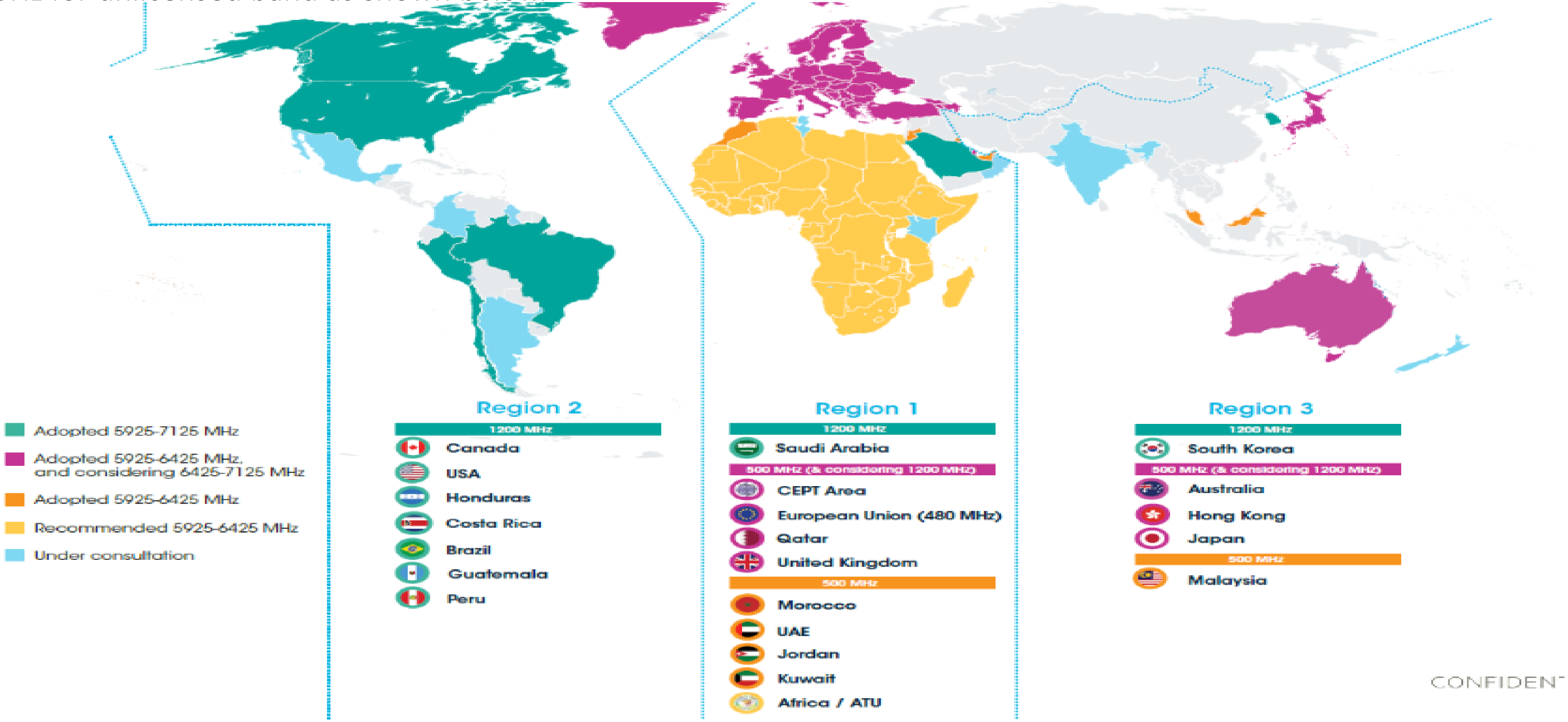
- There is a global momentum in support of licence-exempt use of the 6 GHz band.
  - Numerous countries in all three ITU regions have opened or are in the process of opening the 5925-7125 MHz band for licence-exempt use.
  - After initially making the lower 6 GHz band available for licence-exempt use, Europe is now studying the conditions for coexistence between WAS/RLAN (Wi-Fi) and incumbents in the 6425-7125 MHz band.
  - When defining the Draft WRC-23 position in the RSPG recently, the majority of EU administrations maintained its position from WRC-19 not to support an IMT identification of the 6425-7125 MHz band.
- There is a thriving ecosystem of 6 GHz Wi-Fi chipsets and equipment being shipped globally.



Certified Wi-Fi 6E products
(May 2022)

3. Current Status of Positions

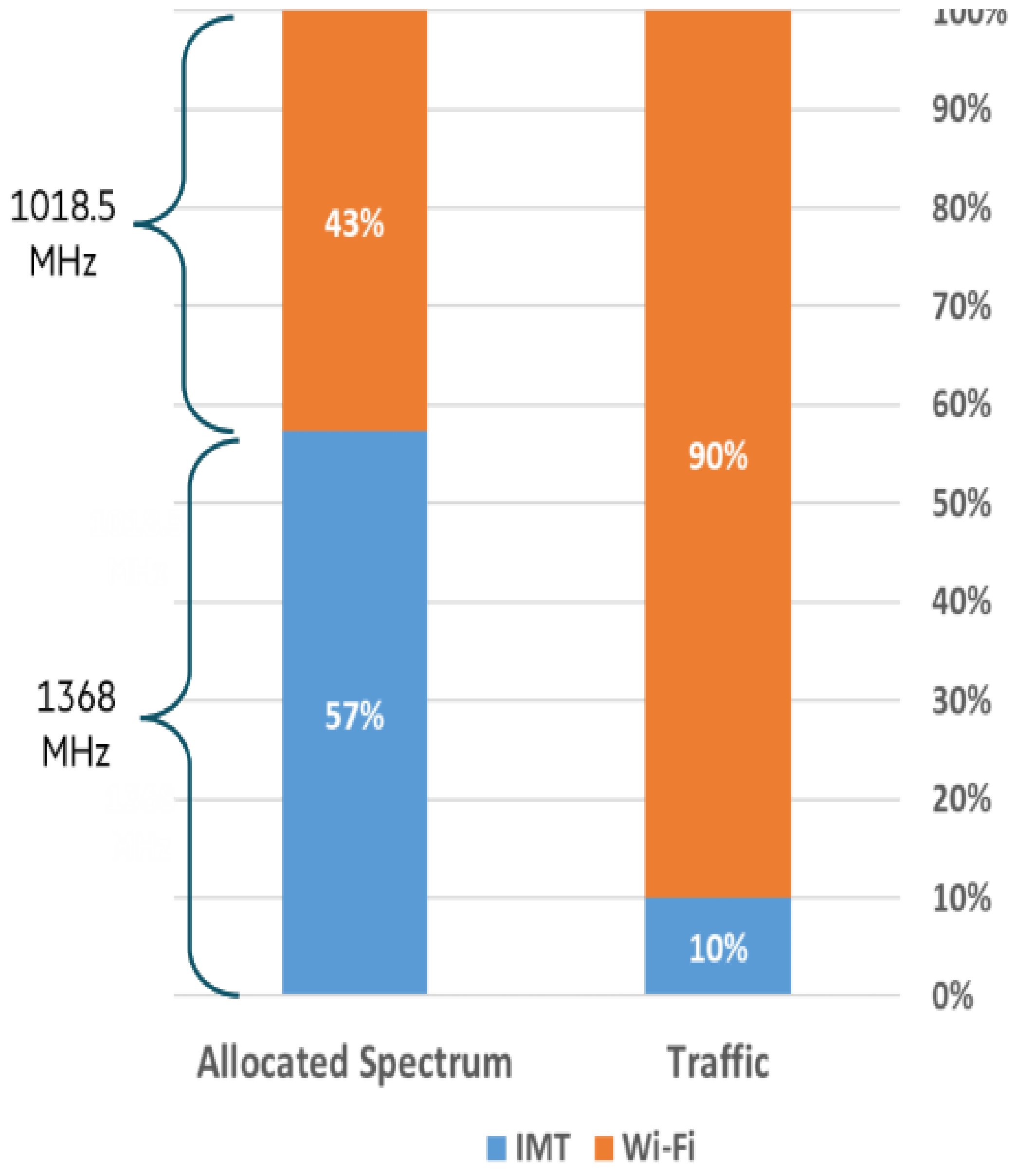
Despite the broad consensus that Appendix 30B allotments should be protected, a few administrations have aligned themselves with pro-IMT positions on the back of technically flawed studies. However, globally, there is a strong momentum in the 6GHz for unlicensed band as shown below.



Protection of national Appendix 30B allotments is a principal requirement for all Administrations on the APAC Region

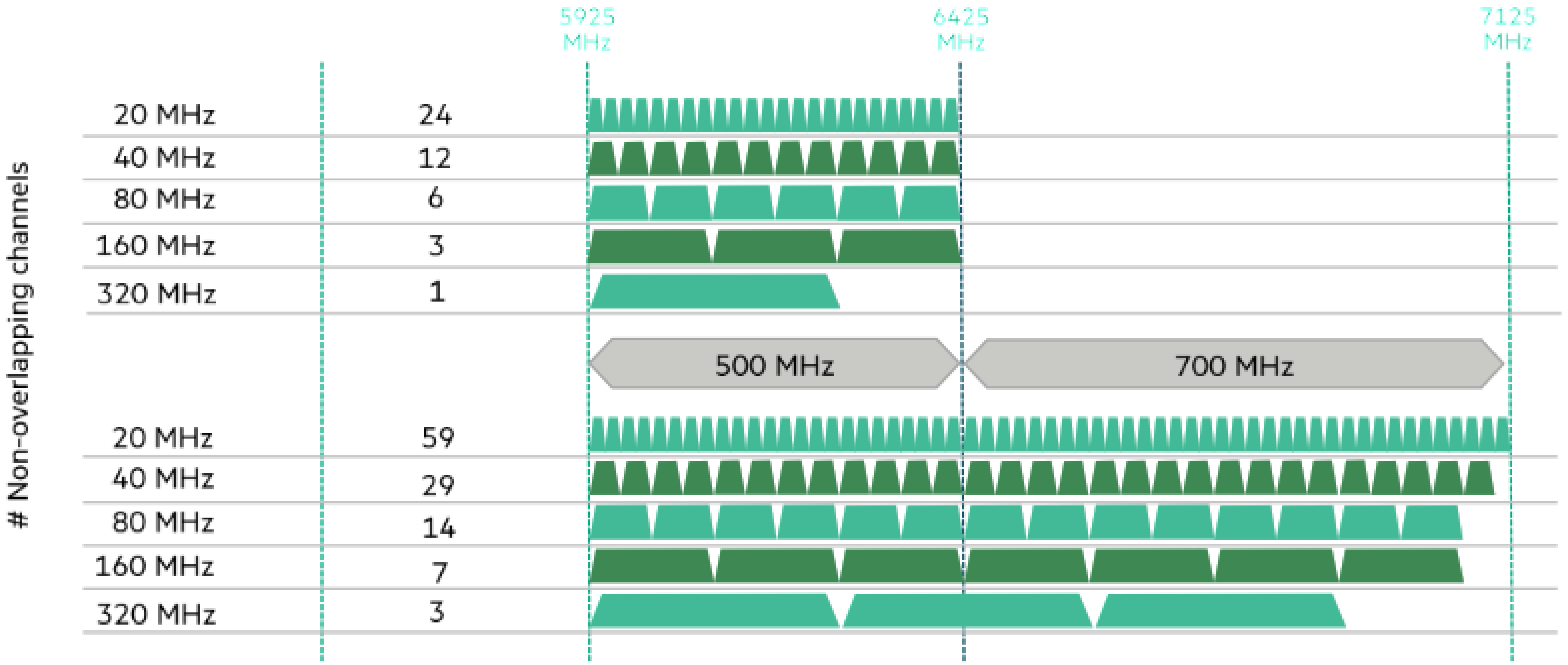
3. IMT AND Wi-Fi Low and Mid-band Spectrum Usage

- Wi-Fi accounts for only 43% of the combined allocated spectrum but carries 90% of the traffic.
- In Germany, for instance, Wi-Fi (operating exclusively in the 2.4 GHz and 5 GHz bands during 2021), delivered approximately 167 GB per Hz of allocated spectrum, compared to 5.2 GB per Hz for mobile networks.
- To turn the vision of a digital world into reality, Wi-Fi must be provisioned with an adequate amount of spectrum.



3. License Exempt Needs the Full 6 GHz Band

- The 5925-7125 MHz band provides a large contiguous bandwidth, more channels, wider channels, more flexible channel assignments (service segmentation and prioritization).
- Opening only the lower 6 GHz band greatly reduces the socio-economic benefits offered by Wi-Fi.



3. Wi-Fi Use Cases of 1200 MHz Spectrum

- High-throughput, high-density, high-reliability, high-versatility, low latency wireless connectivity.

Health care

Application	Latency [ms]	Reliability [%]
Telediagnosis, telemonitoring, and telerehabilitation	50–200	>99.9
Telesurgery	1–10	>99.9999
Exoskeletons and prosthetic hands	5–20	>99.999

Industrial

Application	Latency [ms]	Reliability [%]
Process automation	1–50	>99.99
Human machine interface	50–200	>99.9
Tactile/Haptic technology	1–5	>99.999

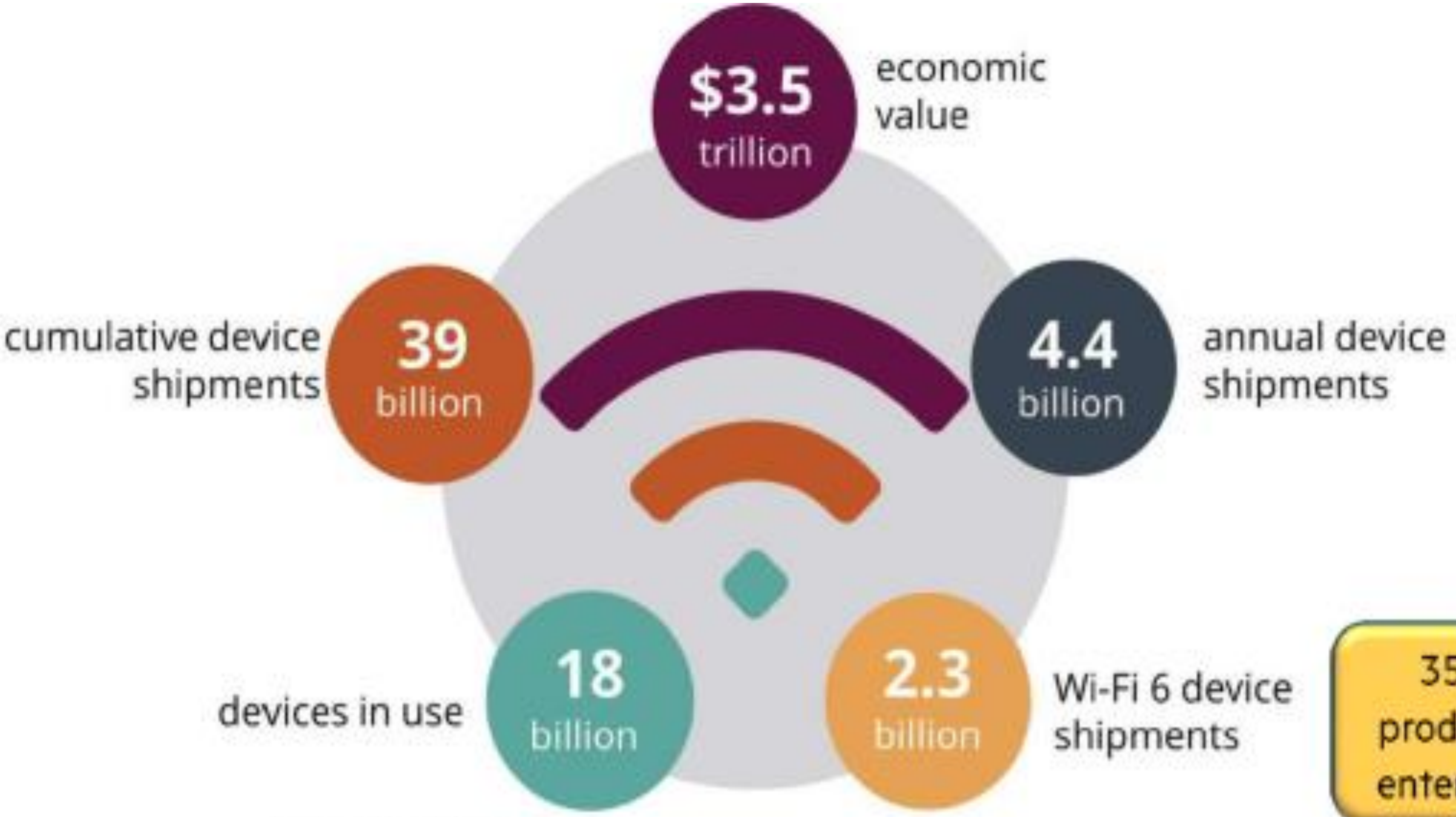
Multimedia

Application	Latency [ms]	Reliability [%]
Real-time high-quality video streaming	3–10	>99.9
Virtual Reality	10–20	>99.9
Augmented Reality	1–50	>99.99
Real-time pro gaming	5–50	>99.9
Cloud gaming	5–50	>99.9

Transport

Application	Latency [ms]	Reliability [%]
Real-time traffic information	40–500	>99
Autonomous vehicle, automated guided vehicle, and drone control	10–100	>99.9999
Remote-controlled vehicle with video	10–100	>99.99

3. Wi-Fi by the Numbers

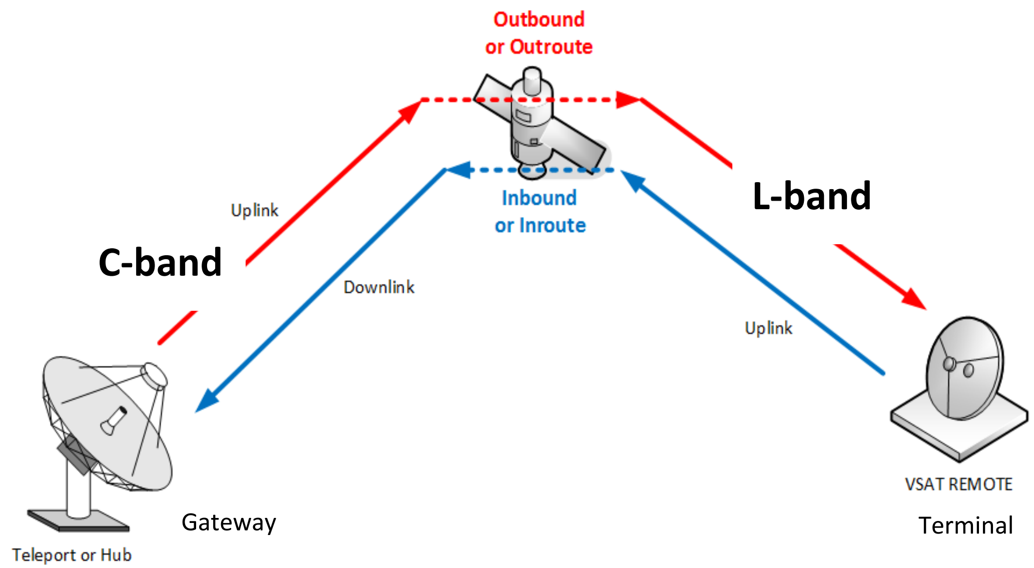


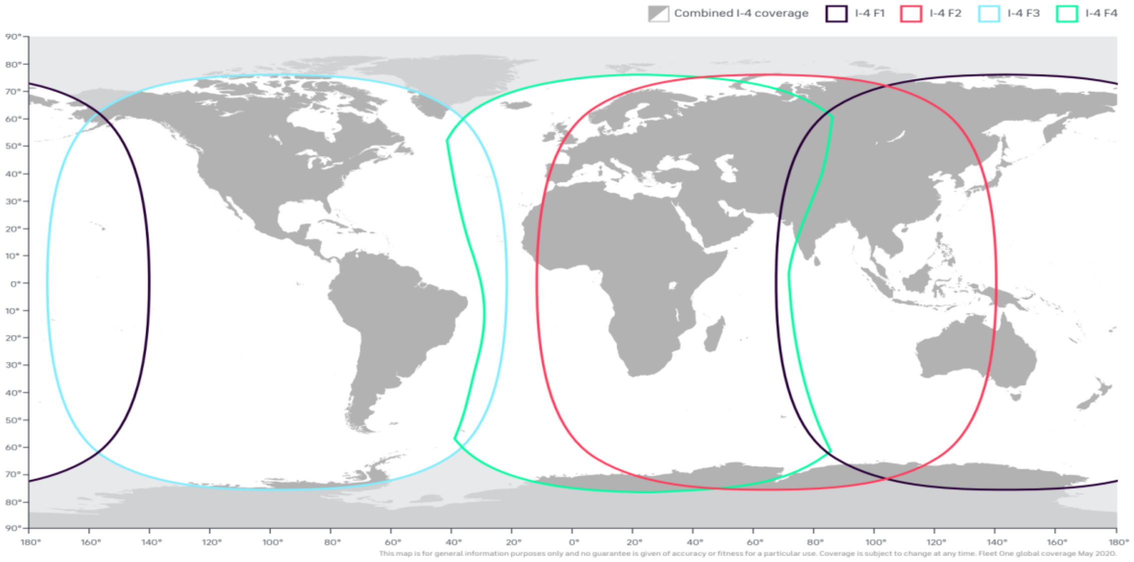
Sources: IDC, Telecom Advisory Services, Wi-Fi Alliance®

350 million Wi-Fi 6E products are expected to enter the market in 2022

4. Use of Uplink in 6GHz

U6 GHz Feeder links are used to carry all L-band traffic, including maritime and aeronautical safety traffic

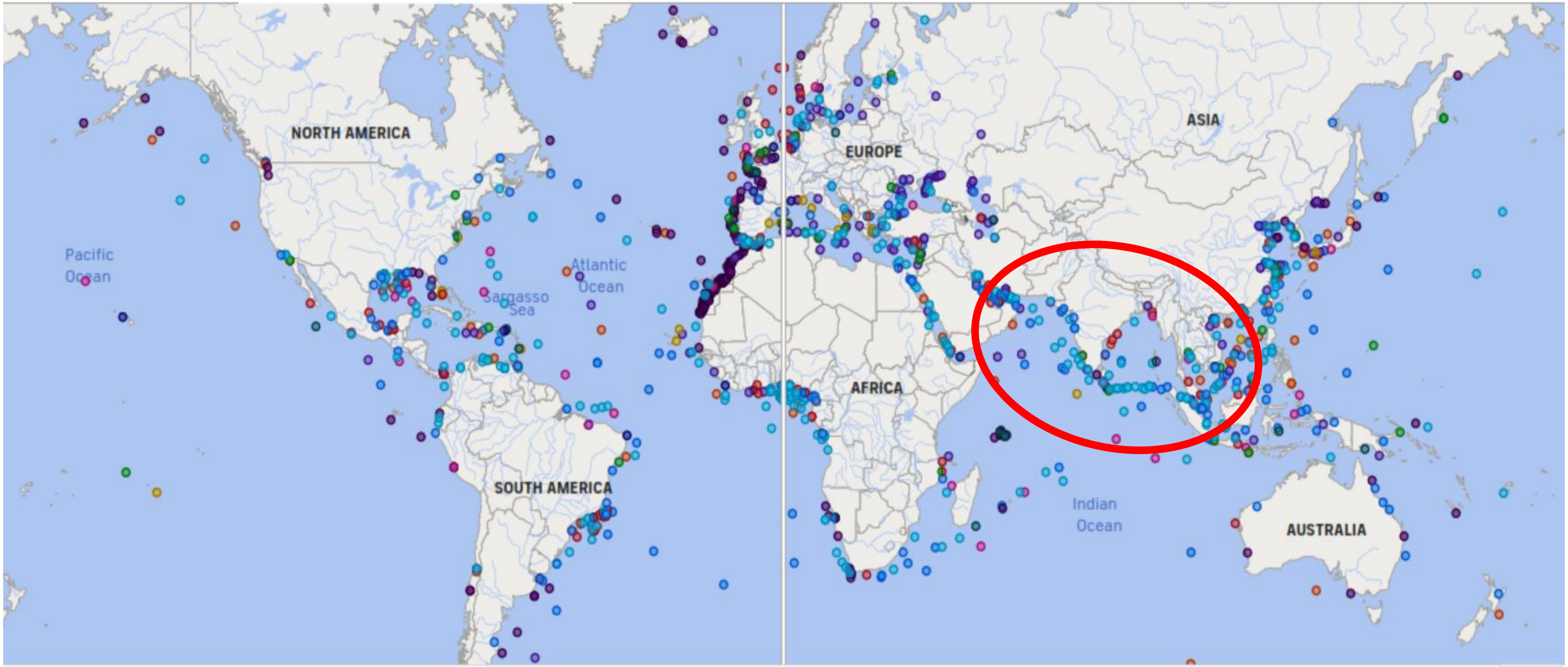




- Used by "global beam" antennas to allow use by gateway stations in almost any country
- Used to support the L-band service downlinks
- Used for feeder links for GNSS augmentation (SBAS) on some satellites

Need to protect critical safety services

4. GMDSS DISTRESS CALLS MAP



Interference to the C band Uplink to the satellite will impact the L-Band downlink for Safety Maritime Services – potentially preventing distress alerts

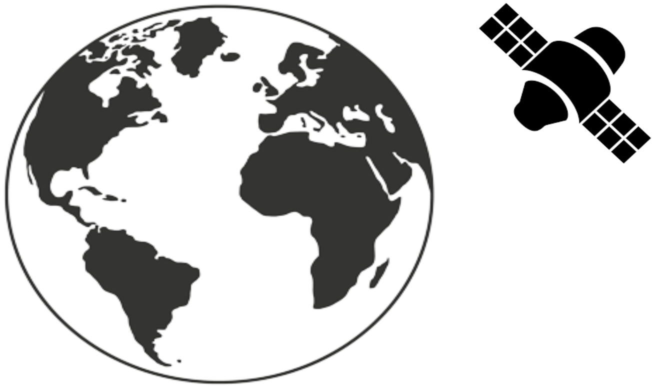
4. Planned Band 6725-7025 MHz – APP 30B considerations

Use of this band by IMT has the potential to make the App 30B allotments unusable

- In ITU Regions, **the band 6725-7025 MHz is subject to Appendix 30B of the ITU Radio Regulations**
- This appendix is intended to **guarantee, for all countries, equitable access to the geostationary-satellite orbit in the 6725-7025 MHz band**.
- Therefore, Many **Developing countries' Administrations have right to operate this band over their territory without time limits.**
- **Any deployment of wireless technologies in the 6725-7025 MHz band will need to protect the Appendix 30B national allotments** of all Developing countries.

EXAMPLE

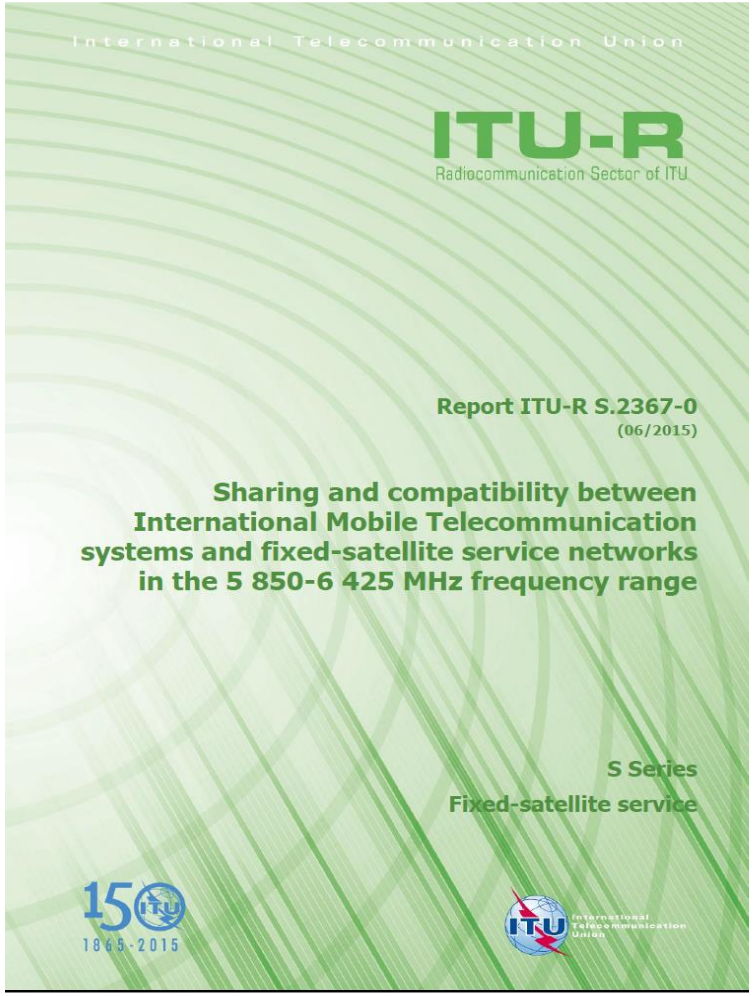
	India
Allotment	INDA00000
Nominal orbital position (deg)	74
Longitude of the boresight (deg)	82.7
Latitude of the boresight (deg)	18.90
Major axis (deg)	6.20
Minor axis (deg)	4.90
Orientation of the ellipse (deg)	120
G_{max}(dBi)	29.6
Receiver temp (K)	500



Use of this band by IMT has the potential to make the App 30B allotments unusable

4. PREVIOUS UPLINK STUDIES (5925- 6425 MHZ)

- Studies have been carried out for **IMT-Advanced in the band 5850-6425 MHz** in **ITU-R Report S.2367**
- **FSS characteristics used in S.2367 are similar to those in the band 6425-6575 MHz**
- Interference from Uplink Ground Earth Stations to IMT-Advanced BSs:
  - Example separation: "10-78 km to protect outdoor macrocell in a suburban environment"
- Interference from IMT-Advanced stations to FSS satellite receivers:
  - ITU-R Report S.2367 conclusion:
    - *that **FSS space receivers would be subjected to excessive levels of interference from the aggregate operation of IMT (small cell) base stations,** irrespective of whether they are deployed outdoors or indoors. It was stated that necessary conditions for deployment of IMT systems would include limitation to indoor only and establishment of strict limits on maximum allowable e.i.r.p. for IMT stations.*

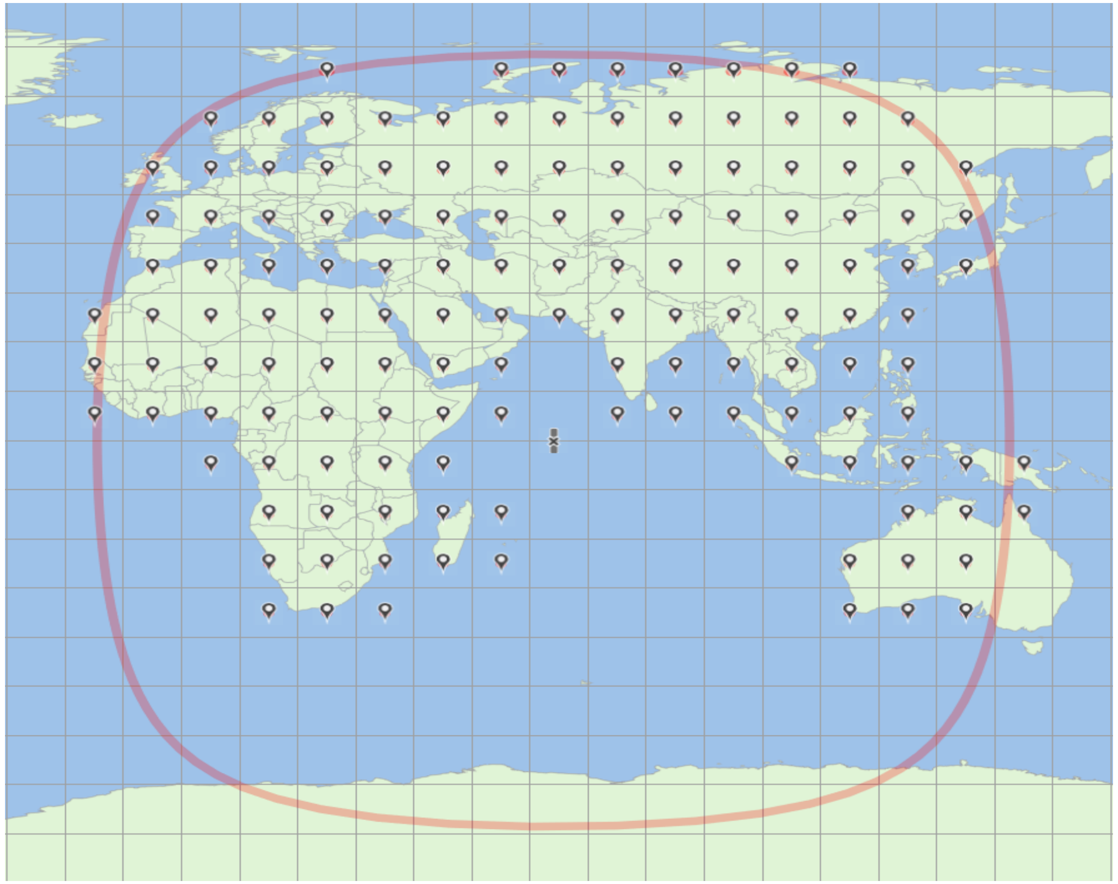


These conclusions are also relevant for the frequency band 6 425-7 025 MHz

4. New Studies - Methodology

All Studies should use Recommended Parameters provided by WP5D & WP4A without adjustment

- WP5D & WP4A provided the necessary parameters to undertake sharing and compatibility studies. July 2021
- Studies take into consideration parameters and assumptions provided by WP5D & 4A.
  - Type of study (Monte Carlo as per M.2102),
  - Satellite location, beam footprint area, elevation angles;
  - Density of BSs, Ra/Rb options, Urban, Suburban & Rural scenarios;
  - Polarization discrimination, AAS, UE power control, elevation angles used in the study, network loading factor (20% or 50%),
  - Clutter loss (application of P.2108, specific percentage, etc.),
  - Interference apportionment from other sources, e.g. FS



All Studies should use Recommended Parameters provided by WP5D & WP4A without adjustment

4. Modelling Assumptions

The outcomes of sharing and compatibility studies are polarised due to differences in modelling assumptions

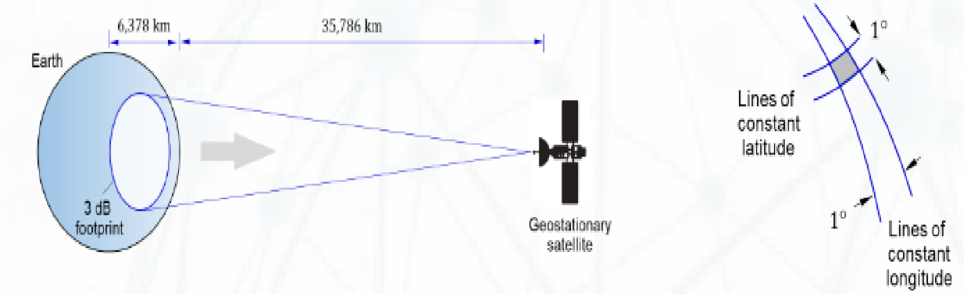
Major Assumptions Driving Different Study Outcomes

1. **Consideration of IMT stations located only within the satellite beam 3 dB contour or throughout the whole area of visibility**
2. **Removing "sparsely populated" areas from the analysis**
3. **Omitting potential interference from mobile systems in Region 3**
4. **Assumptions for the IMT deployment density.**
5. **Inclusion or not of rural base stations**
6. **Apportionment of the interference criterion between multiple services, including other co-primary services (e.g., FS)**
7. **Use of a limited set of FSS characteristics (e.g., considering only the least sensitive satellite characteristics)**
8. **Application of "adjustment factors" to the FSS systems characteristics (e.g. FSS antenna efficiency, feeding network losses)**
9. **Application of different clutter models to IMT base stations**

4. The need to include all “Visible” IMT BSs to the Satellite

It is evident that Area B contains more IMT base stations than Area A

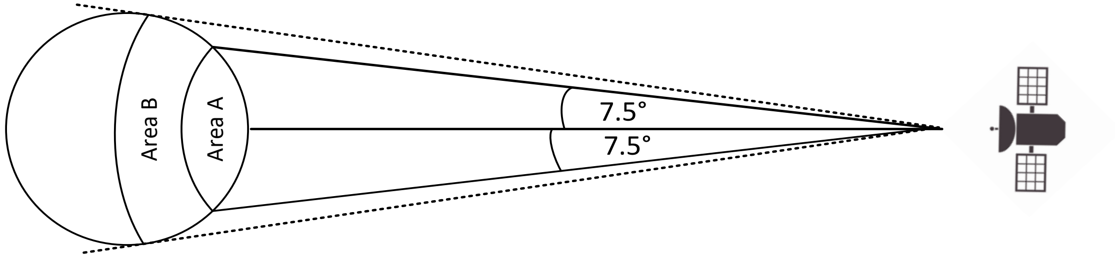
Huawei: Methodology



Step 1 – Calculate the 3 dB beamwidth footprint of the satellite receiving station.

- Exclude unpopulated areas such as the Arctic circle, seas, large deserts/forests.
- Exclude areas where the satellite elevation angle is below 5°.

- The simulation area is then divided into a number of pixels based on a 1° latitude/longitude grid. The area A of each pixel is approximately $111 \times 111 \times \cos(\text{latitude})$ km^2.

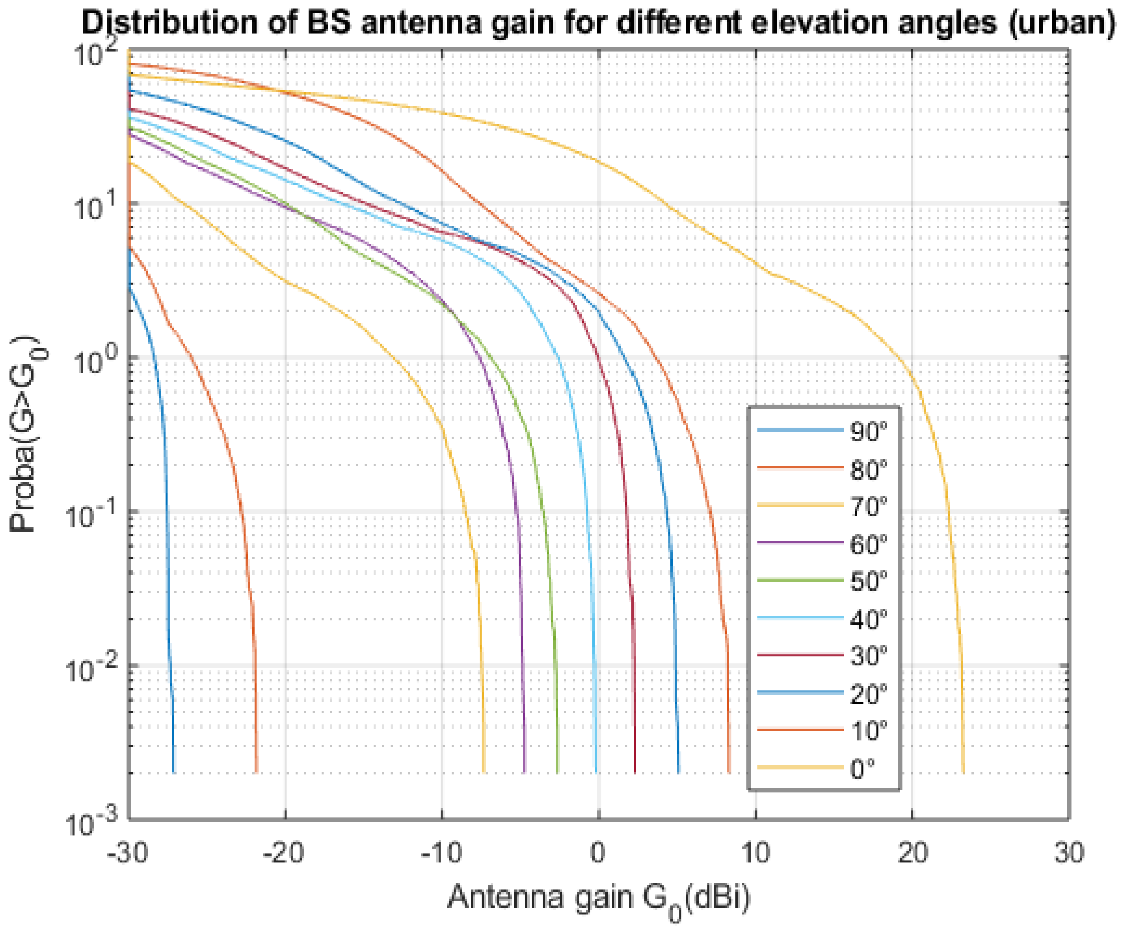


- As we have seen in other studies, limiting the analysis to BSs only in the 3 dB footprint significantly underestimates the interference.
- This is because BSs outside of the 3 dB footprint, which may "see" the GSO satellite at a low elevation angle can contribute more significant interference than those inside the 3 dB contour. To model interference correctly, BSs both inside and outside the contour should be accounted.
- IMT BSs located only within Area A, which corresponds to IMT stations with elevation angles to a GSO satellite between 30.3° and 90°. This equates to an area on the earth’s surface of 99 million sq. km.
- IMT BSs in Area B is not considered in Huawei studies, even though they will contribute to the aggregate interference at the satellite.
- IMT stations in Area B have elevation angles to the GSO satellite between 0° and 30.3°. This equates to an area on the earth’s surface of 118 million sq. km.

Hence Area B contains more IMT base stations than Area A

4. CDF of BS antenna gain for a range of elevation angles

The IMT BSs in Area B transmit much higher EIRP in the satellite direction than those in Area A



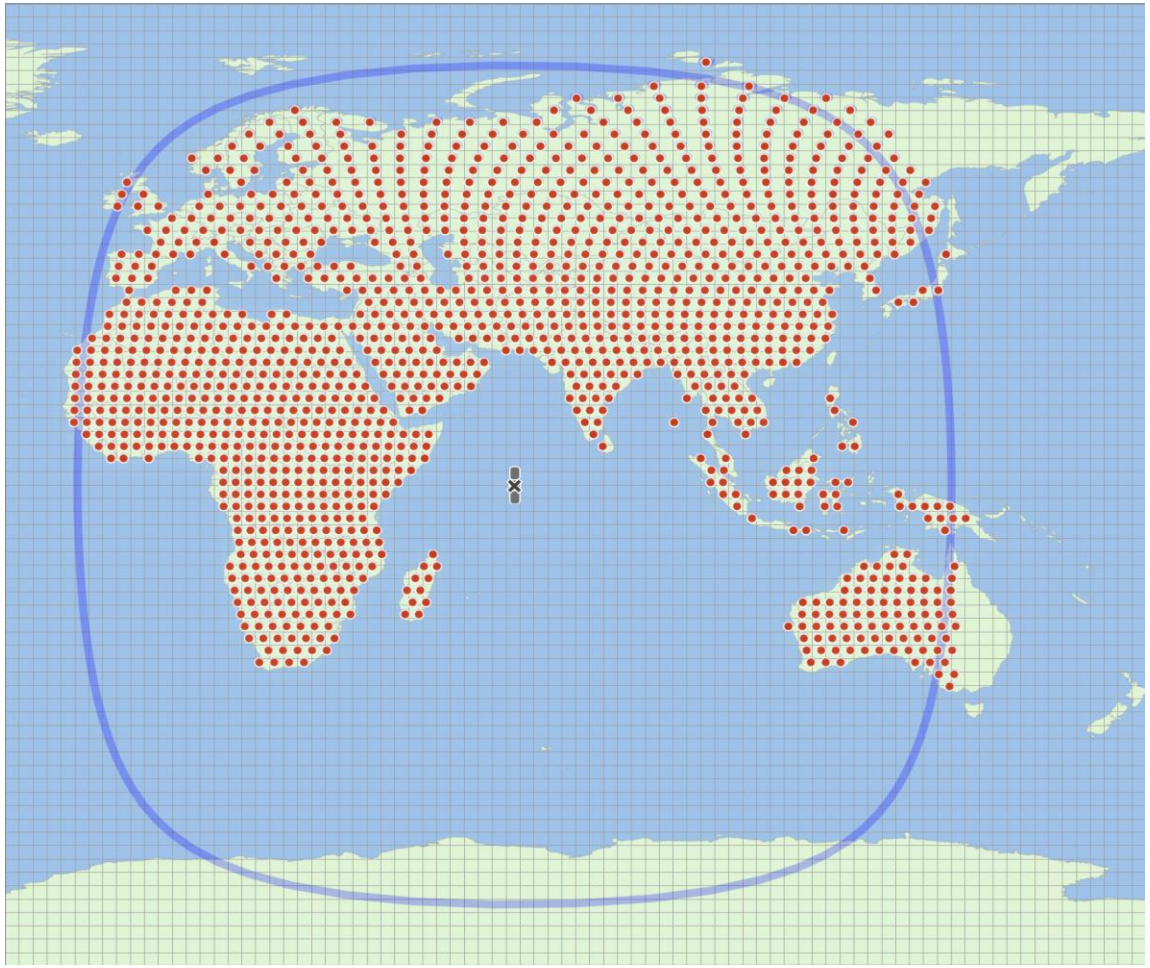
Elevation angle (deg)	Gain exceeded for 10% time (dBi)
0	4
10	-8
20	-13
30	-15

Suburban base station EIRP	73.6	dBm in 100 MHz
Minimum BS antenna discrimination to horizon	1.9	dB
Frequency	6425	MHz
Distance to satellite	41679	km
Basic transmission loss	201.0	dB
Polarisation discrimination	3.0	dB
Sat antenna gain (to the edge of the Earth)	26	dBi
Sat temp	400	K
Sat noise	-92.6	dBm in 100 MHz
Interference received (one IMT station)	-104.4	dBm in 100 MHz
I/N max	-13.5	dB
I max	-106.1	dBm in 100 MHz
Excess interference (from one IMT station)	1.7	dB

The IMT BSs in Area B transmit much higher EIRP in the satellite direction than those in Area A

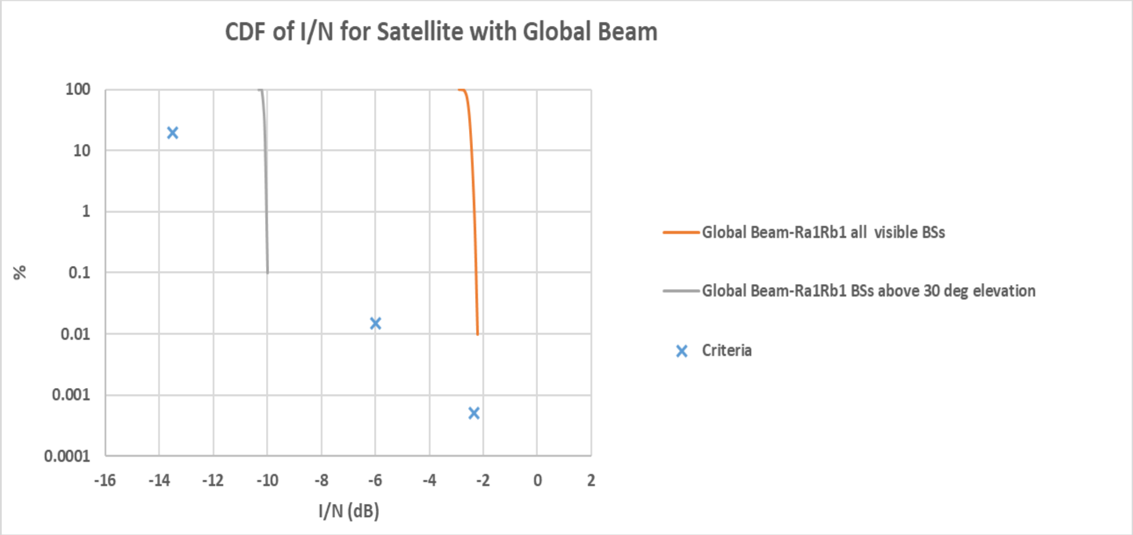
4. Satellite Beam Coverage

It is critical to consider IMT BSs deployed throughout the Visible Area to the Satellite. Those studies that do not include such BSs significantly underestimate the aggregate interference.



Simulations were run for the cases listed below and the results are shown below :

- **Case-1, all BSs visible to the satellite are included.**
- **Case-2, BSs visible to the satellite above 30° elevation angle are included**



	Excess interference in dB	
IMT Deployment scenario	Case-1	Case-2
Ra1 Rb1	11	3.5

7.5dB

It is critical to consider IMT BSs deployed throughout the Visible Area to the Satellite.
Those studies that do not include such BSs significantly underestimate the aggregate interference.

4. Removing “Sparsely populated areas from analysis

	Options *	Macro	Micro
Ra	1	30% Urban (area < 200 000 km^2) 10% Urban (area > 200 000 km^2) 10% Suburban (area < 200 000 km^2) 5% Suburban (area > 200 000 km^2)	10% Urban (area < 200 000 km^2) 5% Urban (area > 200 000 km^2)
	2	45% Urban, 20% Suburban	10% Urban
Rb (depending on the area under study)	1	5% (area < 200 000 km^2) 2% (200 000 - 1 000 000 km^2) 1% (area > 1 000 000 km^2)	5% (area < 200 000 km^2) 2% (200 000 - 1 000 000 km^2) 1% (area > 1 000 000 km^2)
	2	5% (area < 3 500 000 km^2) 3% (area > 3 500 000 km^2)	5% (area < 3 500 000 km^2) 3% (area > 3 500 000 km^2)
	3	2.5% (area < 200 000 km^2) ** 2% (200 000 - 1 000 000 km^2) 1% (area > 1 000 000 km^2)	2.5% (area < 200 000 km^2) ** 2% (200 000 - 1 000 000 km^2) 1% (area > 1 000 000 km^2)

* The Ra and Rb values used in the sharing and compatibility studies should be provided together with the results of studies, for the purpose of comparison, as well as information on which specific geographical location the analysis is applicable to.

** The value is applicable for Region 1, for bands considered globally the value of 5% should be used.

- The values of Rb given in the table range from 1% to 5%. It is stated that “When the size of the area under the study is very large assuming very large satellite-footprint or countries, the Rb value needs to be decreased to reflect sparse population density of the countries.”
- Consistent with this statement, Rb takes low values (1% or 3%) for large areas (> 1 000 000 km^2).
- This reflects that **1% is intended as an average for an area containing some regions with higher values of built area (e.g., 5%) and some regions with lower values of built area (less than 1%, even 0% in some areas).**
- **There is no need to effectively modify the value of Rb by removing some areas even if the value of Rb for those areas is <1%, as some studies have done.**
- **Removing those areas distorts the agreed average for the large area**

Option 1 = Ra1Rb1 = Lowest density - Best case

Option 2 = Ra2Rb2 = Higher density – Worst case

Studies should be conducted for agreed Ra/Rb values throughout the Entire Land Area Visible to the satellite.
The studies that remove IMT BSs only from low population areas are not consistent with existing agreed assumptions and artificially underestimate the interference into the satellite.

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	2	5% (area < 3 500 000 km^2) 3% (area > 3 500 000 km^2)	5% (area < 3 500 000 km^2) 3% (area > 3 500 000 km^2)
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4. Appropriate interference criterion

Frequency Ranges	Percentage of time for which the *I/N* value could be exceeded (%)	*I/N* Criteria (dB) (aggregate)	*I/N* Criteria (dB) (+ 3dB)
6 425-7 075 MHz (E-s)	**20%**	**-10.5**	**-13.5**
	0.001%	-2.33	-
	0.03%	-6	-

- The protection criteria values correspond to the total *I/N* contributions present at the satellite or earth station receiver. **The criteria are aggregate criteria**. hence it is **necessary to consider other potential sources of interference to FSS satellites**

- Several studies related to sharing between IMT and FS systems, **since both FS and IMT systems could potentially operate with geographic separation** and allocated on a co-primary basis, **should be apportioned under equal interference criteria.**

- From all studies on IMT interference that the 20% time (“long-term”) criterion dominates over the short-term criteria, an **equal apportionment of the aggregate criterion would lead to a 3 dB adjustment to the criterion;** hence the **interference from IMT stations would become -13.5dB as shown above**:

Studies should assess interference wrt the criterion: I/N from IMT to exceed -13.5 dB for no more than 20% of the time.

4. Focus - Range of densities IMT deployment assumptions

- Deriving Lowest possible combination of values, as given WP5D by:

  Rb = 1%

  Ra_urban = 10%

  Ra_suburban = 5%

- **Those studies also disregard any IMT deployment in rural areas. These assumptions lead to very low numbers of IMT BSs and very low coverage provided by IMT.** The area covered by 6 GHz IMT macro stations is given by:

  Rb × (Ra_urban + Ra_suburban) = 0.15% of the area for the above values.

- Given that administrations frequently require certain coverage obligations from their operators regarding % population or % coverage, **a service limited only to only 0.15% of any country does not seem credible**.

Country	Area (sq km)	Urban coverage (sq km)	No Urban BSs	Suburban coverage (sq km)	No Suburban BSs	Theoretical Calculation Total BSs	Actual No BSs 2020 (3.6 GHz)
Kenya	580,367	580	1935	290	232	2167	
Nigeria	923,768	924	3079	462	370	3449	
UAE	83,600	84	279	42	33	312	1500
UK	242,495	242	808	121	97	905	6500

IMT deployment assuming the lowest density settings can significantly underestimate the number that may actually be deployed in the 6 GHz band in the future.

Studies should consider a range of values for Ra/Rb, including the highest values agreed already (which leads to 2.02 % of land having IMT coverage – still a low number).

4. Appropriate interference criterion

Frequency Ranges	Percentage of time for which the *I/N* value could be exceeded (%)	*I/N* Criteria (dB) (aggregate)	*I/N* Criteria (dB) (+ 3dB)
6 425-7 075 MHz (E-s)	**20%**	**-10.5**	**-13.5**
	0.001%	-2.33	-
	0.03%	-6	-

- The protection criteria values correspond to the total *I/N* contributions present at the satellite or earth station receiver. **The criteria are aggregate criteria**. hence it is **necessary to consider other potential sources of interference to FSS satellites**
- Several studies related to sharing between IMT and FS systems, **since both FS and IMT systems could potentially operate with geographic separation** and allocated on a co-primary basis, **should be apportioned under equal interference criteria.**
- From all studies on IMT interference that the 20% time ("long-term") criterion dominates over the short-term criteria, an **equal apportionment of the aggregate criterion would lead to a 3 dB adjustment to the criterion;** hence the **interference from IMT stations would become -13.5dB as shown above**:

Studies should assess interference wrt the criterion: I/N from IMT to exceed -13.5 dB for no more than 20% of the time.

4. Use of only the most favourable FSS characteristics

- **WP 4A provided 8 carrier types for use in the studies,** reflecting a range of different FSS system designs and operations in the upper 6 GHz band;
- Some studies have chosen to focus **their analysis only on "Carrier 1"**, which is the **least sensitive to interference** (having a low peak gain global beam, and relatively high noise temperature).
- Interference to **satellites using a "hemispherical beam" or "spot beam" are more sensitive to interference**.

	Excess interference in dB		
Deployment scenario	**Global beam**	**Hemispherical beam**	**Spot beam**
Ra2 Rb2	21	23.9	25.3
Ra1 Rb1	11	13.7	15

Studies that have assessed interference only to the "global beam" FSS carrier should be expanded to cover other FSS systems, as provided by WP 4A.

4. Inappropriate "adjustment factors" to FSS systems

- Some Studies have applied "**adjustment factors" to the FSS system parameters**, claiming that the adjustments are necessary to account for a problem with the Recommendation S.672 pattern recommended by WP 4A, to **account for antenna efficiency, and to account for feeder loss.**

- These studies have **claimed a total adjustment of 6.3 - 7 dB on the satellite Receiver, contrary to WP4A recommendations**.

- WP 4A is now addressing these issues. In the meantime, **it cannot be assumed that any of the proposed adjustments are technically valid**.

Studies using the above adjustments should be revised, to follow the parameters provided by WP 4A without change

4. Comparison of Studies (6425- 7125 MHz)

Some Studies show co-existence by reducing the impact to the satellite by as much as 21 – 25 dB

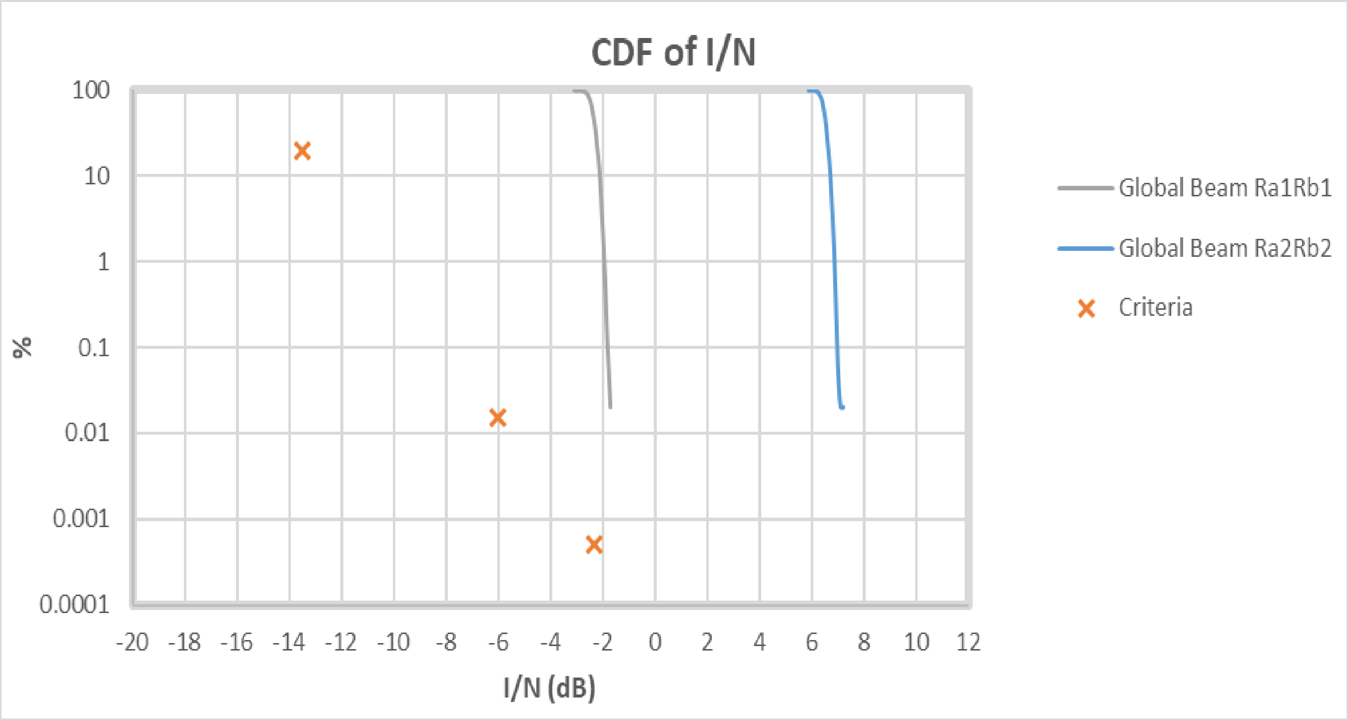
Comparison of Studies	GSOA	Other Studies
1. Consideration of all visible IMT stations within the satellite landmass footprint versus only IMT BSs within the 3 dB contour.	All satellite visible area	Applied 3 dB contour – reducing the landmass coverage area i- **Reducing impact by as much 7dB**
2. Removing "sparsely populated" area from the analysis	Rural deployment included inline with 5D guidelines	No rural considerations - **Reducing impact by 2 - 3dB**
3. Using only the most favourable – and seemingly unrealistic – assumptions for the IMT deployment density	Based on WP 5D Recommendations for best & worst-case scenarios	Not consistent & in line with 5D for IMT BSs deployment – deployed over the smaller area. **Reduce impact by 2 – 3dB**
4. Applying interference criterion without adjustment for multiple sources of interference (FS links)	Taking into account impact of FS links	Ignored impact of FS on interference **Reducing impact by 3dB**
5. Use of only the most favorable FSS characteristics – others that lead to greater interference being ignored (not considering regional/spot beams)	Based on WP4A Recommendations recognizing on the need to protect AP30B	Ignored impact on regional / Spot beams **Reducing impact by 3 – 4 dB**
6. The application of inappropriate "adjustment factors" to the FSS systems characteristics includes modified antenna patterns, antenna efficiency, and feeder loss.	Taken WP4A recommended criterion based on the last 25 yrs of studies	Dismissive of the WP4A Rec criterion & applied own assumptions **To reduce impact by 4 – 5dB**

Some Studies show co-existence by reducing the impact to the satellite by as much as 21 - 25dB

4. Outcome of Uplink Studies (6425- 7125 MHz)

Based on WP5D & WP4A Recommended Parameters, the Studies show that aggregate interference from IMT BSs exceeds the long-term I/N criteria of FSS Rx

- The initial results (I/N) show that **aggregate interference from IMT base stations exceeds both the long-term and short-term criteria of FSS receivers for all cases**, i.e. for both the highest and lowest IMT deployment densities and for all three satellite beams considered.
- **The CDFs are near vertical, indicating an almost constant level of aggregate interference.**



Based on WP5D & WP4A Recommended Parameters, the Studies show that aggregate interference from IMT BSs exceeds the long-term I/N criteria of FSS Rx

4. Future Utilisation of 6 GHz - Key Considerations

- **On 6 GHz Wi-Fi – Establish national policy for the growth of unlicensed band services**, given the growing use of Wi-Fi hotspots – consider adopting full-band 5925 GHz to 7025 GHz for expected demand and include development of Wi-Fi 6E and 7 for nationwide indoor implementation [growing need to utilize entire 1200 MHz – 5925-7125 MHz – many countries are opting for this includes U.S., Saudi Arabia, Canada, South Korea, Brazil..]

- **For 5G/IMT spectrum - examine current utilization, spectrum already available, and possible future requirements**, re-farm existing spectrum, use alternative bands, evolutionary development, etc

- **Appendix 30 B- FSS protection** - **National/Regional protection of band 6725-7025 MHz** subject to Appendix 30B of the ITU Radio Regulations. Domestic development of satellite-based services includes bridging the digital divide, particularly among many developing countries.

- **Preserving provisioning of safety services -** National / Regional considerations for national emergencies /disasters, maritime and aeronautical services in compliance with IMO & ICAO requirements. National and Regional Rescue Coordination operations (RCC).

APAC n users rely heavily on C-band satellites offering vital services that, in many cases, cannot be reliably provided at all by other means. Given the above factors together with existing ITU-R studies between FSS and IMT, it is evident that IMT sharing is not practical nor feasible in 6 GHz Bands with FSS BUT sharing with Wi-Fi is feasible with acceptable power constraints:

4. Update from WP5D on Methods

Band 4 – 6 425-7 025 MHz (Region 1) PROPOSED METHODS FOR CPM

Method 4A

This method proposes no change to the allocations in the frequency band 6 425-7 025 MHz in Region 1 and proposes the suppression of Resolution 245 (WRC-19).

Method 4B

This method proposes to identify the frequency band 6 425-7 025 MHz in Region 1 for IMT by creating a new RR footnote without any conditions.

Method 4C

~~This method proposes to identify the frequency band 6 425-7 025 MHz, or portions thereof, in Region 1 for IMT by creating a new RR footnote without any conditions.~~

Method 4D

This method proposes to identify the frequency band 6 425-7 025 MHz, or portions thereof, in Region 1 for IMT by creating a new RR footnote with conditions that are contained in a new Resolution.

4. Update from WP5D on CPM Method

Band 5 – 7 025-7 125 MHz (globally)

Method 5A

This method proposes no change to the allocations in the frequency band 7 025-7 125 MHz, and proposes the suppression of Resolution 245 (WRC-19).

Method 5B

This method proposes to identify the frequency band 7 025-7 125 MHz for IMT by creating a new RR footnote without any conditions.

Method 5C

~~This method proposes to identify the frequency band 7 025-7 125 MHz, or portions thereof, for IMT, by creating a new RR footnote with conditions which are contained in a new Resolution.~~

Method 5D

This method proposes to identify 7 025-7 125 MHz for IMT by creating a new RR footnote with a requirement to implement technical measures to protect SOS (Earth-to-space) in the band 7 100-7 155 MHz.

5. Open Discussion

5. Innovation in Satellite Connectivity

GLOBAL SAFETY IN L-BAND

A critical layer of always-on connectivity with all-weather resilience.

TERRESTRIAL 5G

Ultra-high capacity at high demand hot spots - supplemented by the power of dynamic wireless mesh networking.

LEO – CONSTELLATIONS

Small complementary constellation layering additional high capacity over further high demand areas.

GLOBAL BROADBAND – Ka-Band

Reliable, high-speed, global coverage with security and full redundancy.

WiFi – 6E / 7

High capacity contiguous bandwidth serving high demand indoor hot spots for multiple AR/VR applications

Digital Transformation through evolution of a unique, multi-dimensional, dynamic mesh network bringing together various access technologies


Portfolio of SATCOM Applications
Airborne intelligence, surveillance for Unmanned vehicles
High-throughput connectivity
Satellite enhances agriculture productivity & food security
Real-time operations & monitoring
Global narrowband satellite network – ideally suited for IoT
Latest evolution of satcom network

5. Future Satcom Innovation / Opportunities

- Currently, Satellite Services (FSS, MSS, & BSS) are extensively utilized across a portfolio of services and applications throughout the India / APAC Region and form part of the national infrastructure

- Critical applications include safety-related services for Land mobile, Maritime and Aeronautical operations that include GMDSS and GADSS that require safeguarding and protection

- Future evolution of Satellite services provides tremendous scope and opportunity for India to integrate within a digital platform and promote a new generation of continent-wide applications and services, including AR/VR

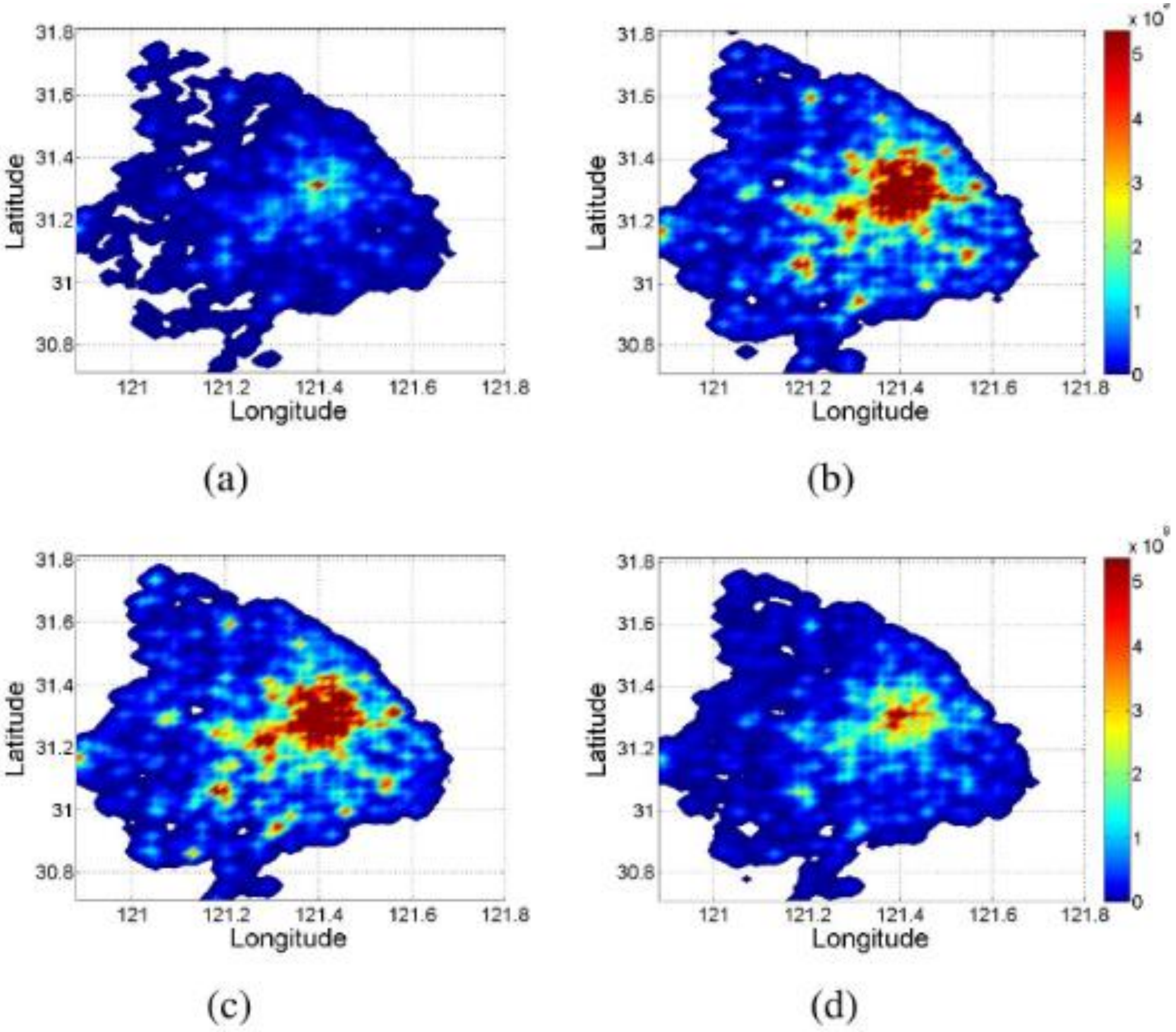
- New generation of satcom networks will provide opportunities for India to consider the integration of multiple access technologies as part of their national digital transformation and to export this innovation continent-wide

- Close cooperation with APAC countries to consider how best to bring about the next generation of innovative solutions through the internet to its digital transformations requirements

5. What would IMT in the 6425-7125 MHz Band be used for?

- **To provide additional outdoor coverage in dense urban and, to a lesser extent, sub-urban areas.**
  - These are the areas that are seeing massive FTTH build-outs.
  - Providing satisfactory indoor coverage from outdoor IMT base stations is not feasible, neither technically nor economically. Building entry loss can exceed 50 dB, resulting in unpredictable indoor signal quality and increased power consumption.
  - Even in dense urban areas, traffic peaks occur only in a small fraction of those areas which can be addressed by densification of mobile networks using allocated mobile spectrum.
  - For coexistence reasons, restrictions would have to be imposed on 6 GHz IMT deployments which would render the business case for outdoor macro-cell deployment infeasible.
- **Enterprise use cases which enhance productivity are not addressed.**
  - For enterprise use cases that could benefit from licensed spectrum, dedicated locally licensed spectrum for local/private IMT networks can be assigned in other bands. Nationwide allocations of a large amount of licensed spectrum are unnecessary.
- **While Wi-Fi covers many use cases, IMT 5G is mostly about entertainment.**
  - Wi-Fi connectivity is an essential feature of a variety of equipment while IMT is mostly used in smartphones.
  - In the APAC region people who have access to smartphones mostly use the Internet to access social media*.
  - Although social media may bring benefits to individuals, communities and businesses, its ultimate effect in building digital societies or economies is very limited*.

5. Urban areas have Enough Mobile Spectrum - Shanghai



Spatial distribution of cellular traffic at different times.
(a) 4 a.m. (b) 10 a.m. (c) 4 p.m. (d) 10 p.m.

The graphs on the left show that even at the busiest times (top right and bottom left) the areas where peak demand occurs represent approximately 9% of the urban area.

- Even in dense urban areas mobile spectrum capacity is never reached outside small locations and only at certain times of the day.
- More nationwide mobile spectrum is a solution for a problem that does not exist."

Source: "Understanding Mobile Traffic Patterns of Large Scale Cellular Towers in Urban Environment"; IEEE/ACM TRANSACTIONS ON NETWORKING, VOL. 25, NO. 2, APRIL 2017)

5. Opening the full 6 GHz band for license-exempt use is the right choice for India

- Licence-exempt = technology neutrality (Wi-Fi, 5G NR-U, others) = flexibility, choice, and innovation.
- Wi-Fi enhances efficiency and productivity, whether it is in education, health, SMEs, or large enterprises, and makes services available to consumers where they need them most, i.e. indoors..
- Global harmonization of the full 6 GHz band for licence-exempt use is already in progress – countries in all three ITU regions have opened the full band – any delay would impact citizens and businesses.
- The 6 GHz Wi-Fi ecosystem is thriving and opening the band would yield benefits in a short time. No such ecosystem exists for IMT in that band and may not for many years.
- Designed to share spectrum, Wi-Fi can coexist with the incumbents (FSS, FS) in the band.
- In **India** the network infrastructure is based on satellite and fiber. Wi-Fi complements and strengthens these technologies.
- An IMT identification of the upper 6 GHz band is unnecessary and would block the band for years.
  - The process of IMT identification, fine-tuning of coexistence rules for each country (requiring studies), removal of incumbents, allocation of spectrum, definition of licensing conditions, auction processes and assignments would take years. All of this before MNOs could start install the first base stations.
  - The restrictions that would have to be imposed on 6 GHz IMT deployments (for coexistence reasons) would make the business case for outdoor macro-cell deployment more than questionable.

THANK YOU FOR LISTENING