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ITU-APT Foundation of India
ITU's Association in India

"5th National Preparatory Workshop for WRC-23"

Agenda Item 1.2 - Focus on 6 GHz

14 February 2023

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WRC-23 Agenda Item 1.2

Agenda Item 1.2 *to consider identification of the frequency bands 3 300-3 400 MHz, 3 600-3 800 MHz, 6 425-7 025 MHz, 7 025-7 125 MHz and 10.0-10.5 GHz for International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution 245 (WRC-19);*

Responsible Group: Working Party 5D

Resolution 245 (WRC-19) calls for studies for the terrestrial component of IMT in the bands:

– 3 300-3 400 MHz and **3 600-3 800 MHz (Region 2);**
– 3 300-3 400 MHz (amend footnote in Region 1);
– **6 425-7 025 MHz (Region 1);**
– **7 025-7 125 MHz (globally);**
– 10 000-10 500 MHz (Region 2),

Current APG Position:

APT Members are of the view that any possible IMT identification in the frequency band 6 425-7 025 MHz in Region **1 shall protect the services to which the frequency band is allocated on a primary basis (and in adjacent bands, as appropriate) in Region 3 so that these services shall in no way be adversely affected**. APT Members support the ongoing Sharing and compatibility studies in ITU-R in accordance with Resolution 245 (WRC-19) for the frequency band.

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3 600-3 800 MHz (Region 2)

Background C-band downlink (3 600-3 800 MHz (Region 2)):

- Existing studies between FSS and IMT in this frequency band were included in **Report ITU-R S.2368**:
  - "In the case of IMT-Advanced suburban/urban macro-cell deployment scenarios: For the long-term interference criterion, the required separation distances are at least in the tens of km. For the **short-term interference criterion, the required separation distances**, including when the effects of terrain are taken into account, **exceed 100 km for most of the cases**."
  - "The **FSS protection criteria should be used to determine the necessary separation distances to ensure the protection of the existing and planned FSS earth stations.** When **FSS earth stations are deployed in a typical ubiquitous manner** or with no individual licensing, **sharing between IMT-Advanced and FSS is not feasible in the same geographical area since no minimum separation distance can be guaranteed**. Deployment of IMT-Advanced would constrain future FSS earth stations from being deployed in the same area in the bands 3 400-4 200 MHz and 4 500-4 800 MHz as shown by the studies."
- **Countries rely heavily on C-band satellite services offering vital services, which in many cases cannot be reliably provided or provided at all by other means.** There is a high number of earth stations deployed, including business-to-consumer (B2C) services, which comprise a very significant number of smaller, often self-installed, antennas located in consumer households.
- **Satellite operators in Region 2 operate existing satellite systems in band 3 600-3 800 MHz (s-E) and have long-term plans for the use of these bands for both existing operations and future satellite systems**. There are no plans to transition to different bands since the bands mentioned above have unique characteristics, such as low degradation to rain fade. In contrast, higher satellite bands (Ku, Ka) are extensively used by existing geostationary and non-geostationary satellites and face high demand for future geostationary satellites and constellations of non-geostationary systems.

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3 600-3 800 MHz (Region 2)

CPM Report Methods

In addition to “No Change” (Method 3A), various Methods were developed in the draft CPM text, including country footnote in 3.6-3.7 GHz (Method 3E) and Region 2 footnote in 3.6-3.7 GHz (Method 3F). A view by Russia was put against all Methods that do not include a short term pfd limit.

Protection conditions for incumbents in Methods	9.21	9.17/9.18	Long term pfd limit	Short term pfd limit	Table 21-4
Method A	NO CHANGE				
Method 3B (USA) 3600-3800 MHz in R2					X
Method 3C (F) 3600-3800 MHz in R2		X	X		X
Method 3D (RUS) 3600-3800 MHz in R2		X		X	X
Method 3E (GSOA/MEX) 3600-3700 MHz country FN	X	X	X		X
Method 3F (GSOA/B) 3600-3700 MHz R2 FN	X	X	X		X

GSOA supports Method A

6 425-7 025 MHz (Region 1)
7 025-7 125 MHz (globally)

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

Unplanned Band - 6425-7075 MHz – FSS E-S

- For geostationary uplinks used by large numbers of GSO FSS networks covering all regions, includes Inmarsat use

Planned Band - 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..."

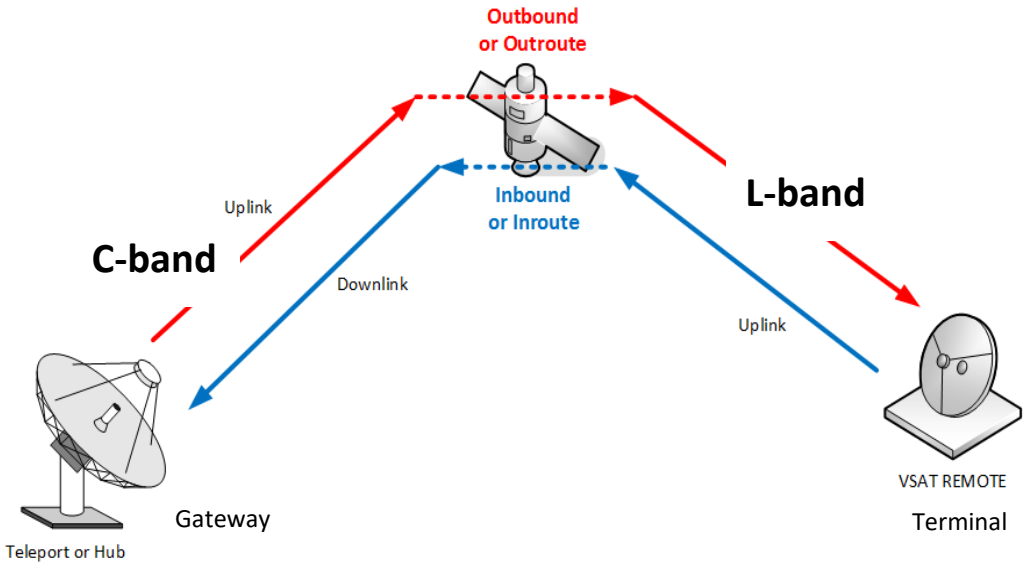
6700-7075 MHz - NGSO MSS DL

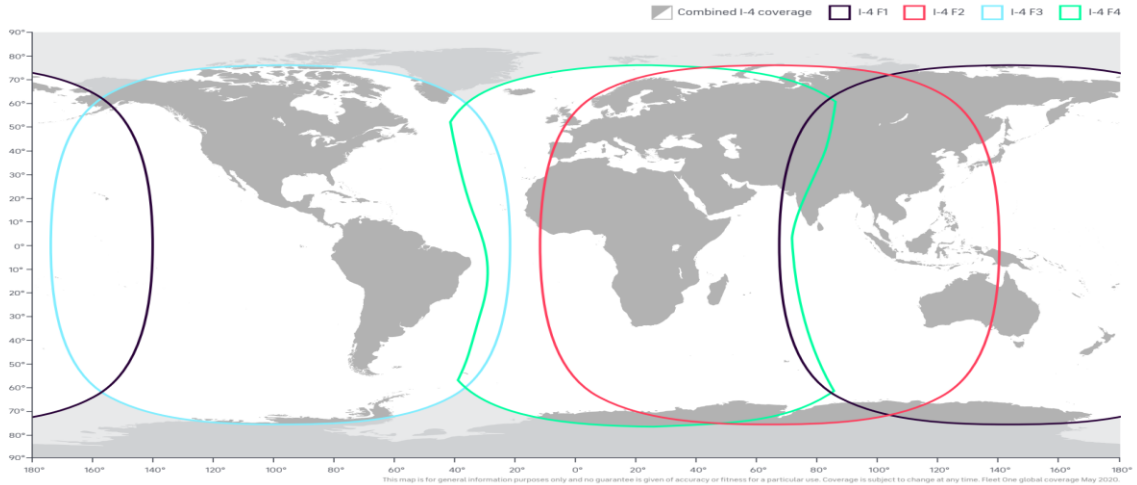
- Gateway earth stations deployed around the world for NGSO MSS systems (e.g., GlobalStar, OmniSpace, EchoStar Helios)
- Providing voice, data, and Internet of Things globally

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

Current status of the 6 GHz Band

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-related services

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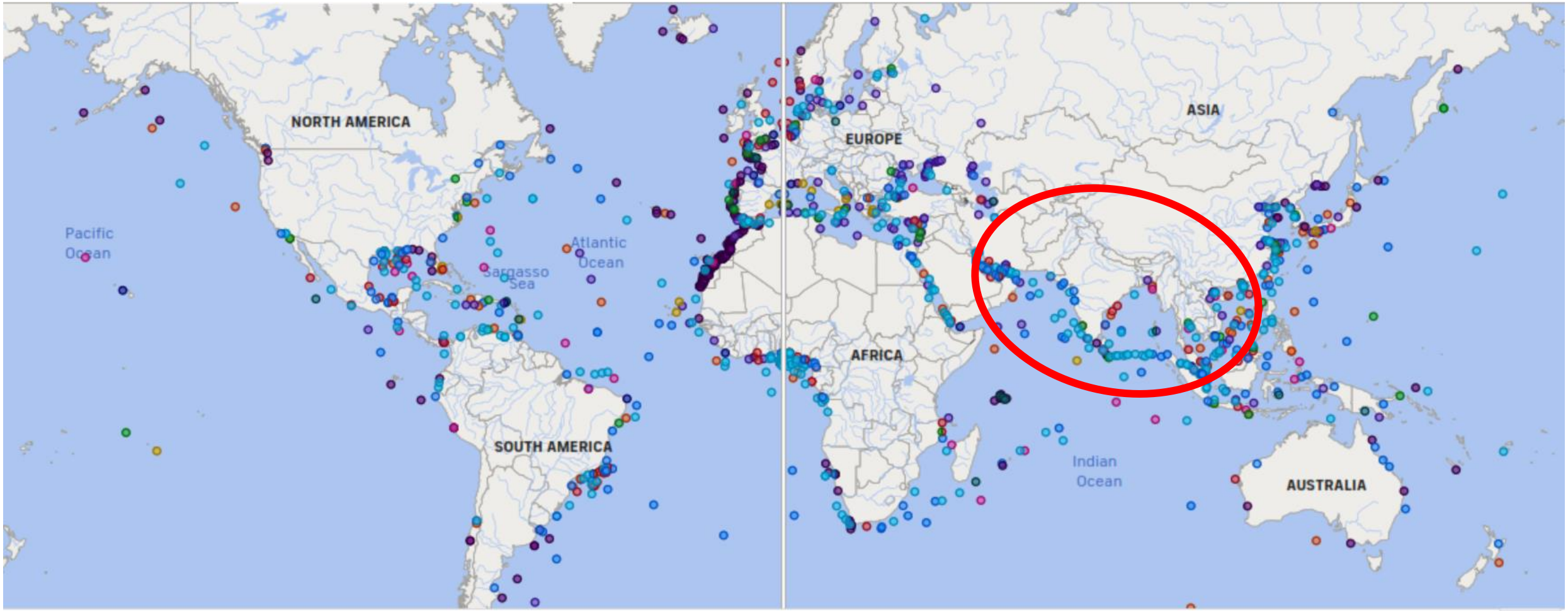
GMDSS Distress Calls Map



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

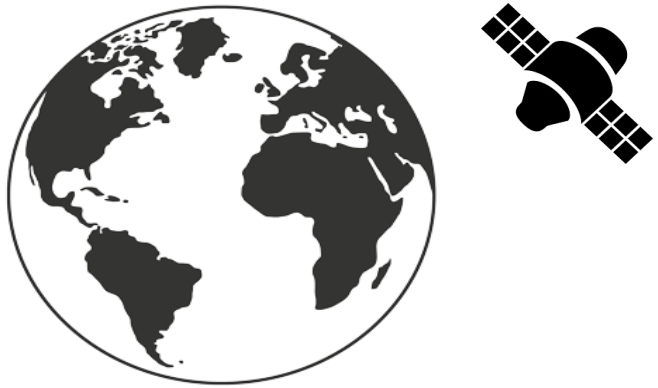
Planned Band 6725-7025 MHz – APP 30B considerations

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

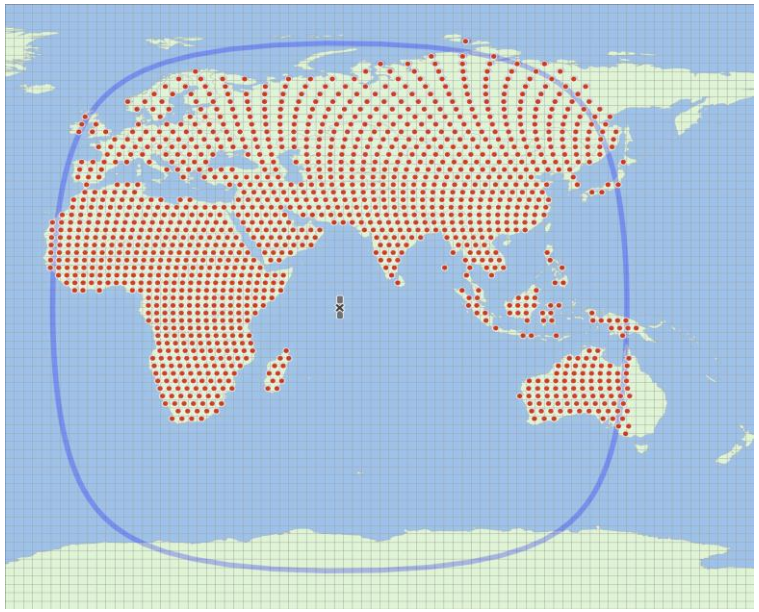
	India
Allotment	INDA00000
Nominal orbital position (deg)	74
Longitude of the boresight (deg)	82.7
Latitude of the boresight (deg)	18.90
Major axis (deg)	6.20
Minor axis (deg)	4.90
Orientation of the ellipse (deg)	120
G_{max}(dBi)	29.6
Receiver temp (K)	500

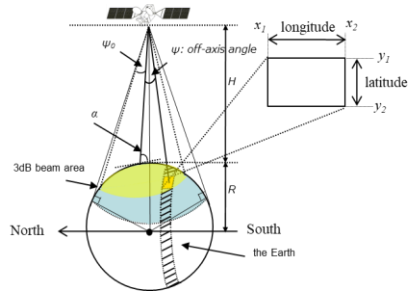


Use of this band by IMT has the potential to make the App 30B allotments unusable

6 425-7 025 MHz (Region 1)
7 025-7 125 MHz (globally)

WP 5D Study Results





WP 5D working document contains 20 studies:

- Some show interference **above** the criterion
- Some show interference **below** the criterion

GSOA results for **low** density of base stations (Ra1Rb1) and **high** density of base stations (Ra2Rb2) show interference above the criterion:

	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**

Results are dependent on the satellite position – 64E, used is probably not the worst case.

Interference is 11-25 dB higher than the FSS protection criterion

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6 425-7 025 MHz (Region 1)
7 025-7 125 MHz (globally)

WRC-23 Agenda Item 1.2 : Study results

- Studies are complex and difficult to compare and analyse the internal models/assumptions
- The studies that show interference below the criterion:
  - Have made multiple favourable assumptions, effectively underpredicting interference
  - Fail a simple boundary case check (i.e. studies predict aggregate interference from 10,000s base stations below the interference from one base station).
- The range of variations in assumptions can lead to around 39 dB difference in results.
- Recent new study from the UK administration shows excessive interference

Parameters	Studies showing interference	Studies not showing interference	Impact on the interference received by satellite
1. Satellite orbital location	Real satellite locations are used	Satellite locations are selected with more extensive ocean coverage	The impact is about 2 dB
2. All IMT BSs visible to the satellite	Use all visible IMT base stations (BSs) (0° to 90° elevation angles)	Use only IMT BSs within the 3-deg contour of the satellite antenna beam or only BSs with elevation angle >5° toward the satellite. Some also exclude IMT stations from Region 3 countries.	The impact is about 7 dB
3. Rural IMT deployment	Included as part of the study	Excluded from studies	The impact is about 2 dB
4. IMT deployment density	Considered both the lowest and highest deployment densities	Only used the lowest deployment density (equivalent to only 0.07% land coverage by IMT)	The overall impact between the lowest and highest density is 10 dB
5. Clutter model used	Used guidance provided by SG3 who are the expert group	Used models which have not been agreed and approved	The impact is about 7 dB
6. Apportionment to include the impact of FS links to the Satellite Rx	Take account of the effects of FS links and allow for 3dB apportionment	Exclude any apportionment for FS links	The impact is 3 dB
7. Satellite parameters	Used a range of parameters	Used only favorable parameters and applied further “adjustments” contrary to the advice of the expert ITU Working Party 4A.	The impact is about 5-8 dB
Potential total underestimation			**Approximately 39 dB**

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6 425-7 025 MHz (Region 1)
7 025-7 125 MHz (globally)

Other examples of interference to satellites

- There are real-world examples where IMT base stations have caused interference to satellite receivers in other bands.
- Cases reported to ITU:
  - **India** MSS satellite in 2.6 GHz band, approx. 3.5 dB degradation in 2019.
    - Signal analysis shows signature of the LTE signal
  - **Inmarsat** MSS satellite serving Europe in the 2 GHz MSS band
    - Received interference from mobile base stations deployed in northern Europe – IMT equipment used for broadband access.
    - Interference many dBs above the noise.
- In both cases, part of the satellite transponder cannot be used
- The ITU has been largely ineffective to resolve, once interference occurs.

FIGURE 2

S-MSS SxC spectrum measured in August 2016

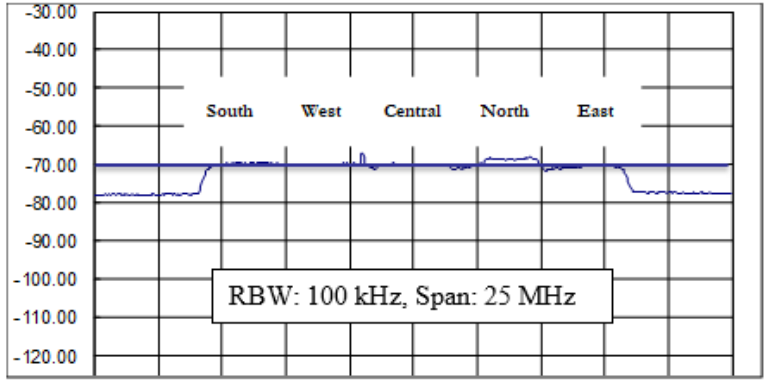
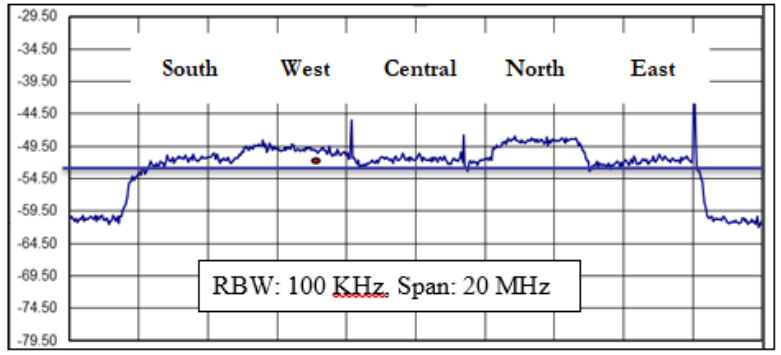


FIGURE 4

S-MSS SxC spectrum measured in May 2019



India satellites measure increase in noise over 3 years from increase in IMT deployment.

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6 425-7 025 MHz (Region 1)
7 025-7 125 MHz (globally)

CPM Report Methods - 6 425 - 7 025 MHz Region 1 (Method 4X) and 7 025 - 7 125 MHz Globally (Method 5X)

Four Methods propose an IMT identification: one with no conditions to protect incumbent services (4B), others with a draft new WRC Resolution providing some protection conditions in part or whole of the band (4C, 4D and 4E).

Protection conditions for incumbents in Methods	Use of IMT as of 2030	IMT base station pointing below horizon	eirp masks per elevation angles in 6425-6525/6575 MHz	eirp limits per elevation angles	eirp limit toward GSO	RR21.5 limit	Review IMT deployment
Method 4A	**No Change**						
Method 4B (IMT) No conditions							
Method 4C (…) Conditions in 6425-7025 MHz		(X)		(X)	(X)	(X)	X
Method 4D (RUS) Conditions in 6425-6525/6575 MHz			(X)	(X)		(X) above 6525/6575 MHz	
Method 4E (F) Conditions in 6425-7025 MHz	X	X			X	X	X

For the band 7025-7125 MHz, Methods 5A to 5E correspond to Methods 4B to 4E, noting there are no FSS uplinks or downlinks above 7075 MHz.

GSOA supports Method A

X: condition proposed in the draft new WRC Resolution
(X): one or several of these conditions would be implemented in the draft new WRC Resolution

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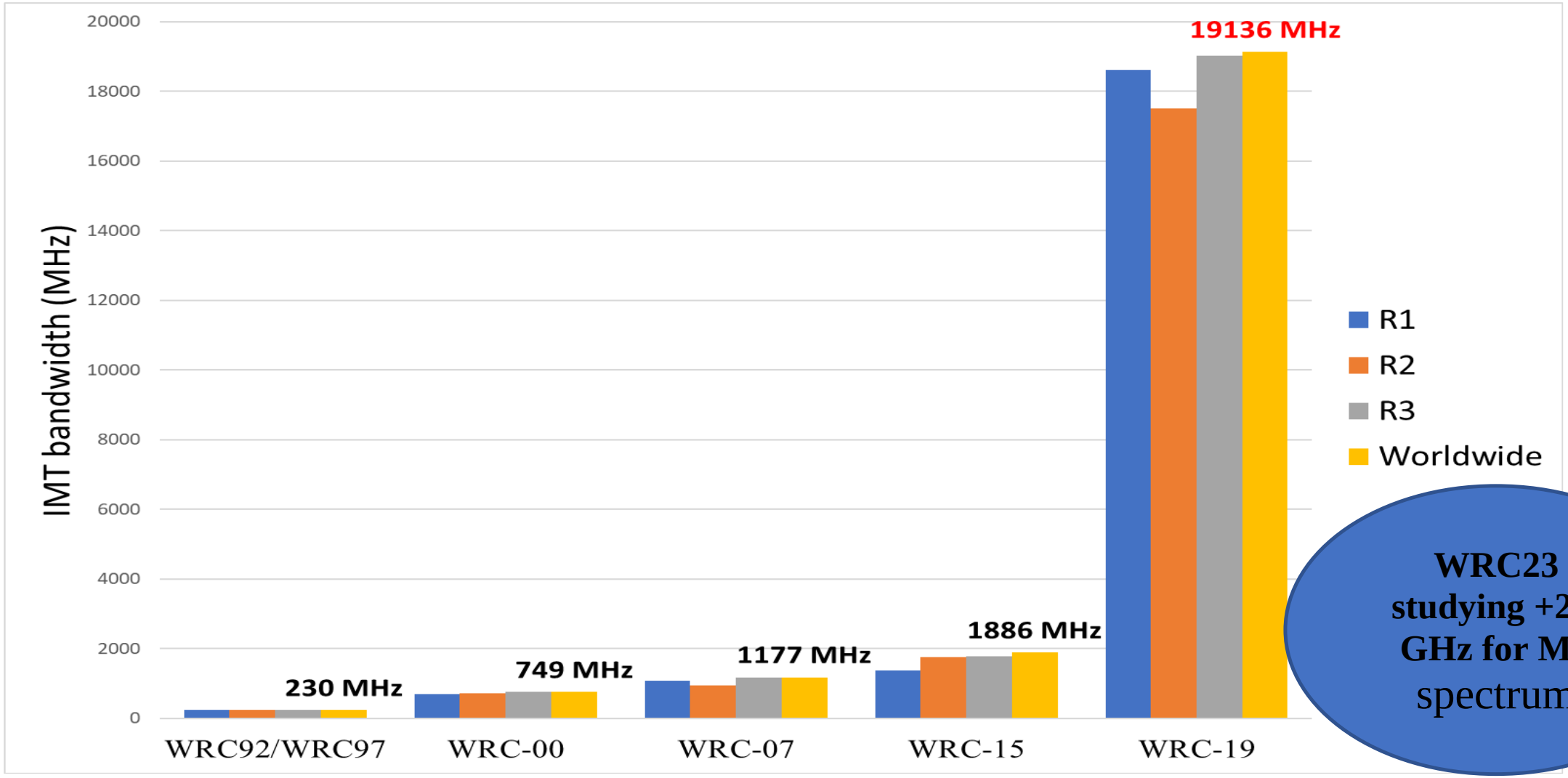
Spectrum Identified for IMT



WRC23 studying +2.2 GHz for MS spectrum

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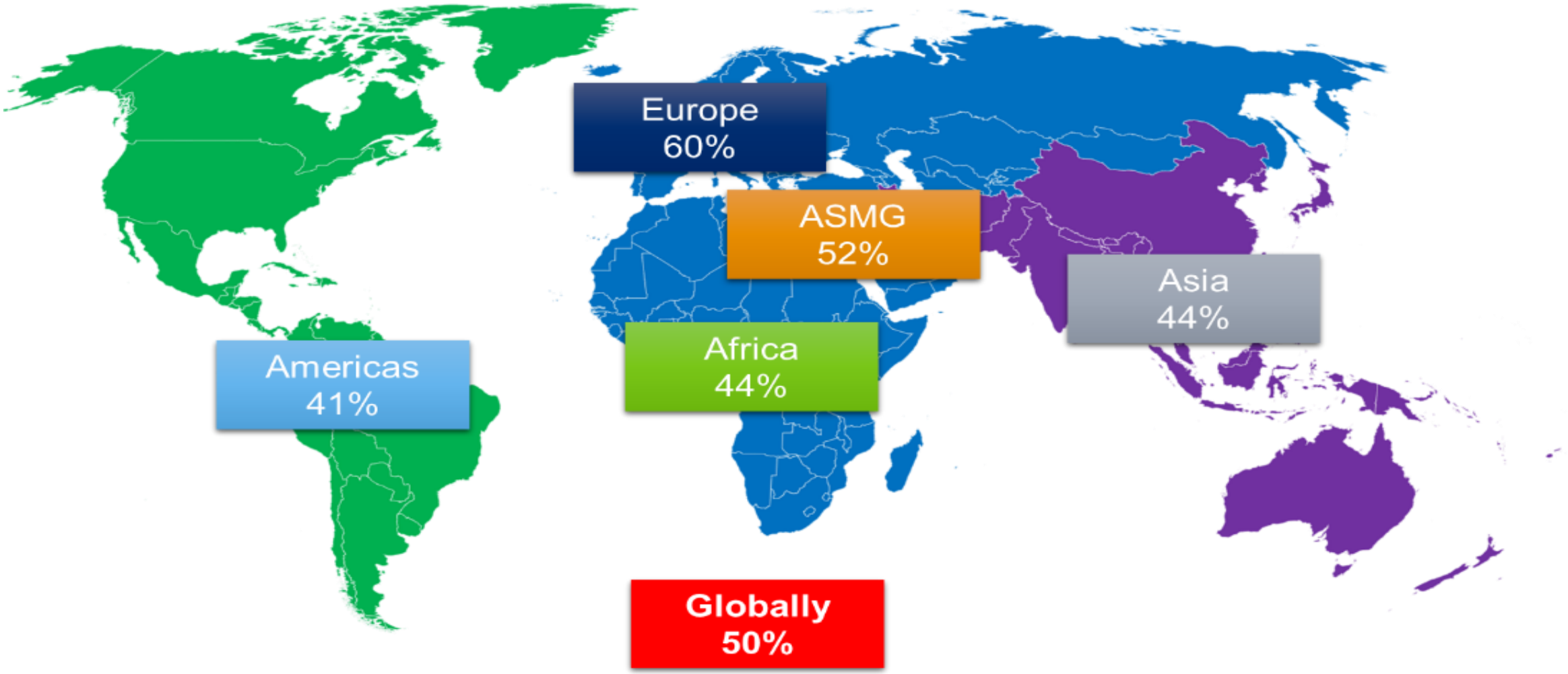
Amount of IMT Spectrum licensed and in Use



Most prudent approach would be to utilize the available spectrum before opening new bands at the cost of existing services or deny introducing newer access technologies

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Limitation in use of IMT in the 6425-7125 MHz Band

- **Limited for outdoor use in dense urban** & to a lesser extent, in sub-urban areas
- **These areas are seeing FTTH build-out**.
- **Indoor coverage from outdoor IMT base stations is NOT Feasible**, **neither technically nor economically.** Building entry loss can exceed 50dB resulting in unpredictable indoor signal quality and increased power consumption.
- Restriction be imposed on 6 GHz IMT deployments which would render the **business case for outdoor macro-cell deployment infeasible**.
- **IMT could be deployed in alternative bands** (refarming 2G, 2.4 GHz, etc.) as many countries that have assigned 1200 MHz for Wi-Fi have found a better alternative.
- **Limitation in using IMT only in smartphones**, whereas Wi-Fi is an essential feature of various equipment and offers far greater economies of scale and global harmonization.

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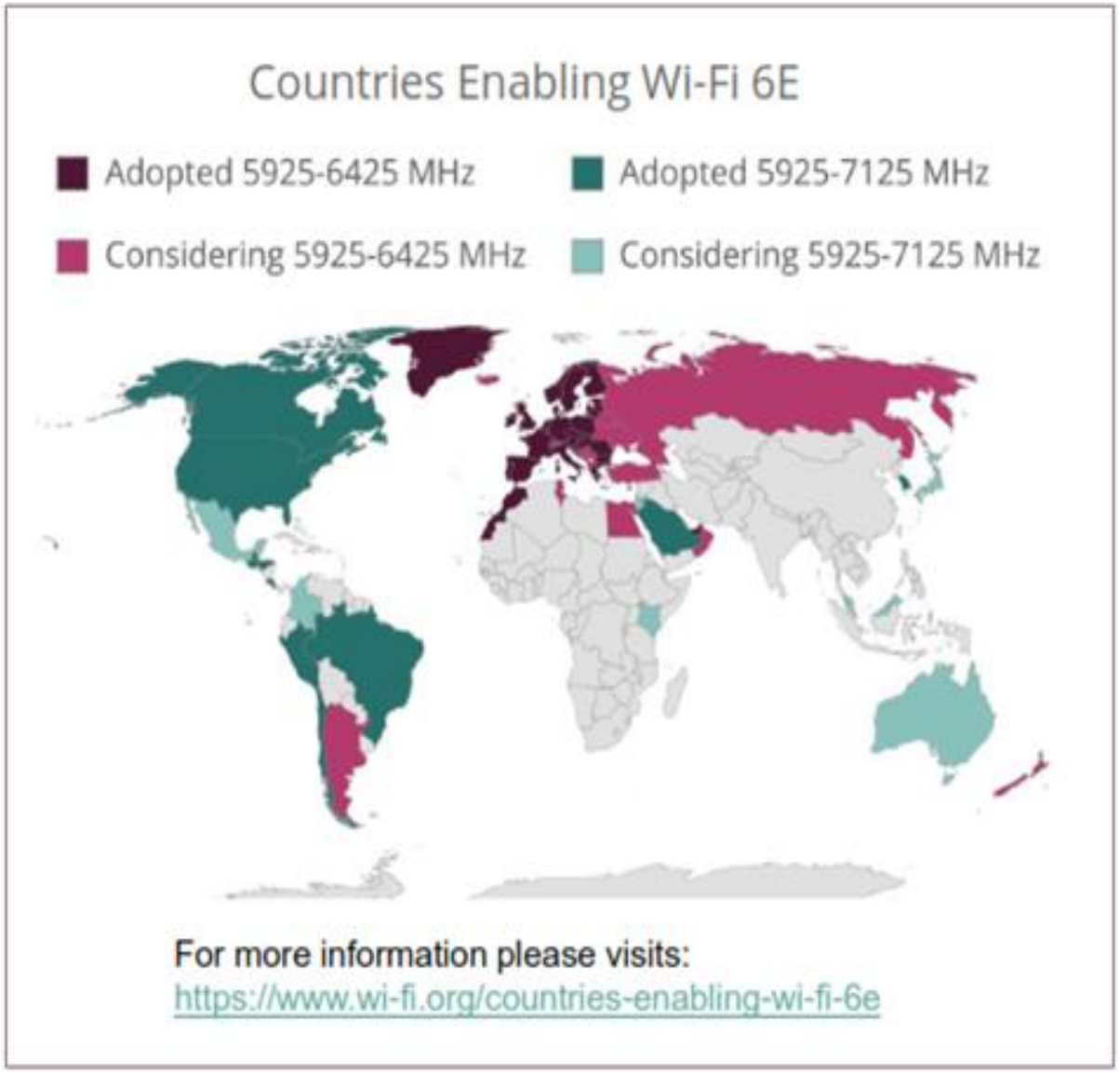
Impact on use of 6 GHz Band for IMT



- There are benefits of frequency harmonization
  - Global/Regional roaming
  - Economies of Scale
- Countries in all 3 Regions deploying RLAN in the band 5925-7125 MHz
  - 53 countries adopted lower 5 925 – 6 425 MHz
  - 17 countries adopted/considering the full band 5 925 – 7 125 MHz
  - Many countries deploying community-based Wi-Fi Hotspots nationally
- Co-Frequency RLANs and IMT coexistence is NOT feasible
- Global or even regional roaming for IMT in 6 425 – 7 125 MHz may NOT be feasible
- Market scale insufficient to support viable Licensed 5G/IMT Ecosystem in 6 425 – 7 125 MHz

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Why is it a good choice to allocate 6 GHz for Unlicensed Bands

- License exempt – offers Technology neutrality, Choice, Innovation – flexibility to deploy a mix of access technologies such as Wi-Fi or 5G NR-U (3GPPP unlicensed band n96 – 5 925-7 125 MHz) and continue to protect existing services including FS/FSS.
- Global harmonization of the full 6 GHz bands for license-exempt use is already in progress
- Most countries' infrastructure is based on fibre and satellite. Wi-Fi complements and strengthens these technologies.
- 6 GHz Wi-Fi ecosystem is thriving, and opening the band would yield national benefits in a short time. No such ecosystem exists for IMT in that band, and it may not be many years.
- 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
- Designed to share spectrum, Wi-Fi can coexist with the incumbents (FSS, FS) in the band.
- An IMT identification of the upper 6GHz band is unnecessary and would block the band for years

Unlicensed 6 GHz band offers Maximum Flexibility in choice of access technologies, innovation in services, economies of scale, and global harmonization of bands

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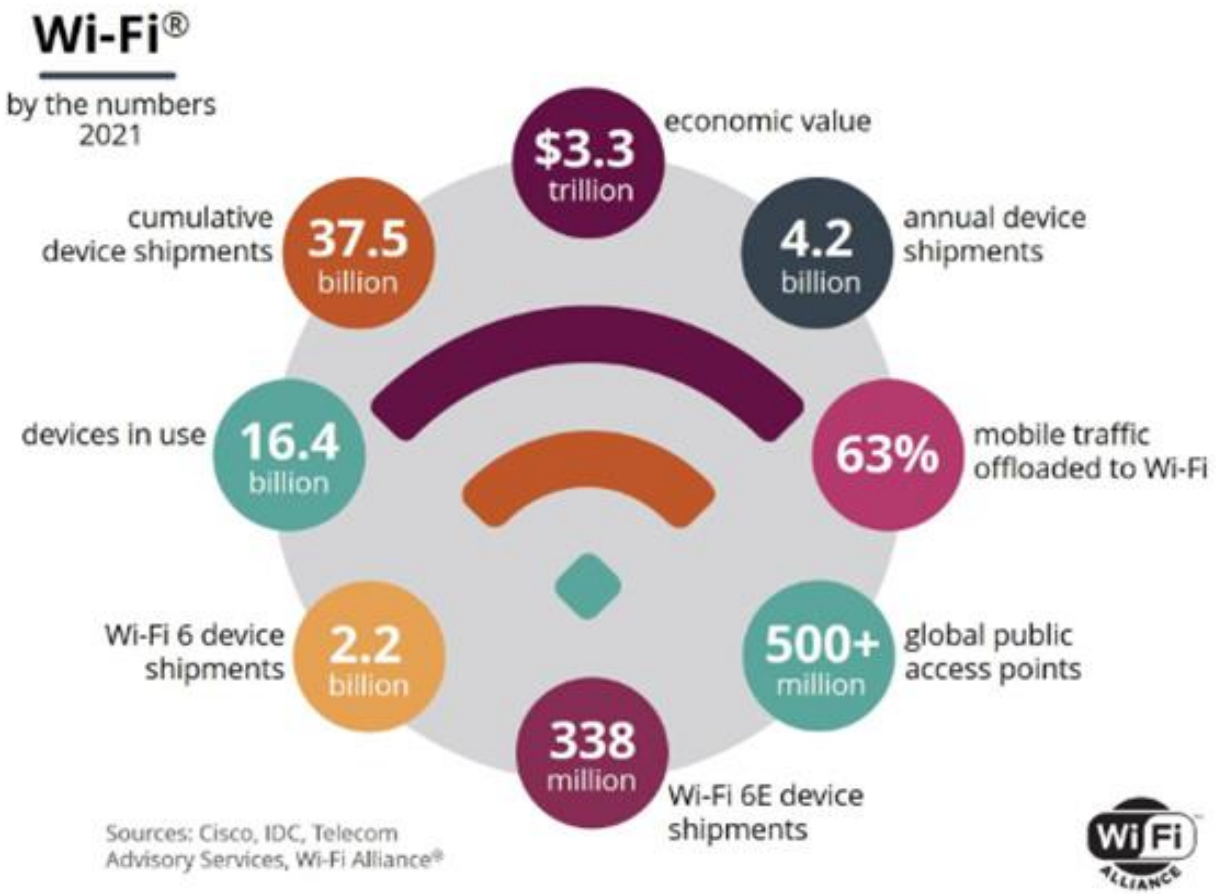
Maximizing Socio-Economic Benefits by allocating 6 GHz for Unlicensed Bands

Source: Telecom Advisory Services



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6 425-7 025 MHz (Region 1)
7 025-7 125 MHz (globally)

GSOA Views on CPM Methods

- **None** of the currently proposed technical measures for IMT identification (Methods 4B-4E, 5B-5E) adequately protect satellite uplinks, and if adopted, will lead to harmful interference to FSS operations.
- ~~In theory, a power **reduction of around 25 dB** in IMT base station power could meet the protection requirements for FSS uplinks. But:~~
  - ~~Would still require limitations on IMT base station deployment density, to keep within study assumptions~~
  - ~~Lower base station power would effectively prevent IMT operation~~
- Method 4A/5A (No Change), is the only method to effectively protect FSS from IMT. This Method would not prevent the introduction of other terrestrial technologies, since primary fixed/mobile allocations exist.

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Conclusion

- Given India's requirements for nationwide coverage and to bridge the digital divide, India should **adopt the upper 6 GHz for an unlicensed band for Maximum flexibility and advocate "No-Change" for Agenda Item 1.2**

- **What does 'No-Change" mean?**
  - **India is not in favour of the upper 6GHz band to be identified for IMT in Region 1**
  - **India wants to maintain its Flexibility of choice to innovations and different access technologies**
  - **India will continue to do its own studies and protect its own FS/FSS, especially AP30B, Safety-related services**

- **India can also decide to allocate the whole 6 GHz bands for the unlicensed band; what would that mean:**
  - **India would be able to take advantage of the current global ecosystem of 20bn+ router devices**
  - **Enable home-grown RLAN manufacturing industry / export-led growth**
  - **Fast track to growing its software sector by developing the next generation of AR/VR applications**
  - **Flexibility to have indoor enterprise solutions for 5G unlicensed band solutions as per 3GPP**

India 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 Licensed outdoor IMT sharing is not practical nor feasible in 6 GHz Bands with FSS, BUT sharing with Wi-Fi is feasible with acceptable power constraints:

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Conclusion (2/2)

- **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).

- **On 6 GHz – Consider establishing a national policy for the growth of unlicensed band services** – consider adopting full-band 5925 GHz to 7125 GHz given the growing use of Wi-Fi hotspots and for the national development of Wi-Fi 6E and 7 for nationwide implementation [given the growing need to utilize entire 1200 MHz – 5925-7125 MHz by several countries, this includes U.S., Saudi Arabia, Canada, South Korea, Brazil..]