Government of India
Ministry of Communications
Department of Telecommunications

Spectrum Roadmap for 6G services

Wireless Planning and Coordination Wing

Contents

1. Introduction

1.1 Radio frequencies are used for many diverse applications, from terrestrial to satellite systems, maritime to aviation, meteorological to radio astronomy services etc. Mobile broadband communications, which is a part of terrestrial services, has emerged as one of the key enablers in bridging the digital divide, promoting equity, and driving economic development. International Mobile Telecommunications (IMT) based technologies refer to these commercial mobile broadband services in general. Adoption of IMT based systems has enabled the penetration of mobile telephony and broadband services throughout the country.

1.2 In the last two decades, India has witnessed tremendous progress in the field of telecommunications, transitioning from a voice-centric 2G era to the data-driven paradigms of 4G and 5G based systems. The pan – India roll-out of 5G services in 2022, marked a milestone event in the telecommunication sector, providing high-speed, low-latency connectivity as well as unlocking a multitude of applications and use cases across healthcare, agriculture, manufacturing, and education sectors.

1.3 However, the pace of technological evolution continues unabated. Around the world, people are already working on the next big step of evolutionary advancement i.e. 6G based systems, which is expected to be available by the year 2030. 6G is expected to revolutionize connectivity with ultra-high speeds (up to 1 Tbps), extremely low latency (sub-millisecond), and massive device density. It will support advanced applications such as holographic communication, immersive extended reality (XR), digital twins, and AI-native networks. With a focus on sustainability, security, and global digital inclusion, 6G aims to be a transformative force in achieving seamless, intelligent, and human-centric connectivity.

1.4 The Department of Telecommunications (DoT) is laying the groundwork for India's emergence as a global leader in sixth-generation (6G) services. To be a leader in this front, India needs to plan ahead and develop a roadmap for managing the radio frequency spectrum, the invisible electromagnetic waves that carry signals through the wireless medium.

1.5 This roadmap sets out a long-term vision and a phased plan viz. short-, medium- and long-term plan, for harnessing spectrum to meet the exponential growth in radiocommunication services. This will make sure that Telecom Service Providers (TSPs) have enough spectrum to roll out better and more affordable services, including the expansion of the existing 5G based networks as well as the future 6G networks. By optimizing and efficiently regulating the RF spectrum use, this roadmap aims to advance the Government's socioeconomic priorities, transform key verticals, and narrow the digital divide, ensuring that every citizen benefits from next-generation telecommunications services.

1.6 This roadmap aims to align with the international practices and key global developments, including outcomes of major events such as the World Radiocommunication Conference 2027 (WRC-27) and the WRC-31. At the same time, it also needs to remain flexible to adapt to the changing needs of new technologies and the evolving market trends.

1.7 By formulating this long-term roadmap, India aims to attract investments, foster indigenous research and development, and cultivate a robust ecosystem for next-generation services. This initiative will also position India as a global hub for 6G innovation

1.8 In summary, the Spectrum Roadmap will equip India's public mobile telecommunications sector to be more resilient, inclusive, and well-prepared to embrace the 6G era.

2. Objective

a) Strategic long term spectrum planning

Provide clear visibility of availability of spectrum, including quantum of spectrum and timelines for availability of the various RF bands over the next 10 years, segmented into Short term (2025-2026), Medium term (2027-2030) and Long term phases (2031-2035).

b) Alignment with ITU-R and WRC Cycles

Synchronise national actions with IMT-2030 study cycle timelines of the Radiocommunication sector of the International Telecommunications Union (ITU-R), thereby ensuring that the India's positions are ready for the WRC-27 agenda items and prospective WRC-31 agenda items.

c) Efficient Re-farming & Coordination

Detail engagement with the incumbent government, captive and commercial users to vacate, re-farm or share the radio frequency bands through modern coexistence techniques; deploy nationwide spectrum monitoring and AI-driven analytics to ensure its efficient utilisation.

d) National Technical Studies & Testbeds

Launch collaborative research programmes with academia and industry to open 6G testbeds for start-ups and Micro, Small, and Medium Enterprises (MSMEs).

e) Promotion of Indigenous R&D and Manufacturing

Establish testbeds, regulatory sandboxes, and R&D grants to spur Make-in-India 6G chipsets, radios, and sub-Terahertz components, reinforcing India's role in global value chains.

3. Existing National and International regulations

3.1 National Regulations

3.1.1 The Telecommunications Act 2023: The Telecommunications Act, 2023, enables the Central Government to manage the RF spectrum effectively and ensure its efficient and optimal use. Section 4 of this Act, vests the Union Government with ownership of RF spectrum and empowers it to update the National Frequency Allocation Plan (NFAP)[1] or even modify the First Schedule of this Act, which enumerates the purposes for which spectrum must be allocated through an administrative process.

The Section 5 of the Act, further authorizes re-farming of RF spectrum as well as the harmonization (rearranging of RF carriers within a frequency band) of any RF band, so that legacy holdings can be replaced with the upcoming technologies including 6G in a contiguous and efficient manner.

The sections 7 and 8 of the Act, legalize secondary assignment, sharing, trading, leasing and surrender of spectrum, thereby allowing the various service providers to meet their 6G spectrum demands.

3.1.2 National Digital Communication Policy (NDCP): Department of Telecommunications has also prescribed the National Digital Communication Policy in 2018. The policy objective on Spectrum Management as per NDCP - 2018 is to r*ecognize RF Spectrum as a key natural resource for public benefit to achieve India's socioeconomic goals, ensure transparency in allocation and optimize availability and utilization.*

3.1.3 National Frequency Allocation Plan: From time-to-time, NFAP is reviewed and updated to accommodate the spectrum requirements for

[1] Presently, the NFAP 2025 is in force
https://dot.gov.in/sites/default/files/National%20Frequency%20Allocation%20Plan-2025.pdf?download=1

latest technological developments keeping the global harmonization in mind.

3.2 International Regulations

3.2.1 The ITU has now placed the next generation of mobile platform, officially called "IMT-2030" and popularly known as 6G, on a well-defined development track that spans its three sectors (Radiocommunication, Standardization and Development). Building on the foundation of IMT-2020 (5G), the 6G platform aims to achieve significantly enhanced performance, embed native intelligence, and promote greater sustainability, while enabling new categories of applications across industry and society.

3.2.2 The spectrum identification studies are also gearing up for the WRC-27 wherein the agenda item 1.7 looks at Sharing and compatibility studies and development of technical conditions for the use of IMT in the frequency bands 4400-4800 MHz, 7125-8400 MHz (or parts thereof), and 14.8-15.35 GHz for the terrestrial component of IMT.

4. Current Spectrum Bands in Use for IMT based services

4.1 India has embraced progressive spectrum management policies to support the growth of its telecom sector. All the RF spectrum assigned through auctions is now technology-neutral, allowing operators the flexibility to deploy any generation of mobile technology—be it 4G, 5G, or beyond.

4.2 In addition, key policy reforms such as spectrum sharing, trading, leasing, liberalization and surrender provisions have been introduced to enhance spectrum efficiency. Measures facilitating mergers and acquisitions have also further streamlined the industry operations.

4.3 These initiatives collectively aim to reduce operational burdens, promote optimal spectrum utilization, and encourage investment and innovation, thereby creating a more competitive and resilient telecom ecosystem aligned with the evolving demands of digital connectivity.

4.4 The current spectrum landscape is a mix of low-band, mid-band, and high-band frequencies, each offering unique benefits in terms of coverage, capacity, and latency as detailed below:

Spectrum Band	Band range (MHz)	Quantum of Spectrum for IMT	Total
600 MHz	663-703 [612-652]	40 MHz	105+105 MHz Total: 210 MHz
700 MHz	703-748 [758-803]	20 MHz	
800 MHz	824-844[869-889]	20 MHz	
900 MHz	890-915 [935-960]	25 MHz	
1800 MHz	1710-1785[1805-1880]	55 MHz	95+95 & 510 MHz Total: 700 MHz
2100 MHz	1920-1980[2110-2170]	40 MHz	
2300 MHz	2300-2400	80 MHz	
2500 MHz	2500-2690	60 MHz	
3300 MHz	3300-3670	370 MHz	
26 GHz	24250-27500	3250 MHz	3250 MHz
	Total		**4160 MHz**

* For paired (FDD) bands, the downlink frequencies are shown in [ ] brackets

**Besides above, in 1800 MHz band, additional spectrum of 15+15 MHz in Kerala and Odisha Licensed service areas and 10+10 MHz spectrum in Haryana, Mumbai and Kolkata Licensed service areas is available for IMT based services.

5. Categorization of frequency bands for IMT based services

5.1 Delivering the 6G vision in India, particularly in densely populated urban areas, presents a significant challenge due to the surging demand for high-speed, low-latency connectivity, along with the need to support a vast number of Massive Machine-Type Communications (mMTC) devices requiring reliable and simultaneous network access. To meet this demand, a substantial amount of mid-band spectrum will be essential, as it offers the optimal balance between coverage and capacity. Recognizing the varied requirements of next-generation networks, the entire RF spectrum identified for IMT based systems has been broadly categorized into three segments based on their characteristics and intended use cases.

5.2 The **Sub-1 GHz band** (< 1 GHz) is ideally suited for deep indoor coverage and rural connectivity, due to its superior propagation characteristics. This enables reliable service delivery in remote regions and improved signal penetration within buildings.

5.3 The **Mid-band spectrum** (1 GHz to 7 GHz), often designated as the coverage and capacity layer, will serve as the backbone for 5G and early 6G deployments, providing a balance between coverage and capacity.

5.4 The M**illimeter wave (mmWave) bands**, (> 24 GHz), are well suited for high-capacity, short-range deployments. These are suitable for urban hotspots, stadiums, and industrial applications. Beyond this, the sub -Terahertz spectrum (above 90 GHz) is also expected to support the peak capacity layer of 6G based systems, enabling ultra-high-speed and extremely low-latency communication for futuristic applications. However, its use will be highly localized due to limited propagation, requiring dense deployment of small cells. A layered and strategic spectrum allocation approach is, therefore, crucial to realize the full potential of 6G.

6 New frequency bands for IMT based services

6.1 In addition to the existing frequency bands, Department of Telecommunications has also identified additional spectrum to support the expansion of 5G and the future rollout of 6G services. To meet growing demand, several new bands are being considered and made available through a structured, consultative process, involving key stakeholders, including the security, space, and broadcasting sectors.

The availability of spectrum along with timeline is as given below:

6.2 **Short Term Planning (2025-2026):** During the period from 2025–2026, a substantial quantum of spectrum is planned to be made available to meet the increasing demand of telecom services for augmenting the existing IMT services as well as for the future generations of IMT based services. In the mid-band, 400 MHz of spectrum in the frequency ranges 6425-6725 MHz and 7025-7125 MHz has been made available for IMT, subject to certain restrictions to ensure protection of space-based services operating in this range.

6.2.1 Additionally, in the millimeter wave (mmWave) band, a large quantum of 3000 MHz of spectrum in the 37-40 GHz range is being considered for making it available for IMT based services. This high-capacity spectrum will be essential for ultra-fast, low-latency applications and forms a key component of future 6G networks.

6.2.2 Besides the above, efforts are also being made for release of additional spectrum within the existing frequency bands that are currently being underutilized by other stakeholders such as security agencies, space, and broadcasting services. Through collaborative and coordinated discussions, the aim is to rationalize and re-farm underutilized spectrum to support the growing demands of public mobile telecommunication services.

6.3 Mid Term Planning (2027-2030): In the subsequent four years, a total of 367 MHz spectrum in the mid-band is being planned to be made available to strengthen mobile telecommunication services. This includes 300 MHz in the upper 6 GHz band (6725-7025 MHz) with certain restrictions and 67 MHz in the 1427-1518 MHz band, for offering improved capacity and coverage.

6.3.1 Additionally, 1000 MHz of spectrum in the mmWave band (42.5–43.5 GHz) is also proposed, subject to the development of the supporting ecosystem. Use of this band may come with certain restrictions to ensure protection of space-based services operating in the adjacent frequencies.

6.3.2 Parallelly, the following frequency bands will be studied for potential identification for IMT based services, through the Agenda Item 1.7 of the WRC-27:

a) 4400–4800 MHz

b) 7125–8400 MHz (or selected portions)

c) 14.8–15.35 GHz

These bands are being considered at the global level for future mobile broadband use. Once identified for IMT during WRC-27, the spectrum in these bands will be assessed for possible re-farming for IMT based services, in India.

6.4 Long Term Planning (2031-2035): It is proposed to consider the 66–71 GHz frequency band for mobile telecommunication services, subject to the development and readiness of the supporting ecosystem.

6.4.1 In addition, several sub-terahertz (sub-THz) frequency bands are planned for study under the agenda items for the WRC-31 for possible IMT identification. These frequency bands include, 102-109.5 GHz, 151.5-164 GHz, 167-174.8 GHz, 209-226 GHz, 252-275 GHz bands.

6.4.2 Post WRC-31, the identified spectrum in these bands will be assessed for re-farming and allocation in India for public mobile telecom services. These high-frequency bands are expected to support ultra-high-speed and low-latency applications, such as holographic communications, tactile internet, and joint communication and sensing systems, which are key features of 6G networks.

6.5 Summary in Tabular Form

Sl. No.	Period	Frequency band	Quantum of new spectrum for 6G	Remarks
1	2025-2026	6425-6725 MHz	300 MHz- identified	Subject to restrictions at certain locations to protect space-based services.
		7025-7125 MHz	100 MHz - identified	
		37-40 GHz	3000 MHz- identified	
2	2027-2030	1427-1518 MHz	67 MHz- identified	Subject to restrictions at certain locations to protect space-based services
		6725-7025 MHz	300 MHz -identified	
		42.5-43.5 GHz	1000 MHz -identified	
		4400–4800 MHz	Spectrum likely to be identified after WRC-27	
		7125–8400 MHz (or selected portions)		
		14.8–15.35 GHz		
3	2031-2035	66-71 GHz	5000 MHz- identified	
		102-109.5 GHz	**Terahertz (THz)** bands - Spectrum likely to be identified after WRC-31	
		151.5-164 GHz		
		167-174.8 GHz		
		209-226 GHz		
		252-275 GHz		

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