EMS MANAGEMENT CHALLENGES & HARMONISATION

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Abstract

EMS is a scarce limited natural resource transcending geographical and political boundaries; hence, coordination at the international level, regarding the efficient, rationale and need-based use of spectrum is the hallmark of spectrum management. Most modern communication technologies depend on the use of radio spectrum usage to facilitate proliferation of voice, video and data, which are instruments of empowerment. Though EMS extending from 3 KHz to 3000 GHz appears to be extensive, it is considerably limited as its usage is contingent to availability of appropriate technologies for communication purposes commercially.

The movement of our society and much of the world from the industrial age to the information age has been hastened largely by the liberalised availability of frequency spectrum. Countries that control the Geo-Technology domain will control all the other three domains of Geo-Strategy, Geo-Politics and Geo- Economics; nations which control these three domains will control the world.

EMS provides digital highways of connectivity required for development of business and for growth of education, healthcare and

other infrastructure. EMS is not merely about communications alone; it is in fact about improvement and growth in the fields of industry, automation, education, healthcare and other infrastructure—the list is endless. It is an end-to-end road for functioning and growth in various fields, as was evident during the recent COVID-19 crisis. With the world locked down to contain the spread of this pandemic, the governance of nations, routine administration, provisioning of essential goods and services, education and commerce was possible only due to the established communication and IT networks, which had been facilitated in no small measure by the grid of wireless networks. This is thus the importance of EMS and it's management.

National security is not restricted to securing the land, air and maritime boundaries and pursuing strategic interests but encompasses all aspects that have a bearing on the nation's well-being, of which EMS is an integral part. This precious resource of frequency spectrum thus needs to be guarded zealously and optimally utilised. EMS also has an associated economic value necessary for any nation-state to be able to leverage it and use the monetary gains for societal and development causes. Defence preparedness is also equally important for safeguarding the sovereignty of the nation, which permits all such commercial activities to take place. Thus, there is a need to reconcile both these requirements. Hence an efficient, rationale and need-based use of spectrum is the hallmark of spectrum management and regulatory mechanisms are key elements for ensuring efficient and interference free spectrum usage.

Introduction

Electromagnetic Spectrum (EMS). It is the entire distribution of electromagnetic (EM) radiation according to frequency or wavelength. Although all electromagnetic waves travel at the speed of light in a vacuum, they do so at a wide range of frequencies, wavelengths, and

photon energies. The EMS comprises the span of all EM radiation and consists of many sub-ranges, commonly referred to as portions, such as visible light or ultraviolet radiation. The various portions bear different names based on differences in behaviour in the emission, transmission, and absorption of the corresponding waves and based on their different practical applications. There are no precisely accepted boundaries between any of these contiguous portions, so the ranges tend to overlap.

Characteristics. Some of the important & typical characteristics of the EMS are:-

(a) Radio frequency spectrum does not respect international geographical boundaries as it is spread over a large terrestrial area.

(b) Use of radio frequency spectrum is susceptible to overlapping interference and requires the application of complex engineering tools to ensure interference-free operation of various wireless networks.

(c) Unlike other natural resources, radio frequency spectrum is not consumed upon its usage. It is wasted whenever it is not used optimally and efficiently.

(d) EMS usage is therefore to be shared amongst the various radio services and must be used efficiently, optimally & economically in conformity with the provisions of national and international laws.

(e) Limitation of the EMS is mainly due to the following factors:-

(i) Propagation characteristics of different types of radio waves.

(ii) Availability of technology and equipment for different types of radio frequency spectrum applications.

(iii) The suitability of frequency bands for specific applications

The information age presents us with tremendous possibilities as well as unique challenges. This is a very exciting time for the communications industry as technology is evolving quickly and new applications are being devised constantly. For a nation considered to be having the fastest-growing telecom industry, the issue of clarity in understanding the **EMS** or Radio Frequency **(RF)** spectrum and its optimum utilisation merits attention. Telecommunications today is considered one of the key factors in the development of a nation-state, be it in the field of economic, social, commercial or cultural issues. The telephone, which just used to be a communication device some time ago, has now the potential of being an instrument of empowerment. Most modern communication technologies are dependent on the use of radio spectrum usage to facilitate proliferation of voice, video and data, converged as triple play services, over the network in digital form.

EMS is a scarce limited natural resource extending from 3 KHz to 3000 GHz wherein spectrum management and regulatory mechanisms are key elements for ensuring efficient and interference free spectrum usage. EMS transcends geographical and political boundaries; hence, coordination at the international level, regarding the efficient, rationale and need-based use of spectrum is the hallmark of spectrum management. While the International Telecom Union **(ITU)** holds court as the international forum for regulating spectrum, there are organisations in India which create a fine balance in meeting the strategic requirements of Defence/ Government agencies as well as commercial requirements, both of which are in the nation's interest. It is thus imperative to have an understanding of the organisations and processes for regulating spectrum at the global, regional and national levels, for optimal projection of the spectrum requirements of the Armed Forces.

Types of EM Radiation. The entire EMS, from the lowest to the highest frequency (longest to shortest wavelength), includes all radio waves (e.g, commercial radio and television, microwaves, radar), infrared radiation, visible light, ultraviolet radiation, X-rays, and gamma rays. The same is depicted in **Figure 1.1** below. Nearly all frequencies and wavelengths of

electromagnetic radiation can be used for spectroscopy. Propagation of radio waves has different characteristics in different frequency bands and these waves are influenced by the phenomenon of cosmic/man-made noises, terrain and varying climatic conditions. Though EMS appears to be extensive, it is considerably limited as its usage is contingent to availability of appropriate technologies for communication purposes commercially. An efficient, rationale and need-based use of spectrum is the hallmark of spectrum management.

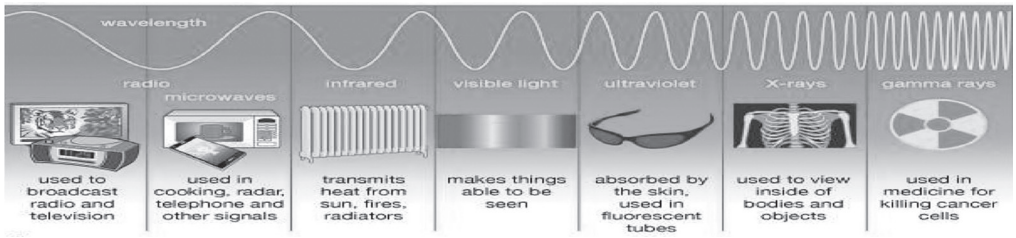


Figure 1.1: Types of Electromagnetic Radiation

Utilisation Based Frequency Distribution. Though the EMS appears to be extensive, it is considerably limited as its usage is contingent to availability of appropriate technologies for military/ communication purposes commercially. Different frequency bands have different characteristics for propagation of radio waves, which dictate its utilization for military/ commercial purposes.

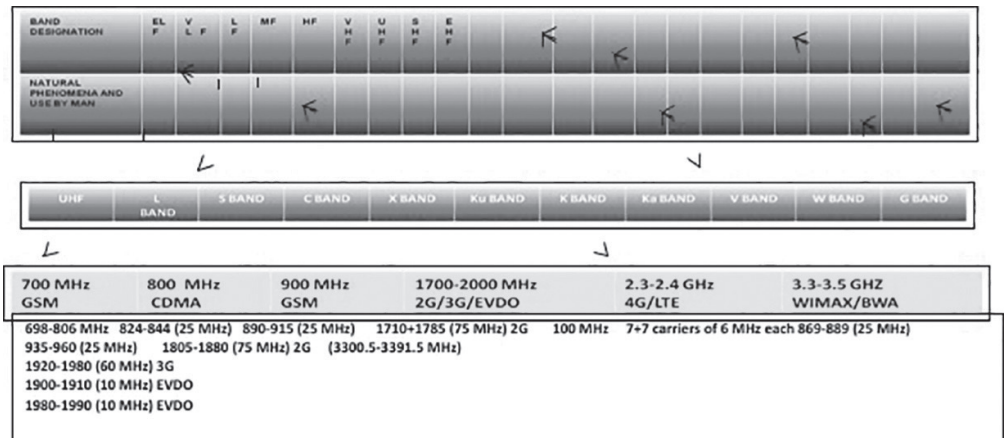


Figure 1.2: Utilisation Based Frequency Distribution

The propagation characteristics are even influenced by the phenomenon of cosmic/ man-made noises, terrain and varying climatic conditions. Figure 1.2 above depicts the 'Utilisation Based Frequency Distribution'. An efficient, rationale and need-based use of spectrum is the hallmark of spectrum management, and the same can facilitate harmonious coexistence of defence and commercial interests.

Background

In the late 90's the world has seen a convergence in telecom and Information Technology (IT), with telecom products being developed on computer platforms and multiple applications converging into a single device. The boundary lines between telecom and IT started blurring and the term Information Communication Technology (ICT) gained currency. With the advent of smartphones and tablets, mobile technology has integrated a number of these technologies with the ability to transmit wirelessly.

In mobile phones, there are no distinct data and voice channels. The introduction of voice over IP (VoIP) protocol though allows voice to be carried over the data networks, yet has a major drawbacks as this form of communication is susceptible to both EW and standard network attacks. Thus now in mobile phones, it is feasible that data-based attacks can impact the voice channels. Mobile phones, especially those with high processing power often double up as a mini computer and have replaced laptops. Mobile phone being a wireless device is the preferred internet gateway. Therefore logically it is susceptible to exploitation of the EMS.

The movement of our society and much of the world from the industrial age to the information age has been hastened largely by the liberalised availability of frequency spectrum which has, in turn, led to the proliferation of social media. The same has had an impact on the Armed Forces, providing both opportunities and challenges to both friend and foe alike. Countries that control the Geo-Technology domain will control all the other three domains of Geo-Strategy, Geo-Politics and

Geo- Economics; nations which control these three domains will control the world. In the emerging world order, India has a major role to play and in order to become a global leader, India needs to optimally utilise the EMS and harness the latest technologies like 5G and IoT.

Relevance of EMS

Previously, if one wanted to develop a village, people used to ask the government to build a road, because the moment a road was built, it opened the door for the villagers to access other parts of the country, where they could sell their produce, besides providing avenues for growth of business, employment, education and healthcare. The village thus used to develop and grow just because of the connectivity provided by the road. In the digital era, EMS provides 2G, 3G, 4G connectivity (with 5G round the corner), which are all types of a digital highways required for development of business and for growth of education, healthcare and other infrastructure. Digital connectivity is not just about communications alone; it is in fact about improvement and growth in the fields of industry, automation, education, healthcare and other infrastructure—the list is endless. It is an end-to-end road for functioning and growth in various fields, as was evident during the recent COVID-19 crisis. With the world locked down to contain the spread of this pandemic, the governance of nations, routine administration, provisioning of essential goods and services, education and commerce was possible only due to the established communication and IT networks, which had been facilitated in no small measure by the grid of wireless networks. This is thus the importance of EMS and it's management.

The EMS has been exploited with telling effect in conflicts like Yom Kippur War, Falkland and Lebanon and more recently in Ukraine, Syria, Libya, Nagorno- Karabakh and Israel-Hamas. India's adversaries are demonstrating growing capabilities in hybrid operational environments, especially aimed to degrade our capabilities in the cyber and EMS. Our C4ISR systems are critical for success in operations, ensuring the availability and reliability of communication and information systems, even in degraded environments. Concurrently, we must have the

capability to degrade and disrupt the adversary's communication and information systems. Coupled with this is the importance of availability of EMS for the nation's economic prosperity and communication technologies. Thus EMS management entails a fine balance between technology innovation, national security, growth and wealth creation & will be of special significance in the Gray Zone (a metaphorical state of being between war and peace), which is where the wars of future are likely to be fought. Such activity is most effective when malign activity is executed within legal boundaries so as not to set off any alarms or cross traditional warning trigger points. This paper explores the EMS Management Challenges & the need for Harmonisation of the scarce frequency spectrum.

Effect of Convergence between Communication and IT on EMS

With the advent of technology, multiple applications have converged into singular devices, and the boundary lines between communications and IT have started blurring. This convergence has also given rise to the commonly used term ICT. Modern day smartphones are capable of providing voice, data, video services, besides providing functions like calculator, camera, radio, news, entertainment, scanner, web browser, navigational aid, internet hot spot and so on. Mobile phone is however a wireless device and is the gateway to the internet. It is therefore susceptible to exploitation of the EMS, to carry out traditional EW functions, or to carry out cyber warfare.

ICT by its inherent attributes is able to integrate operations more effectively, provide decision support and thus an overwhelming degree of simultaneity can be achieved. If optimally utilized, ICT can fundamentally change the both the manner of conduct and the outcome of military operations. New and emerging Cyberspace and EMS threats first made their presence felt in the wars in Iraq and Afghanistan. Insurgents actively used the internet both for communication and for propaganda. At the same time, they skilfully used weapons enabled by the EMS, especially Radio controlled Improvised Explosive Devices **(IEDs)** or RCIEDs. All over the world cyber warfare through EMS is now being acknowledged

as the 5th dimension of warfare (after Land, Air, Sea and Space), as the same has the potential to tilt the balance of power, thus compounding the requirement and exploitation of EMS.

With the connectivity becoming increasingly wireless, the network technology is moving towards IP for all services. As per the TCP/ IP Model on which the whole data communication process relies, the IP Layer i.e. layer 3 and the layers above it were the standard cyber warfare gateway. However now, with the proliferation of wireless technology, the means to access & infect a computer network are now also available at physical layer in the form of Radio Frequency **(RF)** linkages. Hence simple RF level brute force jamming can be optimally exploited. With the advent of 5G and Internet of Things (IoT), the situation is getting more complicated. Technologies like mobile phone, satellites, wireless backhaul radios, software defined radio **(SDR)** etc are vulnerable to cyberattacks through wireless channels.

EMS in Ops. Operation Orchard. On 06 Sep 2007, with the launch of Operation Orchard, it which was probably the first time a converged EW and Cyber effort had taken place in modern warfare and the true potential of EMS was seen. Operation Orchard comprised of an Israeli airstrike on a suspected nuclear reactor in the Deir ezZor region of Syria, which occurred just after midnight. The Israel Air Force systems took over Syria's air defence systems, possibly using Digital Radio Frequency Memory **(DRFM)** technology to feed misleading information of a false sky-picture to the Syrian air defence radar system, for the entire period of time that the Israeli fighter jets needed to cross Syria, bomb their target and return.

Most of the telecom equipment, be it a router, a switch, or an IP radio is mostly being provided as a software service over a computing platform. Even telecom hardware based systems like telephone exchanges and satellite etc. are being managed through computer systems. The Combat Net Radio **(CNR)** is also now migrating to Software Defined radio **(SDR),** which provides an opportunity to carry out cyber warfare through exploitation of RF spectrum. Satellite phones,

surveillance devices, cellular phones, and trunked radio systems are also being used by the modern soldier in battle field. All these use a wireless access point and are thus vulnerable to cyber warfare through exploitation of EMS. This changed battle field ICT environment gives both sides enough opportunity to exploit EMS for conduct of operations. With the imminent advent of Internet of Things **(IoT),** the situation is likely to aggravate further because if IoT is to succeed, it has be wireless. Boundaries are being blurred and cyber warfare which was historically associated at strategic level (in state level conflicts) is now available at tactical and operational levels also due to the exploitation of EMS. Correspondingly, with traditionally civil services like banking, transportation, communications, power supply etc now being targeted, the common citizens sitting in the hinterland, will also be drawn into the conflict and will be connected to the outcome of the actions at the battlefield level. Thus digital attacks against vital infrastructure like banking systems or power grid, which can be launched through EMS, give attackers a way of bypassing a country's traditional defences. There is thus a strong correlation in the use of EMS by military and non-military elements of national power thus compounding the challenges of EMS management.

Blurring Domains. Both EW and cyberspace operations use wireless communication platforms, networking, digital platforms integrated with computers and multiply the effect of the other. EMS is used as a medium to exchange information between computers and this brings in the possibility of intrusion into a computer through EM spectrum. EW weapon systems are now being developed on computer platforms and are no longer discrete electronic based systems. Few examples of this latest genre of EW systems are SDR and DF systems. Traditionally EW targeted enemy communication systems through EMS and the Cyber Warfare used to target enemy computer networks. Now the dividing lines between these two are blurring and more often than not their roles overlap, thus enhancing the significance of management of EMS.

Management of EMS

The Defence requirements in the EMS need to be judiciously managed and aligned at the national, regional and global levels, for ensuring efficient and interference free spectrum utilisation. In view of the ongoing contest for spectrum allocation for commercial applications, it is necessary that Defence be aware of and have an understanding of the organisations and processes for regulating EMS at the global, regional and national levels, to ensure optimal projection of the EMS requirements of the Armed Forces. EMS is no longer merely about communication systems alone. The requirement of EMS is all-pervasive and is likely to effect and shape all platforms of war fighting in the days to come. Spectrum can be treated akin to a digital national highway, whose presence and availability is essential to drive various means of transport. It is thus extremely important to understand the EMS requirements, in order to be able to apply it or exploit it optimally for reaping military benefits.

Historical Perspective. The defence forces were earlier holding the majority of the frequency spectrum until 2006. However, with the growing demand for spectrum, primarily for mobile telephony (especially 2G & 3G services) and digital TV broadcasting, a need was felt to offset spectrum currently held with the defence forces for commercial use. This led to a review of the National Frequency Action Plan **(NFAP).** At the same time, to cater for the communication requirements of the Armed Forces, the Defence Band (DB) was identified and promulgated in 2015 wherein 09 sub-bands were earmarked exclusively for defence use, while in the remaining 42 sub bands the defence forces were asked to coexist with other commercial users. The Defence Band in the EM spectrum is a prime resource and it needs to be judiciously managed for ensuring efficient and interference-free utilisation.

The DB is however open to review and it is also possible that a few portions of the frequency spectrum, presently earmarked for Defence, might be reviewed in consultation with the MoD, if found to be lying un-utilised and might be made available for auction for commercial/ other purposes. The impending rollout of 5G and other national interests

may possibly warrant an earlier review of the DB and the Armed Forces must be prepared for the same. There is likely to be increased pressure from commercial players on the part of EM spectrum promulgated as a defence band. Defence preparedness is however equally important for safeguarding the sovereignty of the nation, which permits all such commercial activities to take place.

In view of the likely contest for spectrum allocation for commercial applications, there is thus a need to reconcile both these requirements well. At the same time, the Defence Band (DB) needs to be viewed in the light of the strategic implications of defence operations, the long gestation period in fructification of defence procurements and key reform initiatives being undertaken at the highest level. The EMS for defence cannot be taken in isolation as spectrum being a national resource has linkages of frequency spectrum for defence with legacy equipment, the future changes in technology, market structure and government policy. This paper endeavours to explain the necessity to understand and address this issue.

Knowledge regarding the various EMS regulating organisations at the global, regional and national levels and the processes that are followed is essential to understand the criticality of EMS. There is thus a need to put in place systems and procedures, that despite the peculiar constraints of the Armed Forces, they are able to overcome the challenges of spectrum access constraints, while continuing to deliver on the mandated task.

EMS Management at International Level. All nations share the EMS and reserve their right to its unlimited use. However, for international telecommunications, cooperation to support trade, transportation, communications, and mutual protection against interference, they have agreed to an International Telecommunications Convention. This serves as the basic instrument of the ITU and its supporting bodies. The United Nations recognizes the ITU as the specialized agency in the telecommunications field. The ITU maintains cooperation to improve all telecommunications. It allocates the international radio frequency **(RF)**

spectrum, registers frequency assignments, and coordinates resolving interference. Upon ratification by member-nations, ITU regulations have treaty status. Each ITU member-nation imposes regulatory measures within its administration. These measures must comply with the current **Radio Regulations (RR)** unless expressly excluded either by footnotes or by special arrangements.

National EMS Management Orgnisation. The Wireless Planning & Coordination **(WPC)** Wing under the Ministry of Communications **(MoC)** in the country plays the role of Spectrum Manager, while the Telecom Regulatory Authority of India **(TRAI)** plays the role of the national Regulatory Authority. Both these create a fine balance in meeting the strategic requirements of Defence/ Government agencies as well as the commercial requirements, both of which are in the nation's interests.

WPC. The **WPC** Wing of the Ministry of Communications, created in 1952, is the National Radio Regulatory Authority responsible for Frequency Spectrum Management, including licensing, and caters to the needs of all wireless users (government and private) in the country. It exercises the statutory functions of the Central Government and issues licenses to establish, maintain and operate wireless stations. It is divided into major sections like Licensing and Regulation **(LR),** New Technology Group **(NTG)** and Standing Advisory Committee on Radio Frequency Allocation **(SACFA)**. SACFA makes the recommendations on major frequency allocation issues, formulates frequency allocation plans, makes recommendations on the various issues related to International Telecom Union **(ITU),** resolves problems referred to the committee by various wireless users, provides site clearance of all wireless installations in the country, etc. All the allocations for use of radio spectrum are managed by different types of services (eg broadcast/ navigation etc) & exceptions to these allocations may be mentioned in footnotes for specific countries or reservations made by that country at the World Radio Conference **(WRC).**

TRAI. It was set up by an Act of Parliament in 1997. It acts as an independent regulator of the business of telecommunications in the country. Its mission is to create and nurture such conditions that

encourage the growth of the telecommunications sector in India so that the country can play an important role in the world telecommunications society. The main objective of TRAI is to form a transparent and fair policy environment that encourages fair competition. TRAI recommends the timing and need for the introduction of a service provider that is new, ensures successful inter-connection and technical compatibility between various service providers, and suggests the conditions and terms on which licences would be provided to a service provider. The National Frequency Allocation Plan **(NFAP)** forms the basis for development and manufacturing of wireless equipment and spectrum utilization in the country. It contains the service options in various frequency bands for India and also provides the channelling plan in different bands. Some of the typical frequency bands allocated for certain types of radio services in India in various areas are as given below:-

Sr No	Radio Service	Frequency Band
(a)	Radio Navigation	9 – 14 KHz
(b)	Mobile (Distress & Calling)	495 – 505 KHz
(c)	Broadcasting	526.5 – 1606.5 KHz
(d)	Maritime Mobile	2065 – 2107 KHz 2170 – 2178.5 KHz 2190.5– 2194 KHz
(e)	Fixed, Mobile, Broadcasting Radio Astronomy	610 – 806 MHz
(f)	Mobile, Fixed, Broadcasting	890 – 960 MHz
(g)	Mobile Satellite	942 – 960 MHz
(h)	Radio Location	1350 – 1400 MHz
(j)	Mobile, Fixed, Space operation, Space research	1710 – 1930 MHz

In India, allocation of spectrum to various services has been given in NFAP which covers frequency ranges from 9kHz to 3000 GHz and are being used for different types of services like fixed communication,

mobile communication, broadcasting, radio navigation, radio-location, fixed and mobile satellite service, aeronautical satellite service, radio navigational satellite service, etc.

Spectrum Regulating Organisations and Processes

The ITU Organization. The Plenipotentiary Conference is the supreme agency of the ITU. It formulates general policies, establishes budgetary guidelines, elects members, and concludes agreements between the ITU and other international communications organizations. It has three organizations: the World Radio Conference **(WRC),** the International Frequency Registration Board **(IFRB),** and the International Radio Consultative Committee **(CCIR).**

WRC may deal with all the radio communications services, or it may deal with specific radio communications services such as space, maritime, or aeronautical. Each WRC updates the Radio Regulations **(RRs)** which allocate radio spectrum use on a worldwide basis except where regional requirements differ and are agreed. Figure 1.3 below shows the three recognized regions.

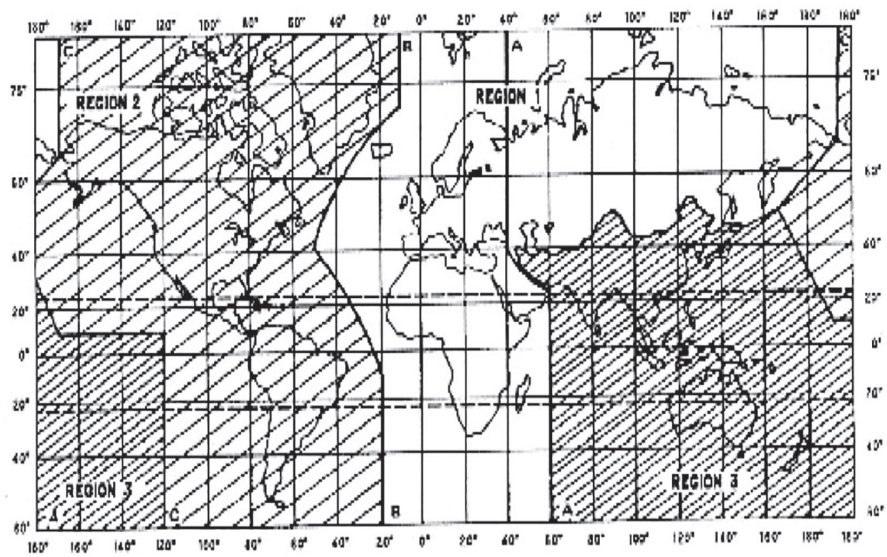


Figure 1.3: The three recognized regions as per ITU

In addition, the tropical area centred on the equator has additional provisions to offset its higher electrical noise. The IFRB records ITU member-nation frequency assignments. It advises the WRCs and member-nations on technical matters on harmful interference and radio spectrum use. The IFRB serves as the office of record of frequency assignments in priority and adjudicates interference conflicts among member-nations. The CCIR provides technical criteria on frequency sharing and examines technical and operational questions about international radio use. It also addresses technically related questions pertinent to ITU member nations and forthcoming WRCs. The findings of the CCIR serve a significant influence on the state-of-the-art and as a basis for **RRs.** However, these findings are recommendations rather than having an obligatory treaty status.

EMS Management at Regional Level: Asia Pacific Telecommunity (APT). The APT is an organisation of governments, telecom service providers, manufacturers of communication equipment, research and development organisations and other stakeholders active in the field of communication and information technology and serves as the focal organisation for communication and information technology in the Asia Pacific region. The APT now has 38 Members, 04 Associate Members and 137 Affiliate Members. Throughout the years, the APT has been able to help members in their preparation for global conferences such as the World Telecommunication Development Conference **(WTDC),** WRC, World Summit on Information Technology **(WSIS),** and the ITU meetings as well as promoting regional harmonization for these events. The APT Conference Preparatory Group for WRC **(APG)** is an important activity of the APT. The APG was started in 1996 with the objective of harmonizing views and developing common proposals from the Asia-Pacific region for the World Radio Conference **(WRC)**. The main objective of the APG is to take regional preparation to harmonize the views of the members and to develop common proposals for submission to the ITU World Radio Conference **(WRC).**

Telecom Circles, EMS Allocation Process & Harmonisation

Telecom Circles in India. The 22 telecom circles in India are shown in **Fig 1.4.**



SN	Telecom Circle Name	Circle Type
1	Delhi Metro Telecom Circle	Metro
2	Mumbai Metro Telecom Circle	Metro
3	Kolkata Metro Telecom Circle	Metro
4	Gujarat Telecom Circle	A
5	Karnataka Telecom Circle	A
6	Tamil Nadu Telecom Circle	A
7	Andhra Pradesh Telecom Circle	A
8	Maharashtra Telecom Circle	A
9	Haryana Telecom Circle	B
10	Punjab Telecom Circle	B
11	Kerala Telecom Circle	B
12	Rajasthan Telecom Circle	B
13	West Bengal Telecom Circle	B
14	Uttar Pradesh (West) Telecom Circle	B
15	Madhya Pradesh Telecom Circle	B
16	Uttar Pradesh (East) Telecom Circle	B
17	Bihar Telecom Circle	C
18	Northeast Telecom Circle	C
19	Assam Telecom Circle	C
20	Orissa Telecom Circle	C
21	Himachal Pradesh Telecom Circle	C
22	Jammu & Kashmir Telecom Circle	C

Figure 1.4: The 22 Telecom Circles in India

In Figure 1.4 shown above, Goa, Andaman and Nicobar Islands and Lakshadweep Islands are, respectively, parts of Maharashtra, West Bengal and Kerala Telecom Circles. Chennai was for some time a Metro Telecom Circles before it was merged into the Tamil Nadu Telecom Circle.

Spectrum Allotment Procedure. Any telecom company that wants to offer services in any of the 22 telecom circles in India, as explained in Figure 1.4 above, must purchase a Unified Access Services Licence **(UASL)** to operate in that circle. ASL was converted to Universal Licence **(UL)** after the 2012 Supreme Court decision on the 2G fraud delinked

spectrum from licences. The UAS, introduced in November 2003, is valid for a period of 20 years, which can be extended by an additional 10 years once, per licence per circle. As per the earlier policy, a mobile network operator who was awarded a licence to operate in any of the 22 telecom circles in India was allocated frequencies in that circle for a fixed period. After the expiry of the licence, the company was required to bid again to renew the licence. Only in certain cases were licences awarded Until Further Notice **(UFN).** The new telecom policy was announced by the Government in 2011. As a result, when an operator renews its licence, it must also pay separately for spectrum. The NTP 2011 has since been replaced by the National Digital Communication Policy **(NDCP)** of 2018.

Thus in the case of licensed telecom service providers, spectrum was initially allotted in accordance with the relevant provisions of the service licence agreements. Initially, the Government promoted additional free spectrum if TSPs could achieve a certain target number of subscribers.

Harmonisation. Harmonisation means de-conflicting defence and non-defence users by shifting their services to their respective share of spectrum to avoid electromagnetic interference.

A case in point is the harmonisation of 1700-2000 MHz Band. On promulgation of the DB, the Cabinet had directed defence and non-defence users to shift to their respective shares of allocated bands in the 1700-2000 MHz band by 23 January 2016, i.e., within a year of promulgation of the DB. This involved the relocation of Defence and Telecom Service Provider **(TSPs)** frequency assignments to their respective share of spectrum, as directed by the Union Cabinet. In this regard, Defence had submitted its harmonization plan to MoC & IT, well within the time frame. However the harmonisation process got slightly delayed due to non-availability of the harmonization plan of the TSPs with MoC & IT(now MoC). On its receipt, harmonisation was carried out pan India in five stages, staggered over a period of five months, in all the 22 Telecom circles in the country. Post completion of the harmonization in October 2016, the balance 20 MHz of spectrum as part of Network for Spectrum **(NFS)** stood released.

Methodology for Management of Defence Band

Rationale for Defence Band. The rationale for creating a Defence Band has been the national endeavour to allocate part of the national spectrum resources to the Defence Services, so that they can plan, develop, procure and operate systems so essential for the Defence forces for meeting any eventuality. Thus, a Defence Band has been identified mutually between the MoD and MoC & IT (now called **MoC**). The Defence Band covers the spectrum requirements of the Defence Services in the frequency bands up to 40GHz. However, in some sub-bands of the DB, some assignments of other ministries/ commercial services are present and would continue to exist till they are relocated outside the DB. The process of earmarking frequency for usage is done in three steps. The details and its connotation in the context of the DB are as follows:-

(a) **Allocation.** Allocation of a frequency band implies entry in the table of frequency allocation of a given frequency band for the purpose of it's use by one or more terrestrial or space radio communication services or radio astronomy services under specified conditions. In the context of the Defence Services, the identification of DB itself may loosely be construed as Allocation as WPC seeks clearance from Defence, i.e., JCES, HQ IDS, if any frequency spot within the DB, is sought by agencies other than Defence.

(b) **Allotment.** Allotment of a radio frequency or a radio frequency channel implies entry of a designated frequency channel in an agreed plan, adopted by a competent conference, for use by one or more administration for a terrestrial or space radio communication service in one or more identified countries or geographical areas under specified conditions. In the context of the Defence Band, it implies that if a frequency or frequency channel is allotted to a particular user, the user is free to develop/ procure its equipment for that frequency or frequency channel. Allotment of a radio frequency should be sought by the users before finalizing the GSQRs.

(c) **Assignment.** Assignment of a radio frequency or radio frequency channel implies that authorization has been given by an administration for a radio station to use a radio frequency or radio frequency channel under specified conditions. In the context of the Defence Band, it implies that a specific user would be allowed to operate the equipment or system under specified conditions (linked to location, time or technical conditions like power output, type of antenna, etc). Assignment of a radio frequency should be sought by the users only after the supply order for the equipment has been placed.

Safeguarding Defence Spectrum Requirements. Defence spectrum requirements are evolving as per the ongoing modernisation of the Armed Forces. Since the economic value of the spectrum cannot be ignored, it is required that the requirement of the Armed Forces be articulated holistically. This is required to be carried out in the Defence Band also as today the spectrum for the Armed Forces is no longer a 'given' thing. The spectrum identified as the Defence Band is also subject to review for development and societal reasons. In order to identify spectrum needs, the following is recommended:-

(a) Spectrum needs based on Long Term Acquisition Plan in respect surveillance, communication and weapon platforms be formulated.

(b) Utilisation of Defence Band be maximised and at the same time additional spectrum requirements for futuristic modernization be projected to MoC through MoD at the earliest.

(c) Build-up of roadmap for achieving Net centricity.

(d) Development of software tools to ensure effective spectrum management at all levels.

(e) Identify communication technologies that optimise spectrum usage in terms of bandwidth and fall within the Defence Band.

(f) Feasibility of re-use of spectrum at national and theatre levels be explored.

(g) Analysis of National Telecom Policy and policy roadmap for digital India which can impact spectrum usage at the national level.

(h) Study of adversaries EW capabilities to identify impact on own communication methodologies and it's overall spectrum requirement down to theatre level, to offset the same

(j) Spectrum requirements are subject to change. Hence, we can identify spectrum dependent systems and then identify the spectrum based on the life cycle of the platform for which it is required.

Meeting the increased requirement for spectrum dedicated to support unmanned systems likely to be used in a big way in future will require increased attention to spectrum management schemes and scheduling to promote sharing of frequencies. Additionally, technologies that increase on-board processing and compression of sensor data will assist in reducing the amount of contiguous bandwidth needed to support airborne data links. Without significant spectrum reuse and fielding of spectrum efficient technologies, unmanned systems will be constrained in their use of spectrum to achieve overall mission needs and may require highly refined scheduling plans to ensure that operations are executed within the limits of available spectrum.

Conclusion

National security is not restricted to securing the land, air and maritime boundaries and pursuing strategic interests but encompasses all aspects that have a bearing on the nation's well-being. In an information-dominated world, EMS is instrumental in providing the competitive edge among the global community, strategic and tactical superiority in conflict situations, and projection of national power and influence. In addition to capability enhancement towards national aspirations, investments are also necessary for securing these facilities against deliberate or unintentional intrusions or attacks and in ensuring safe and sustainable

operations. Wireless medium using frequency spectrum will be the preferred highway of choice where all these battles will be waged using the latest high–tech weapons. **This precious resource of frequency spectrum thus needs to be guarded zealously and optimally utilised.**

The spectrum also has an associated economic value necessary for any nation-state to be able to leverage it and use the monetary gains for societal and development causes. Telecom services are further planned to be rolled out in the country and there might be a requirement for spectrum, presently earmarked for defence, to be considered to be released for commercial purposes, in the overall national interests. Defence preparedness is also equally important for safeguarding the sovereignty of the nation, which permits all such commercial activities to take place. Thus, there is a need to reconcile both these requirements. The peculiar constraints of the Armed Forces, especially in so far as the long gestation period in fructification of defence procurements, needs to be factored into deliberations on these matters.

There is going to be increased pressure from commercial players on the part of EMS promulgated as the Defence Band. In order to obviate such a situation from arising, the three Services will have to diversify along the full spectrum, with suitable gaps for their own future expansions. There is thus a requirement to be aware of the various spectrum regulating organisations at the global, regional and national levels, analyse the Spectrum Management techniques and the processes that are followed, in order to better understand them. Knowledge regarding the EMS allocation process in India is also essential to understand the criticality of spectrum. There is thus a need to put in place systems and procedures that, despite the peculiar service specific constraints, the Armed Forces are able to overcome the challenges of spectrum access constraints, while continuing to deliver on their mandated task.

In view of the ongoing contest for spectrum allocation for commercial applications, it is necessary that defence must be prepared to optimally plan for utilization of the frequency spectrum allocated to them and ensure that the present holding is being managed well in a

judicious manner. At the same time, the need for continued retention of the Defence Band needs to be viewed in the light of the strategic implications of defence operations and key reform initiatives being undertaken at the highest level. This needs to be addressed in a holistic manner so that the defence forces are able to overcome the challenges of spectrum access constraints while continuing to deliver on the mandated task.

Though the defence spectrum requirement is a strategic need of the country, it should not be taken for granted due to pressures from other sectors. There is an urgent need to optimise the usage of the Defence Band by means of projecting for spectrum requirements to support both the present and future capacity build-up of the Armed Forces. The ready availability of requisite EMS for the Armed Forces and its effective management will be the deciding factor. Denying the war fighters' the use of any portion of the EMS would reduce flexibility and jeopardize mission accomplishment. The current Armed Forces EMS requirements are extensive and are likely to grow in the future.

Meeting the increased requirement for spectrum dedicated to support unmanned systems will require increased attention to spectrum management schemes and scheduling to promote sharing of frequencies. Additionally, technologies that increase on-board processing and compression of sensor data will assist in reducing the amount of contiguous bandwidth needed to support airborne data links. Without significant spectrum reuse and fielding of spectrum efficient technologies, unmanned systems will be constrained in their use of spectrum to achieve overall mission needs and may require highly refined scheduling plans to ensure that operations are executed within the limits of available spectrum.

The Armed Forces need to recognize the tremendous role that wireless communication, and thus, spectrum, can play in Defence. At the national level, there is always the classic guns versus butter paradigm, but security concerns must be addressed and the concerns of national

security need to be adequately addressed and should not be sacrificed at the altar of commercial progress.

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