Open Spectrum for Development

India Case Study

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Acronyms

2G	Second Generation
3G	Third Generation
BSNL	Bharat Sanchar Nigam Limited
BWA	Broadband Wireless Access
CIT	Communications and Information Technology
CLC	Communications licensing Committee
DoT	Department of Telecommunications
EGoM	Empowered Group of Ministers
ERP	Effective Radiated Power
GoT	Group on Telecommunications
GHz	Gigahertz
GSM	Global System for Mobile Communications
ICT	Information and Communications Technology
ISP	Internet Service Provider
ISPAI	Internet Service Providers' Association of India
ITA	Indian Telegraph Act, 1885
ITU	International Telecommunications Union
IWTA	Indian Wireless Telegraphy Act
LR	Licensing and Regulation
MHz	Megahertz
MOU	Minutes of Use
MTNL	Mahanagar Telephone Nigam Limited
NRRA	National Radio Regulatory Authority
NTG	New Technology Group
RF	Radio Frequency
RFID	Radio Frequency Identification
SACFA	Standing Advisory Committee on Radio Frequency Allocation
SMC	Spectrum Management Committee
TC	Telecom Commission
TRAI	Telecom Regulatory Authority of India
VoIP	Voice over Internet Protocol
WPC	Wireless Planning and Coordination
WRC	World Radiocommunication Conference

Summary of Key Findings

1. The key decision makers on spectrum allocation and assignment include the WPC, the DoT, the Ministry for CIT and ad hoc groups such as the EGoM for 3G and BWA spectrum auctions. The TRAI is the telecommunications regulator and can make recommendations to the DoT while the DoT has the actual authority to issue licenses.

2. The WPC is in charge of the policy of spectrum management, wireless licensing and assignment of frequencies and has different sections for handling different functions. The SACFA which is the frequency allocation section of the WPC not only makes the allocation and assignment decisions but also resolves disputes between wireless users.

3. Spectrum assignment in India was initially done by bundling spectrum with the franchise license, with additional assignments done on a case-by-case basis. With a shortage of available spectrum due to a rapid increase in the number of operators, the DoT developed a system of assignment in 2002 on the basis of the number of subscribers.

4. The differences between the TRAI and the DoT on key issues of the telecommunications sector in addition to the competition between state-owned and private sector operators and the Government's conflicting interests in encouraging competition created intense controversy in the run up to the first 3G and BWA auctions. The TRAI is, however, continually considering new approaches to spectrum management.

5. Rigid spectrum caps may inhibit mobile broadband development in India by crippling innovative operators from deploying new services, causing economic inefficiencies due to cell-splitting and congestionleading to under-investment, while the number of operators may be unsustainable.

6. Spectrum assignment in the last 10 years has been for commercial use. India also has unlicensed and license-exempt frequency bands available for use but no light-license frequency bands are available. According to the ISPAI, there are 44 ISPs in India using the unlicensed/license-exempt spectrum.

7. Any commercial wireless network operator in India needs a Universal Access Service License from the DoT. VoIP is legal in India and licenses are granted in accordance with the TRAI's recommendations.

8. The globally used WiMax band of 2.5-2.7 GHz has been used in India for satellite-based mobile and broadcast applications such as national emergencies and natural disasters. Now, the government is planning to free 2.5 GHz spectrum for WiMax.

9. While the TRAI has been making recommendations regarding a national broadband strategy, the results suggest that there is no accepted broadband strategy to date. Further, there is also no specific policy in place which addresses effective and efficient use of spectrum in India.

10. India is actively preparing for the WRC 2011 and key organizations who are also involved in the preparations include the WPC, the Cellular Operators Association of India (GSM), The Association of Unified Telecom Service Providers of India (CDMA), the ISPAI, and the Amateur Radio Association of India.

Open Spectrum For Development: Country Research From India

1. Spectrum Policy Regulatory Environment

Regulation of spectrum licensing, allocation and management in India is characterized by two key regulatory structures:

- Policies and Laws
- Governmental Bodies

Laws and rules governing spectrum regulation and management in India are elements of several legislations and policies, namely:

- The Indian Telegraph Act, 1885[2]
- Cable Television Networks (Regulation) Act, 1995[3]
- The Indian Wireless Telegraphy Act, 1933[4]
- The Telegraph Wires (Unlawful Possession) Act, 1950[5]
- Telecom Regulatory Authority of India Act, 1997[6]
- The Telecom Regulatory Authority of India (Amendment) Act, 2000[7]
- New Telecom Policy, 1999[8]

The key decision makers on spectrum allocation and assignment include the Wireless Planning and Coordination (WPC) wing, the Department of Telecommunications (DoT), the Ministry for Communications and Information Technology (CIT) and ad hoc groups such as the Empowered Group of Ministers (EGoM) for third generation (3G) and Broadband Wireless Access (BWA) spectrum auctions.

Spectrum management and regulation is the collective responsibility of more than one body in India. There are different bodies handling spectrum licensing, regulation, pricing, and the levy of penalties; some bodies have only an advisory role.

Spectrum regulation and management in India is the responsibility of the WPC wing, established in 1952 in the Ministry of Communications. The WPC also handles licensing use of spectrum for wireless purposes for government and private users including for commercial use in India. The WPC is in fact the National Radio Regulatory Authority (NRRA), responsible for the statutory functions of the Central Government, including the issue of licenses to establish, maintain and operate wireless stations. The WPC has different sections such as Licensing and Regulation (LR), New Technology Group (NTG) and the Standing Advisory Committee on Radio Frequency Allocation (SACFA). The WPC is headed by the Wireless Advisor who reports to the Member (Technology) of the Telecom Commission (TC). The TC, in turn, is headed by the Secretary[9], DoT and the Chairman, TC.

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[2] Full text available at http://www.trai.gov.in/telegraphact.asp (last visited 20 November 2010)
[3] Full text available at http://www.trai.gov.in/cablenetworkact.asp (last visited 20 November 2010)
[4] Full text available at http://www.trai.gov.in/wirelessact.asp (last visited 20 November 2010)
[5] Full text available at http://indiankanoon.org/doc/980662/ (last visited 20 November 2010)
[6] Full text available at http://www.trai.gov.in/trai_act.asp (last visited 20 November 2010)
[7] Full text available at http://www.trai.gov.in/amendment_act.asp (last visited 20 November 2010)
[8] Full text available at http://www.trai.gov.in/TelecomPolicy_ntp99.asp (last visited 20 November 2010)
[9] The Secretary is a civil servant and reports to the Minister for CIT through the Minister of State for Communications & Information Technology.

The SACFA makes recommendations on major frequency allocation issues, formulation of the frequency allocation plan, and on issues related to the International Telecom Union (ITU). The SACFA also resolves disputes between wireless users referred to the WPC, apart from site clearances for all wireless installations in India.[10] It is important to note that the SACFA makes the actual allocation and assignment decisions.

The Department of Telecommunications, Ministry of Communications & Information Technology, has expressly assigned the WPC the responsibility for managing the "policy of spectrum management, wireless licensing, frequency assignments, international coordination for spectrum management and administration of the Indian Telegraph Act, 1885 (ITA) for radio communication systems and the Indian Wireless Telegraphy Act, 1933 (IWTA)."[11]

The Telecom Regulatory Authority of India (TRAI) as the name suggests, is the telecommunications regulator in India and is responsible for making recommendations on various matters including spectrum allocation and pricing.[12] While the TRAI can only make recommendations to the DoT, only the DoT has the authority to issue licenses.

There have been occasions where special committees have been set up to consider and make recommendations relating to spectrum management in India. For instance, in 1998, there was a Spectrum Management Committee (SMC) which made recommendations to a Group on Telecommunications (GoT).[13] There was an EGoM set up in 2010[14] which made decisions on the ongoing 3G and BWA spectrum auctions.

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[10] Website of the Wireless Planning and Coordination Wing, Ministry of Communications, Department of Telecommunications, available at http://210.212.79.13/ (last visited 1 December 2010)
[11] Department of Telecommunications, Ministry of Communications and Information Technology, Government of India "Annual Report 2009-2010" at p.31, available at http://www.dot.gov.in/annualreport/2010/final.pdf (last visited 1 December 2010)
[12] Website of the Telecom Regulatory Authority of India, available at http://trai.gov.in (last visited 1 December 2010)
[13] Group on Telecommunications, "Report of Spectrum Management Committee" available at http://indiaimage.nic.in/pmcouncils/got/report/chap7.htm (last visited 1 December 2010)
[14] See BS Reporter, "Government Constitutes EGoM on 3G Auction", Business Standard, July 14, 2009 available at http://www.business-standard.com/india/news/government-constitutes-egom3g-auction/363877/ (last visited 1 December 2010)

2. The Spectrum Management Process

2.1 Spectrum Allocation

The SACFA is the decision making authority for allocation of spectrum frequency.[15] With regard to the relative allocation of spectrum in India and Africa, African countries are grouped in Region 1, while India is in Region 3.[16] A few deviations from the allocations listed in the table were noticed. Here are some examples:

Table 1: Deviations in Spectrum Allocations

Sl.No.	Frequency (in Megahertz (MHz))	Deviation
1.	9-70	Similar deviation for all regions
2.	70-72	Regions 1 and 2 - 5.60 MHz Radionavigation Region 3 - Fixed + 5.57 MHz Maritime mobile + 5.59 MHz Radiolocation (should have been at 9-70 MHz)
3.	72-84	Region 1 – 5.56 MHz Radionavigation (in addition to 5.60 MHz as in Region 3) (should have been at 9-70 MHz)
4.	86-90	Region 1 – 5.56 MHz Radionavigation (should have been at 9-70 MHz)

2.2 Spectrum Assignment Process

Spectrum assignment in India was initially done by bundling a band of spectrum with the franchise license for a service (for example, GSM 900). Additional assignments were at the discretion of the DoT on a case-by-case basis. The DoT also issued additional licenses. While more spectrum was also auctioned to Global System for Mobile Communications (GSM) operators, a plethora of operators in each geographical area has resulted in a shortage of spectrum. The DoT instituted a system of assignment in 2002 based on the number of subscribers, which is currently in effect for 2G services.[17]

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[15] The table of spectrum frequency allocations is available at http://210.212.79.13/DocFiles/Book.pdf (last visited 2 December 2010) India's spectrum frequency allocation table also provides details of international frequency allocations by the ITU for Regions 1, 2 and 3 including India.
[16] Map of the regions available at http://www4.plala.or.jp/nomrax/ITU_Reg.htm (last visited 1 December 2010)
[17] For details of subscriber-linked calculations, See T.V. Ramachandran, "Radio Resource Management in Highly Populated Developing Countries" available at http://www.itu.int/osg/spu/stn/spectrum/spectrum_resources/general_resources/Ramachandran_URSI.pdf (last visited 2 December 2010)

Plum Consulting's report on the spectrum management policy of India[18] describes the process of spectrum assignment as follows:

Under the current spectrum policy in India:

- Initial spectrum is bundled with each license
- Newly licensed cellular operators receive an initial assignment of spectrum to enable them to start operations. GSM licensees receive 2x4.4 MHz and CDMA licensees 2x2.5 MHz.
-
- Operators then receive additional spectrum as the number of subscribers grow. This is available on a first come first served basis to any entity which complies with the eligibility criteria on subscriber numbers.
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- In the initial years the Indian Government followed a case by case approach, which was subsequently formalized into subscriber linked criteria in 2002. The number of subscribers required to be eligible for a given spectrum assignment has increased over the years. Figure 2.1 illustrates.[19] It specifies the number of subscribers required in order for a GSM operator to be eligible for a given assignment of spectrum. We can see that the Indian Government Order of January 2008, based on TRAI recommendations, increased the number of subscribers required for a given spectrum assignment by a factor of two to four times.
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- In 2007, the DOT assigned some spectrum for 2G to a subset of applicant. This matter was investigated and is being prosecuted in court.
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- At present, the first 3G and BWA auction is in progress.

Another independent report commissioned by the GSM Association on 'Mobile Broadband, Competition and Spectrum Caps' by Martyn Roetter discusses spectrum management in India.[20] The following is an excerpt from the report:

India presents an extreme example of detailed spectrum management or micro-management by a regulator. Uniquely additional spectrum in this country is attributed to an operator on the basis of its number of subscribers. Furthermore, the total spectrum which a 2G operator can hold is linked to the technology it uses on the basis of the supposed spectrum efficiency of that technology. Current 2G spectrum caps are 15 MHz/GSM operator and 7.5MHz/CDMA operator (earlier proposals were 7.2 MHz and 5MHz respectively), on the grounds that CDMA technology is more spectrally efficient than GSM. Additional spectrum within the caps is attributed in 0.8 and 1 MHz "chunks" (previously 1, 2, 2.4, and 2.6 MHz) when specified subscriber thresholds are reached.

The issues of spectrum caps and criteria for attributing additional spectrum have fueled long delays in decision making and intense controversy between and even within the sector regulator,

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[18] David Lewin et al, supra n.15
[19] Annex 1 [Please use 'Annex'or 'Appendix' – 'annexure' is incorrect]
[20] Dr. Martin F. Roetter, "Mobile Broadband, Competition and Spectrum Caps: An Independent Paper Prepared for the GSM Association", January 2009 (Arthur D. Little) available at
http://www.gsmworld.com/documents/Spectrum_Caps_Report_Jan09.pdf (last visited 1 December 2010)

the Telecommunications Regulatory Authority of India (TRAI), and the Department of Telecommunications (DOT), as well as the industry. Traditionally the regulator and the Government (DOT) have not seen eye-to-eye on many key matters affecting the development of the telecommunications sector in India. This sector's environment is also complicated or muddied by competition between state-owned operators and private sector competitors in which the rules of the game are far from symmetric, and the Government has potentially conflicting interests in encouraging competition, while at the same time not wishing to harm the prospects and revenues and profits of businesses which it owns. This situation is apparent in the lead up to long awaited 3G auctions…

MTNL is the incumbent in the two major metropolitan areas of Delhi and Mumbai, and BSNL in the rest of the country.

…MTNL is reportedly test launching a 3G network in New Delhi and may make the service available by early 2009 as well. A second network in Mumbai is scheduled to launch also early in 2009. Similar detailed management of the spectrum attributed to individual operators is also evident in the case of frequencies for BWA services. The DOT now appears willing to auction off more BWA spectrum per license winner than was previously suggested by either the government or TRAI. A total of 80MHz of spectrum in the 2.3GHz and 2.5GHz frequency bands (40MHz per band) is to be made available for four operators (20MHz each). The state-owned operators BSNL and MTNL have been given set asides of 20MHz at 2.5GHz in their respective regions, while another three operators will be authorized to acquire the remaining 60MHz. Both 2.3GHz and 2.5GHz are standardized frequencies for the 802.16e mobile WiMax system. The 2.5GHz band is also standardized for FDD technologies such as HSPA+ and LTE in option 1 of the International Telecommunications Union's (ITU) planning for this band (2500MHz-2690MHz). In addition, the DOT has announced that spectrum blocks in the 3.3-3.6GHz and 700MHz frequency bands will also be auctioned off as they become available. The DOT has now also proposed that the BWA license holders should be able to offer mobile voice service in addition to mobile data. India's very detailed prescriptions for spectrum attribution and the asymmetric nature of the way in which Government-owned and private sector operators acquire spectrum raise multiple concerns that will be exacerbated in a future mobile broadband environment that will demand substantially more bandwidth if broadband services are to be provided efficiently and effectively, notably:

- Inappropriate low spectrum caps and parsimonious additional attributions over time may penalize successful operators via congestion, or give them an added competitive advantage via early access to more spectrum on the basis of what might possibly only be a temporary market lead if its competitors had equal amounts of spectrum to exploit.

- Operators are motivated to exaggerate subscriber numbers to acquire more spectrum.

- The prices of mobile services in India are very low, and as a consequence the average Minutes of Use (MOU) is very high by international standards (450+ MOU/month, compared to about 150 in Chile for example), which further increases the likelihood that Indian mobile networks will experience congestion unless more spectrum is made available in a timely manner.

- Application of tight, detailed prescriptions for spectrum attribution may lead to:

– An uneconomically large number of entrants,

– Corresponding inefficiencies (inability to exploit economies of scale) in the services available to customers, and

– Inflexibility in responding to developments in the market that are inherently unpredictable and may change rapidly.

- Perceived competitive inequalities and obstacles (guaranteed spectrum for state-owned operators, lack of access to 2G spectrum for 3G entrants) may discourage capable firms, e.g. foreign operators, from entering the market.

- The current Indian approach to allocating and attributing spectrum is fraught with risks to the demand-driven development of mobile broadband services, which will likely be delayed and frustrated unless the underlying policies and the processes for resolving the kinds of disputes it provokes are substantially revised.

The report makes certain conclusions with respect to spectrum management in Latin America based on this study. These conclusions are equally valid for India:

Tight spectrum caps such as are in place in some countries in Latin America will inhibit mobile broadband development. These caps entail substantial risks in the emerging and unpredictable mobile broadband environment, with regard to:

- The ability of innovative operators to deploy new valuable services may be impaired if they are subject to some current rigid spectrum caps that will not allow them to acquire sufficient additional spectrum to exploit the maximum efficiencies of new broadband wireless technologies and offer a wide portfolio of broadband services to their customers.
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- Techno-economic efficiencies may be reduced as cell splitting has to increase when spectrum becomes congested.
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- The number of operators may increase beyond an economically sustainable number, leading to under-investment while the assets of weaker participants are reorganized and caps have to be renegotiated.[21]

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[21]R. Prasad & V. Sidhar, "Optimal Number of Mobile Service Providers in India: Trade-Off between Efficiency and Competition", R. Prasad and V. Sidhar, International Journal of Business Data Communications and Networking , Volume 4, Issue 3, July -September 2008

While information on the explicit frequency assignment to specific users is unavailable, the amount of spectrum assigned to specific users is available.[22] Spectrum assignment in the last 10 years, for instance, has been for commercial use.[23] Apart from details of the users who were assigned spectrum since May 2008, a graphic representation of all operators and areas is also available.[24]

3. Spectrum Management – The Future

The TRAI's recommendations state that all spectrum is to be auctioned. However, in 2007, the DoT assigned spectrum to the first five comers for 2G services and this is now being contested in court. The Government conducted the first auction of 3G and BWA spectrum in May 2010.

The TRAI continually considers new approaches to spectrum management. It held consultations on spectrum management in October and November 2009. All stakeholders sent in their written comments[25] on a questionnaire and many participated in the open house hearings held over three days.

4. Access to Unlicensed/License-Exempt Spectrum

India has unlicensed and license-exempt frequency bands available for use. However, there are no light-license frequency bands for use in India. Details of specific bands allotted for unlicensed and license-exempt use is listed below, including information about any kind of technical restrictions that may apply to the use of such frequency bands.[26]

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[22] See Telecom Regulatory Authority of India, "Consultation Paper on Mobile Virtual Network Operator (MVNO)", May 2008 available at http://www.trai.gov.in/trai/upload/PressReleases/570/cpaper5may08.pdf (last visited 1 December 2010); See David Lewin et al, "An Assessment of Spectrum Management Policy in India – A Final Report to the GSMA", December 2008 (Plum Consulting) available at http://www.plumconsulting.co.uk/pdfs/GSMA%20spectrum%20management%20policy%20in%20India.pdf (last visited 1 December 2010)

[23] For details on users who were assigned spectrum since May 2008, see Ibid; Annexure 2

[24] Graphic representation of operators and areas of spectrum allocation is available at http://4.bp.blogspot.com/_023ZOs2T_5c/SsRT9ZrcO6I/AAAAAAAAAf0/1MIDL1aBfvU/s400/Spectrum+Status-JP+Morgan-Jan+14,+2009.jpg (last visited 2 December 2010). Please note that the representation available is a scanned image of a hard copy and is not very legible.

[25] CIS' comments on the questionnaire are available at http://www.trai.gov.in/WriteReadData/trai/upload/ConsultationPapers/176/TICS.pdf (last visited 2 December 2010) and http://www.trai.gov.in/WriteReadData/trai/upload/ConsultationPapers/176/CISCC.pdf (last visited 2 December 2010)

[26] See "Remarks in the National Frequency Allocation Table" available at http://www.wpc.dot.gov.in/DocFiles/NFAP/NPR.doc (last visited 1 December 2010); Also See "India Remarks in the National Frequency Allocation Table – National Frequency Allocation Plan, 2008" available at http://210.212.79.13/DocFiles/NFAP2008/IND%20REMARK.doc (last visited 1 December 2010)

4.1 IND01

Use of very low power devices in the frequency band 50-200 on non- interference, non-protection and shared (non-exclusive) basis has been exempted from licensing requirement.

4.2 IND02

Use of very low power devices, like tyre pressure indicator systems for use by airlines during all phases of flight, vehicle security systems and other low power devices, in frequency band 125-135 KHz on non-interference, non- protection and shared (non-exclusive) basis has been exempted from licensing requirement.

4.3 IND04

The following frequencies are earmarked for Cordless Telephones:

Base unit: 1610, 1640, 1675, 1690 kHz, 43.720, 43.740, 43.820, 43.840, 43.920, 43.960, 44.120, 44.160, 44.180, 44.200, 44.320, 44.360, 44.400, 44.460, 44.480, 46.610, 46.630, 46.670, 46.675, 46.710, 46.725, 46.730, 46.770, 46.775, 46.825, 46.830, 46.870, 46.930 and 46.970 MHz.

Remote Unit: 26.375, 26.475, 26.575, 26.625, 48.760, 48.840, 48.860, 48.920, 49.020, 49.080, 49.100, 49.160, 49.200, 49.240, 49.280, 49.360, 49.400, 49.460, 49.500, 49.670, 49.770, 49.830, 49.845, 49.850, 49.860, 49.875, 49.890, 49.930, 49.970, 49.990, 150.350, 150.750, 150.850 and 150.950 MHz.

4.4 IND07

The frequency spots 3213, 5218, 13862.4 kHz, 73.675, 79.025, 159.55, 436.525 & 461.525 MHz are earmarked for demonstration of equipment.

4.5 IND10

Use of wireless equipment intended to be used while in motion or during halts, in the frequency band 26.957-27.283 MHz, with a maximum Effective Radiated Power (ERP) of 5 Watts has been exempted from licensing requirements.

4.6 IND19

Use of low power equipment for the remote control of cranes using frequencies 335.7125, 335.7375, 335.7625, 335.7875, 335.8125 and 335.8375 MHz, with a channel bandwidth of 10 KHz and maximum transmit power of 1 mW has been exempted from licensing requirement.

4.7 IND31

Use of very low power remote cardiac monitoring RF wireless medical devices, medical implant communication/ telemetry systems and other such medical Radio Frequency (RF) wireless devices in frequency band 402-405 MHz using a maximum radiated power of 25 micro watts or less with channel emission bandwidth within 300 KHz has been exempted from licensing requirement.

4.8 IND43

Use of low power Radio Frequency Identification (RFID) equipment or any other low power wireless devices or equipment in the frequency band 865-867 MHz with a maximum transmitter power of 1 Watt (4 Watts Effective Radiated Power) with 200 KHz carrier bandwidth has been exempted from licensing requirement.

4.9 IND50

Certain frequency spots in the frequency band 926 – 926.5 MHz may be considered for very low power cordless telephone systems. The use of this band for such purpose is on the basis of non-interference, non-protection and non-exclusiveness.

4.10   IND58

Use of low power equipment in the frequency band 2.4-2.4835   GHz   using a maximum transmitter output power of 1 Watt (4 Watts Effective Radiated Power) with spectrum spread of 10 MHz or higher has been exempted from licensing requirement.

4.11   IND63

Use of low power equipment for cellular telecom systems including Radio Local Area Networks, in the frequency band 5.150-5.350 GHz and 5.725 – 5.875 GHz using a maximum mean Effective Isotropic Radiated Power of 200 mW and a maximum mean Effective Isotropic Radiated Power density of 10 mW/MHz in any 1 MHz bandwidth, for indoor applications has been exempted from licensing requirement.

4.12   IND65

The requirement of very low power radio gadgets, radio toys, etc., with maximum power of 100 microwatts may be considered in the frequency band 5725-5875 MHz. Such use will be on the basis of non-interference, non-protection and non-exclusiveness.

4.13   IND66

Use of low power equipment in the frequency band 5.825 to 5.875 GHz using a maximum transmitter output power of 1 Watt (4 Watts Effective Radiated Power) with spectrum spread of 10 MHz or higher has been exempted from licensing requirements.

5. Exploiting Wireless

Any commercial wireless network operator in India needs a Universal Access Service License from the DoT which costs Rs. 1,650 crore (USD 360 million) for a countrywide license, apart from spectrum charges which are additional.

According to the Internet Service Providers' Association of India (ISPAI), [27] there are currently 44 (forty four) wireless Internet Service Providers (ISPs)[28] in India using unlicensed/licence-exempt spectrum to provide services. Of these 44 service providers, Bharat Sanchar Nigam Limited (BSNL), Mahanagar Telephone Nigam Limited (MTNL), Bharti, Reliance and Hathway were the five major ISPs whose combined share constituted 90% of the market in India at the end of March 2010.[29] The ISPAI provides detailed information about licence categories, fees and guarantees for obtaining ISP licenses in India.[30]

Voice over Internet Protocol (VoIP) is legal in India and licenses are granted in accordance with TRAI's recommendations for Internet Service Providers (ISPs) made in 2002 and 2008 as well as for connection to an ISP through authorized cable operators. The cost of a VoIP license is similar to that of an ISP license.

Wireless Access Providers have come together to form an association, the WiMAX-U, which seeks to promote the interests of providers of wireless access and other services.

6. Other Spectrum

Apart from the standard mobile and unlicensed frequencies, the Government is currently auctioning the 3G and BWA spectrum (May 2010) in the frequency bands of 2.1 GHz and 2.3 GHz to companies providing fixed or mobile telecommunication services. The globally used WiMax band of 2.5-2.7 GHz has been used in India for satellite-based mobile and broadcast applications such as national emergencies and natural disasters. Now, the government is planning to free 2.5 GHz spectrum for WiMax. The status of frequency allocations and spectrum assignments as at the end of February 2008 is described in Annex 3.

As far as government spectrum re-use is concerned, the defence forces were to give up some of their spectrum as they were to get an optical fibre cable network for their communications system. But work on this network, being built by state-owned BSNL, has been delayed, possibly delaying the vacation of spectrum. Orders for equipment were to have been placed by January 2010.[31] We have no specific information about bands of unused spectrum which may present an opportunity for improved access in India, other than the general issue of the "digital dividend" from redeployment of spectrum used for terrestrial TV transmission.

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[27] See Official Website of the ISPAI available at http://www.ispai.in/siteMap.php (last visited 20 November 2010)

[28] List of organizations/ISPs in India available at http://www.ispai.in/ispai-view/organizationlist.php (last visited 20 November 2010)

[29] ISPAI, "Market Share of 5 major ISPs as on March 2010" available at http://www.ispai.in/Stat4-MarketShare.php (last visited 20 November 2010)

[30] ISPAI, "How to Become an ISP" available at http://www.ispai.in/HowToBecome-ISP.php (last visited 20 November 2010)

[31] See Shauvik Ghosh, "Spectrum Allocation Hinges on Defence Vacating Frequencies", Livemint, March 11, 2010 available at http://www.livemint.com/2010/03/11224202/Spectrum-allocation-hinges-on.html (last visited 1 December 2010)

7. National Broadband Strategy

Service providers[32], consumer groups[33] and the Government (including the DoT, Ministry of Communications and Information Technology, WPC, SACFA and the Ministry of Defence), and the Ministry of Finance are engaged in the spectrum debate and are active stakeholders. Audits of spectrum have been conducted by some networks although such audit has not been done either at a national level or on a mandatory basis. While the TRAI has been making recommendations regarding a national broadband strategy, the results suggest that there is no accepted broadband strategy to date. Further, there is also no specific policy in place which addresses efficient use of spectrum in India.

8. International Coordination

In the context of engaging in spectrum policy and management at the international level, India is actively preparing for the World Radiocommunication Conference (WRC) 2011 expected to be held in Geneva in October-November 2011. The Joint Wireless Advisor from India attended the WRC-11 meeting in Geneva between November 25-28, 2008.[34] A further meeting was held on August 28, 2009 in preparation for the WRC 2011 of which India was a participant.[35] The key organizations which are involved in preparing for the WRC 2011 include the WPC and groups like the Cellular Operators Association of India (GSM), The Association of Unified Telecom Service Providers of India (CDMA), the ISP Association of India, and the Amateur Radio Association of India.

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[32] See TRAI, "Details of Service Providers and Consumer Groups" available at
http://www.trai.gov.in/serviceproviders.asp (last visited 2 December 2010)
[33] See TRAI, "List of Consumer Organisations/NGO Registered with TRAI" available at
http://www.trai.gov.in/consumergroups.asp (last visited 2 December 2010)
[34] See Ministry of Communications and Information Technology, "International Relations" available at
http://www.dot.gov.in/irelation.htm (last visited 2 December 2010)
[35] See ITU-APT Foundation of India, "Preparatory Workshop on the World Radiocommunication Conference 2011" available at http://www.itu-apt.org/wrc11.html (last visited 2 December 2010)

ANNEX 1

Subscriber-linked Criterion for Spectrum Assignment

Figure 2.1: The number of subscribers (in 00,000s) required for a GSM operator to be eligible for a given spectrum assignment

Service Area	Delhi & Mumbai		Kolkata & Chennai		Circle A		Circle B		Circle C	
Assignment (in MHz)	From 3/06	From 1/08	From 3/06	From 1/08	From 3/06	From 1/08	From 3/06	From 1/08	From 3/06	From 1/08
4.4	*	*	*	*	*	*	*	*	*	*
6.2	3	5	2	5	4	8	3	8	2	6
7.2		15		15		30		30		20
8	6		4		8		6		4	
8.2		18		18		41		41		31
9.2		21		21		53		53		42
10	10		6		14		10		6	
10.2		26		26		68		68		52
11.2		32		32		82		82		62
12.2		40		40		90		90		70
12.4	16		10		20		16		9	
13.2		48		48		98		98		78
14.2		57		57		107		107		87
15	21	65	13	65	26	116	21	116	12	96

ANNEX 2

Spectrum Allocation to Mobile Service Providers   May 2008

Sl. No.	Name of service provider	Service area	Type of service	Spectrum allotted (in MHz)
1	Bharti	Delhi	GSM	10.00
2	Vodafone	Delhi	GSM	10.00
3	MTNL	Delhi	GSM	8.00
4	Idea Cellular	Delhi	GSM	8.00
5	Aircel Ltd.	Delhi	GSM	4.40
6	Reliance	Delhi	GSM	4.40
7	MTNL	Delhi	CDMA	3.75
8	Reliance Infocomm	Delhi	CDMA	5.00
9	Tata Teleservices	Delhi	CDMA	5.00
10	BPL	Mumbai	GSM	10.00
11	Vodafone	Mumbai	GSM	10.00
12	MTNL	Mumbai	GSM	8.00
13	Bharti	Mumbai	GSM	9.20
14	Aircel Ltd.	Mumbai	GSM	4.40
15	Idea Cellular Ltd.	Mumbai	GSM	4.40
16	Reliance	Mumbai	GSM	4.40
17	MTNL	Mumbai	CDMA	5.00
18	Reliance Infocomm	Mumbai	CDMA	5.00
19	Tata Teleservices	Mumbai	CDMA	5.00
20	Aircel Cellular Ltd.	Chennai	GSM	8.60
21	Bharti	Chennai	GSM	8.60
22	BSNL	Chennai	GSM	8.00
23	Vodafone	Chennai	GSM	8.00
24	TTSL	Chennai	GSM	4.40
25	BSNL	Chennai	CDMA	2.50
26	Reliance Infocomm	Chennai	CDMA	5.00
27	Tata Teleservices	Chennai	CDMA	3.75
28	Bharti	Kolkata	GSM	8.00
29	Vodafone	Kolkata	GSM	9.80
30	BSNL	Kolkata	GSM	6.20
31	Reliable Internet	Kolkata	GSM	6.20
32	Dishnet Wireless Ltd	Kolkata	GSM	4.40
33	BSNL	Kolkata	CDMA	2.50

34	Reliance Infocomm	Kolkata	CDMA	5.00
35	Tata Teleservices	Kolkata	CDMA	3.75
36	Vodafone	Maharashtra	GSM	6.20
37	Idea Cellular Ltd.	Maharashtra	GSM	9.80
38	BSNL	Maharashtra	GSM	8.00
39	Bharti	Maharashtra	GSM	6.20
40	Aircel Ltd.	Maharashtra	GSM	4.40
41	Reliance	Maharashtra	GSM	4.40
42	BSNL	Maharashtra	CDMA	2.50

43	Reliance Infocomm	Maharashtra	CDMA	5.00
44	Tata Teleservices	Maharashtra	CDMA	5.00
45	Vodafone	Gujarat	GSM	9.80
46	Idea Cellular Ltd.	Gujarat	GSM	6.20
47	BSNL	Gujarat	GSM	7.40
48	Bharti	Gujarat	GSM	6.20
49	Aircel Ltd.	Gujarat	GSM	4.40
50	Reliance	Gujarat	GSM	4.40
51	BSNL	Gujarat	CDMA	2.50
52	Reliance Infocomm	Gujarat	CDMA	3.75
53	Tata Teleservices	Gujarat	CDMA	3.75
54	Idea Cellular Ltd.	Andhra Pradesh	GSM	8.00
55	Bharti	Andhra Pradesh	GSM	7.80
56	BSNL	Andhra Pradesh	GSM	8.00
57	Vodafone	Andhra Pradesh	GSM	6.20
58	Aircel Ltd.	Andhra Pradesh	GSM	4.40
59	Reliance	Andhra Pradesh	GSM	4.40
60	BSNL	Andhra Pradesh	CDMA	2.50
61	Reliance Infocomm	Andhra Pradesh	CDMA	5.00
62	Tata Teleservices	Andhra Pradesh	CDMA	5.00
63	Shyam Telelink	Andhra Pradesh	CDMA	2.50
64	Bharti	Karnataka	GSM	9.80
65	Spice	Karnataka	GSM	6.20
66	BSNL	Karnataka	GSM	8.00
67	Vodafone	Karnataka	GSM	8.00
68	Aircel Ltd.	Karnataka	GSM	4.40
69	Reliance	Karnataka	GSM	4.40
70	BSNL	Karnataka	CDMA	2.50
71	Reliance Infocomm	Karnataka	CDMA	5.00
72	Tata Teleservices	Karnataka	CDMA	3.75
73	Vodafone	Tamil Nadu	GSM	6.20
74	Aircel Ltd.	Tamil Nadu	GSM	9.80
75	BSNL	Tamil Nadu	GSM	8.00

76	Bharti	Tamil Nadu	GSM	8.20
77	Reliance	Tamil Nadu	GSM	4.40
78	Idea	Tamil Nadu	GSM	4.40
79	Swan	Tamil Nadu	GSM	4.40
80	Loop	Tamil Nadu	GSM	4.40
81	Datacom	Tamil Nadu	GSM	4.40
82	Unitech	Tamil Nadu	GSM	4.40
83	TTSL (Dual)	Tamil Nadu	GSM	4.40
84	BSNL	Tamil Nadu	CDMA	2.50
85	Reliance Infocomm	Tamil Nadu	CDMA	5.00
86	Tata Teleservices	Tamil Nadu	CDMA	2.50
87	Shyam Telelink	Tamil Nadu (incl. Chennai)	CDMA	2.50
88	Idea Communications Ltd.	Kerala	GSM	8.00
89	Vodafone	Kerala	GSM	6.20
90	BSNL	Kerala	GSM	8.00

91	Bharti	Kerala	GSM	6.20
92	Dishnet Wireless Ltd.	Kerala	GSM	4.40
93	Reliance	Kerala	GSM	4.40
94	BSNL	Kerala	CDMA	3.75
95	Reliance Infocomm	Kerala	CDMA	5.00
96	Tata Teleservices	Kerala	CDMA	3.75
97	Spice	Punjab	GSM	7.80
98	Bharti	Punjab	GSM	7.80
99	BSNL	Punjab	GSM	6.20
100	Vodafone	Punjab	GSM	6.20
101	Dishnet Wireless Ltd	Punjab	GSM	4.40
102	Reliance	Punjab	GSM	4.40
103	Aircel	Punjab	GSM	4.40
104	BSNL	Punjab	CDMA	2.50
105	Reliance Infocomm	Punjab	CDMA	3.75
106	HFCL Infocomm	Punjab	CDMA	2.50
107	Tata Teleservices	Punjab	CDMA	3.75
108	Idea Communications Ltd.	Haryana	GSM	6.20
109	Vodafone	Haryana	GSM	6.20
110	BSNL	Haryana	GSM	6.20
111	Bharti	Haryana	GSM	6.20
112	Dishnet Wireless Ltd	Haryana	GSM	4.40
113	Reliance	Haryana	GSM	4.40
114	BSNL	Haryana	CDMA	2.50
115	Reliance	Haryana	CDMA	3.75

		Infocomm			
116	Tata Teleservices	Haryana	CDMA	3.75
117	Shyam Telelink	Haryana	CDMA	2.50
118	Idea Communications Ltd.	UP-W	GSM	8.00
119	Bharti	UP-W	GSM	6.20
120	BSNL	UP-W	GSM	8.00
121	Vodafone	UP-W	GSM	6.20
122	Dishnet Wireless Ltd	UP-W	GSM	4.40
123	Reliance	UP-W	GSM	4.40
124	Aircel	UP-W	GSM	4.40
125	BSNL	UP-W	CDMA	2.50
126	Reliance Infocomm	UP-W	CDMA	5.00
127	Tata Teleservices	UP-W	CDMA	3.75
128	Shyam Telelink	UP-W	CDMA	2.50
129	Vodafone	UP-E	GSM	8.00
130	BSNL	UP-E	GSM	8.00
131	Bharti	UP-E	GSM	6.20
132	Idea Telecommunications Ltd.	UP-E	GSM	6.20
133	Dishnet Wireless Ltd	UP-E	GSM	4.40
134	Reliance	UP-E	GSM	4.40
135	BSNL	UP-E	CDMA	2.50
136	Reliance Infocomm	UP-E	CDMA	5.00
137	Tata Teleservices	UP-E	CDMA	3.75
138	Shyam Telelink	UP-E	CDMA	2.50
139	Vodafone	Rajasthan	GSM	6.20

140	Hexacom (Bharti)	Rajasthan	GSM	6.20
141	BSNL	Rajasthan	GSM	8.00
142	Idea Telecommunications Ltd.	Rajasthan	GSM	6.20
143	Aircel Ltd.	Rajasthan	GSM	4.40
144	Reliance	Rajasthan	GSM	4.40
145	BSNL	Rajasthan	CDMA	2.50
146	Reliance Infocomm	Rajasthan	CDMA	3.75
147	Shyam Telelink	Rajasthan	CDMA	5.00
148	Tata Teleservices	Rajasthan	CDMA	3.75
149	Idea	Madhya Pradesh	GSM	8.00
150	Reliance	Madhya Pradesh	GSM	6.20
151	BSNL	Madhya Pradesh	GSM	6.20
152	Bharti	Madhya Pradesh	GSM	6.20
153	Dishnet Wireless Ltd	Madhya Pradesh	GSM	4.40

154	Vodafone	Madhya Pradesh	GSM	4.40
155	BSNL	Madhya Pradesh	CDMA	2.50
156	Reliance Infocomm	Madhya Pradesh	CDMA	5.00
157	Tata Teleservices	Madhya Pradesh	CDMA	2.50
158	Shyam Telelink	Madhya Pradesh	CDMA	2.50
159	Reliance	WB & AN	GSM	6.20
160	BSNL	WB & AN	GSM	6.20
161	Bharti	WB & AN	GSM	6.20
162	Vodafone	WB & AN	GSM	6.20
163	Dishnet Wireless Ltd	WB & AN	GSM	4.40
164	BSNL	WB & AN	CDMA	2.50
165	Reliance Infocomm	WB & AN	CDMA	3.75
166	Tata Teleservices	WB & AN	CDMA	2.50
167	Shyam Telelink	WB & AN	CDMA	2.50
168	Bharti	Himachal Pradesh	GSM	6.20
169	Reliance	Himachal Pradesh	GSM	6.20
170	BSNL	Himachal Pradesh	GSM	6.20
171	Idea Telecommunications Ltd.	Himachal Pradesh	GSM	4.40
172	Dishnet Wireless Ltd	Himachal Pradesh	GSM	4.40
173	Vodafone	Himachal Pradesh	GSM	4.40
174	BSNL	Himachal Pradesh	CDMA	2.50
175	Reliance Infocomm	Himachal Pradesh	CDMA	2.50
176	Tata Teleservices	Himachal Pradesh	CDMA	2.50
177	Shyam Telelink	Himachal Pradesh	CDMA	2.50
178	Reliance	Bihar	GSM	8.00
179	BSNL	Bihar	GSM	8.00
180	Bharti	Bihar	GSM	8.00
181	Dishnet Wireless Ltd	Bihar	GSM	4.40
182	Vodafone	Bihar	GSM	4.40
183	Aditya Birla Telecom Ltd. (Idea)	Bihar	GSM	4.40
184	BSNL	Bihar	CDMA	2.50
185	Reliance Infocomm	Bihar	CDMA	5.00
186	Tata Teleservices	Bihar	CDMA	3.75
187	Shyam Telelink	Bihar	CDMA	2.50
188	Reliance	Orissa	GSM	6.20

ANNEX 3

Band Allocations
The status of existing assignments in 2.5-2.69 GHz band in India is as follows:
2.5-2.52 GHz paired with 2.67-2.69 GHz is being used for Mobile Satellite Service (MSS)
2.52-2.535 GHz paired with 2.655-2.670 GHz is proposed for MSS
2.535-2.550 GHz and 2.630-2.655 GHz are being used for Local Multichannel Distribution System (LMDS) and Microwave, Multichannel Distribution System (MMDS) applications
2.550-2.630 GHz is being used for Broadcasting Satellite Service (BSS)
Source: TRAI

Spectrum Allocation		
Spectrum Assigned	**Operator**	**Area of License (No of Cities)**
2x6 MHz	VSNL/TTSL	50+
2x5MHz	Spectranet	6+
2x6 MHz	RCom	10+
2x6 MHz	Dishnet DSL	120+
2x6 MHz	SIFY	48+
2x7 MHz	BSNL	200+
2x6 MHz	Bharti	62+
Source: TRAI		