Consultation Paper no. 8 /2008

Telecom Regulatory Authority of India

Consultation Paper

On

Allocation and Pricing for
2.3-2.4 GHz, 2.5-2.69 GHz & 3.3-3.6 GHz bands

New Delhi

2nd MAY, 2008

Preface

The Authority had sent its recommendations to the Government on "**Allocation and pricing of spectrum for 3G and broadband wireless access services"** on 27th September, 2006. When the Authority gave its recommendations, the spectrum in the 2.3-2.4 GHz and 2.5-2.69 GHz bands was not available for allocation and therefore the Authority had decided that allocation and pricing methodology of spectrum in these bands will be decided as and when these are made available.

Recently, the International Telecommunications Union-Radio (**ITU-R**) has identified 2.3-2.4 GHz band also as **IMT** (International Mobile Technology) band (spectrum in the band of 2.5-2.69 GHz band was already identified as IMT-2000 band) and the DoT, as per its recent guidelines on BWA, is also considering allotment of spectrum in these bands(2.3-2.4 GHz & 2.5-2.69 GHz) after vacation.

The use of 2.3-2.4 GHZ and 2.5- 2.69 GHz band offers significant scope for innovation with the potential for induction of new technologies, services, applications and devices. With the availability of mobile services in this band, it provides an important opportunity for the introduction of **next generation mobile technologies** (BWA). Therefore, with the likely vacation of spectrum in these two bands, **the allocation and pricing methodology for the spectrum in these bands need to be decided.**

In this consultation paper the limited issues like Eligibility for allocation, Maximum amount of the spectrum to each bidder and pricing related to the spectrum bands (2.3.-2.4 GHz and 2.5-2.69 GHz) have been discussed along with the need for revisiting of pricing of 3.3-3.6 GHz spectrum band in view of the technological advancement in the interim.

TRAI solicits Comments from the stakeholders on this consultation paper. The consultation paper is available on TRAI's website www.trai.gov.in. The stakeholders are requested to send their comments on the various issues mentioned in the consultation paper by 16th May 2008. In case of any clarification/information, please contact Sudhir Gupta, Advisor (MN), Tel. No. +91-11-23220018 Fax No:- +91-11-23212014 or email-at sudhirgupta@trai.gov.in

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Chapter-1

TRAI's recommendations on allocation and pricing of 3G[1] & BWA[2] services

1.1. The Govt. had sought TRAI's recommendations on "**methodology and allotment of spectrum for 3G services and its pricing aspects**" in May, 2006.Though the DoT's reference was only for spectrum for 3G services and its pricing, the Authority believed that it would be relevant to discuss and seek comments on spectrum allocation and pricing for Broadband Wireless Access (BWA) technologies as well, as these technologies will play a major role in future to boost broadband penetration in the country, especially in the rural areas. The authority was of the view that any forward-looking spectrum policy should take into account the developments both in 3G and BWA services so as to create a clear and stable regulatory framework for the future. Therefore, the Authority brought out the consultation paper on 12th June, 2006 on various issues involved in **"Allocation and pricing of spectrum for 3G and broadband wireless access services**". After considering the comments of the stakeholders, the Authority made recommendations on:

1 Band identification for 3G services

2 Allocation methodology and pricing for 3G spectrum

3 Band identification, allocation and pricing of BWA spectrum

The Authority sent its recommendations on "**Allocation and pricing of spectrum for 3G and broadband wireless access services"** on 27th September, 2006 to the Government. **The salient points in the recommendations were**:-

[1] 3G- Third Generation

[2] BWA- Broadband Wireless Access

1.2. **Allocation methodology and pricing for 3G spectrum**

- With the current availability of 2 x 25 MHz of spectrum in the 2.1 GHz band, five operators should be accommodated in blocks of 2 x 5 MHz in this band in the first lot. Remaining operators should be allocated spectrum as and when it is available. Since the quantum of spectrum in the 800 MHz band is limited, the Authority recommended that this band be allocated among the UASL CDMA operators. DoT should also allocate 2 x 5 MHz in the 450 MHz band to one of the existing UASL CDMA operators based on the specified allocation process.

- An UASL CDMA operator will have the option to seek 2 x 1.25 MHz in the 800 MHz band at a determined price. Additionally, it will have the option of taking spectrum in either the 2.1 GHz or 450 MHz bands. In case it opts for the 2.1 GHz band, the UASL CDMA operator will have to bid along with the other operators. In case it is among the successful bidder, he will have an option of either retaining 2 x 1.25 MHz in the 800 MHz and getting an additional 2 x 3.75 MHz in the 2.1 GHz band, or giving up the option on 2 x 1.25 MHz in the 800 MHz band and getting 2 x 5 MHz in the 2.1 GHz band.

- In the 450 MHz band, if more than one operator opts for 2 x 5 MHz, the Authority recommended that a single stage bidding process be conducted. The reserve price for 2 x 5 MHz in the 450 MHz band will be half of the reserve price set for 2.1 GHz band for that service area.

1.3 **Spectrum pricing**

- The Government should charge a spectrum acquisition fee from all operators wishing to provide services using the 800 MHz band and/or 450 MHz band. The allocation criteria followed for the identified carriers in 800 MHz should also be a spectrum acquisition fee.

- The Government may allocate spectrum blocks in the 2.1 GHz band using a simultaneous ascending auction system. If there are more operators interested in the 450 MHz or 800 MHz bands than the amount of available spectrum, then a one-stage bidding process should be organized to decide the winners.

- Ascending auctions have a reserve price, a minimum price above which bidders must place their bids. The Authority recommended a specific reserve price for the 2.1 GHz and 450 MHz bands. For the 800 MHz band 3G carriers, the Authority recommended that the second-highest winning bid in the 2.1 GHz auction should be pro-rated to a per-2 x 1.25 MHz price.

- **The reserve price for spectrum auctions in the 2.1 GHz band for 2 x 5 MHz blocks of spectrum should be:**

Circle	Reserve price (Cr Rs)
Mumbai, Delhi, Category A	**80.00**
Chennai, Kolkatta, Category B	**40.00**
Category C	**15.00**

- DoT should have a one year moratorium on incremental annual spectrum fees for 3G spectrum from the time of spectrum assignment. After this one year, the DoT should charge operators an additional annual spectrum charge of 1 per cent of the operator's total adjusted gross revenue (AGR).
- There are specific roll out obligations and conditions to be enforced for the 2.1 GHz and 450 MHz bands.

1.4 Spectrum for BWA technologies

- The Authority considered the following bands for BWA systems:
  - 700 MHz,
  - 2.3 - 2.4 GHz,
  - 2.5 - 2.69 GHz,
  - 3.3 - 3.4 GHz,
  - 3.4 - 3.6 GHz,

- In order to ensure that sufficient spectrum is available for BWA systems, the Authority recommended that at least 200 MHz of spectrum should be made available for BWA to accommodate growth requirement until 2007, and an additional 100 MHz of spectrum should be coordinated by 2010.

- Operators with current spectrum assignments in the 3.3-3.4 GHz band should be given the option to migrate to circle-wide operations by December 2006, and the DoT should then allocate this spectrum for BWA technologies.

- The DoT should coordinate with Department of Space (DoS) to get 100 MHz for broadband wireless applications in the 3.4 - 3.6 GHz band immediately.

- DoT should coordinate some part of 700 MHz spectrum for making it available for rural wireless networks in the near future. Also keeping in mind the suitability of 2.3-2.4 GHz band for BWA applications and the need for additional spectrum later, the Authority recommended that DoT should plan to vacate/re-farm this 100 MHz band from the existing users by end-2007 and allocate it for BWA services.

- The Authority also recommended that the DoT should initiate the process to vacate portions of the 2.5 - 2.69 GHz band that might not be in use at this time, or which have marginal uses limited in nature. This spectrum should be earmarked for wireless telecommunications systems, and the Authority will recommend the precise allocation at a later stage depending on technological developments and market demand.

- The Authority recommended allocation of the 200 MHz of spectrum in the 3.3-3.4 GHz and 3.4-3.6 GHz bands to 13 operators in contiguous blocks of 15 MHz each. The Authority will make recommendations about future allocations of spectrum in bands such as 2.3 GHz, 2.5 GHz, or 700 MHz, as and when these bands are made available.

- Twelve blocks of BWA spectrum as identified should be allocated among UASLs, CMSPs, or Category A and B ISPs for circle level deployments. One block of spectrum

should be allocated to Category A, B, and C ISP licenses in cities or SSAs with population less than one million. DoT may use a first-come first-serve allocation mechanism for this one block of spectrum if needed.

- DoT should organize a one-stage sealed bid auction for every circle to allocate BWA spectrum for circle-wide licensees. Reserve prices have been specified.

- **The reserve price for 15 MHz of BWA spectrum in different circles will be as follows:**

Circle	Reserve Price (for 15MHz in Cr Rs)	PBG (Cr Rs)
Metros & A	**10**	**5.0**
B	**5**	**2.5**
C	**2**	**1.0**

- Specific roll out obligations and conditions for operators offering BWA services will be:-

Time Line	Metro Circles	A,B &C Circles	Local operator/ captive circles
2 Years		**25% Rural SDCAs area Coverage**	
5 years	**90% area Coverage**	**50% Rural SDCAs area Coverage**	**90% area Coverage**

1.5 **DoT Guidelines for 3G and BWA services:-**

Subsequent to the TRAI's recommendation, the DoT issued the "Guidelines for 3G services" and "Guidelines for Broadband Wireless Access (BWA) services" on 12th November, 2007. In the guidelines for BWA services, the DoT averred that these guidelines are being issued with the aim to increase the level of broadband penetration in the country, especially in rural areas as the introduction of Broadband Wireless Access (BWA) services will enhance the penetration as well as growth of broadband subscribers.

1.6 **Following are the salient points in the guidelines for 3G and BWA services**:-

Guidelines for 3G Services:

- 3G spectrum will be permitted in the 2.1 GHz band.
- The 3G spectrum would be granted through a controlled, simultaneous ascending e-auction, by a specialised agency to ensure transparency in the selection process.
- Besides the initial, one time spectrum charge, it has been decided that the successful service provider would pay additional spectrum charge of 0.5 % of their total Adjusted Gross Revenue (AGR), as the recurring annual spectrum charge. This additional revenue share is proposed to be 1% of AGR after 3 years from the date of spectrum assignment.
- The roll out requirements, including rural roll-out, as well as stiff penalties for non compliance of the same has been stipulated.
- Mergers will not be allowed during the initial five years. No trading/ reselling of spectrum is allowed.
- The CDMA spectrum in 800 MHz band for EV-DO applications would be treated separately from 2.1 GHz spectrum. If the CDMA based service provider(s) ask for the EV-DO carrier of 2 x 1.25 MHz, they would have to pay an amount proportionate to the highest bid for spectrum in 2.1 GHz band.

Guidelines for Broadband Wireless Access (BWA)services:-

- BWA services will be permitted in the 2.5 GHz band by UASL and Category 'A' ISPs, besides BSNL/MTNL.
- Each service provider will be allotted spectrum upto 2 x 10 MHz in 2.5 GHz band, for use by the service provider in FDD (paired) or TDD mode.
- The BWA services would be permitted through a controlled, simultaneous ascending e-auction, by a specialised agency to ensure transparency in the selection process.
- The base/ reserve price would be 25% of amount for 3G spectrum.
- Besides the initial, one time spectrum charge, additional spectrum charge of 0.5% of total Adjusted Gross Revenue (AGR), will be levied as the recurring annual spectrum charge. This additional revenue share is proposed to be 1% of AGR after 3 years from the time of

spectrum assignment.

- The roll out conditions, including rural roll-out, as well as stiff penalties for non-compliance of the same has been stipulated. .
- Mergers will not be allowed during the initial five years. No trading/ reselling of spectrum is allowed.
- Other service providers will be considered for spectrum allotment for BWA services in the 2.3 GHz band and 3.3 – 3.4 GHz band.
- After assessing the compatibility with satellite based services, the allotment of spectrum in the 3.4 – 3.6 GHz band will be considered.

1.7 **Subsequently the Government issued an order on 9th January, 2008 in which following has been stated**:-

- The Guidelines for Broadband Wireless Access (BWA) services have been released by the Government on 12 November, 2007. In accordance with these guidelines, to begin with, the BWA services will be permitted in the 2.5 GHz band by UASL and category 'A' ISPs, besides BSNL/MTNL for which fresh allotment of frequencies would be made through e-auction.
- In view of the guidelines issued for BWA services in November, 2007, the wireless users/ operators who have assignments in the frequency band 2.5 GHz as well as 3.3 GHz are required to shift their operations from 2.5 GHz band and consolidate in 3.3-3.4 GHz band immediately. Further, the operators, who have assignments only in 2.5 GHz band, are required to relocate their operations from 2.5 GHz band to 2.7-2.9 GHz band.
- For this purpose, wireless users/ operators who have already been assigned frequencies in 2.5 GHz and 3.3-3.4 GHz bands, have to apply for shifting of those BTS which are presently working in 2.5 GHz band for consolidation in 3.3-3.4 GHz band.
- For those wireless users/operators who have frequency assignments only in 2.5 GHz band (and do not have frequency assignments in 3.3-3.4 GHz band) have to apply for frequency assignment in 2.7-2.9 GHz for relocating their existing operations from 2.5 GHz band.
- All the above actions are required to be initiated immediately in order to complete the process by 28th February 2008.

1.8 **Developments in the Indian telecom Sector**

As stated earlier, the Authority had given its recommendations on "Allocation and pricing of spectrum for 3G and broadband wireless access services" on 27th September 2006. Since then, a number of developments have taken place in the telecom sector of the country. Some of the salient points are given below:

- The net mobile subscription has increased from 5 million to around 9 million per month.
- The DoT has issued new UAS licenses in all the service areas. This has resulted in increase in the number of operators from 4-7 to 13-14 in each service area.
- The spectrum allocation criterion for CMTS/UAS Licensees has been revised upwards, taking into consideration the availability of advanced spectral efficient technologies etc.
- The issue of new licenses in all the service areas and upward revision of the subscriber criterion has resulted in increased valuation of the spectrum in all the commercial bands (2G, 3G & BWA).
- The Govt. issued guidelines for infrastructure sharing wherein Sharing of active infrastructure amongst Service Providers has been permitted but is limited to antenna, feeder cable, Node B, Radio Access Network (RAN) and transmission system only. Sharing of the allocated spectrum is not permitted
- The growth of broadband continues to lag far behind the target proposed.

1.9 In view of the above developments in the Indian telecom sector and the inclusion of new spectrum bands in the IMT -2000 bands in the WRC-07 and also the likely vacation of spectrum in the 2.3-2.4 GHz and 2.5-2.69 GHz bands, as detailed in the chapter 2, the Authority has decided to revisit its earlier recommendation on allocation and pricing of spectrum for the BWA.

CHAPTER-2

Recent Developments & Need for Revisiting the Recommendations

Recent developments

2.1 Decision in WRC-2007 for Inclusion of Wi-Max derived technologies in IMT-2000

2.2 In October-2007, the International Telecommunication Union (ITU) Radiocommunication Assembly in the WRC-07 decided to revise the ITU Recommendation M.1457 "**Detailed specifications of the radio interfaces of IMT**[3] and included the sixth new radio interface into the IMT technology family called **OFDMA**[4]**TDD**[5] **WMAN**[6]**,** with a view to make ways for the deployment of a range of voice, data, and multimedia services to both stationary and mobile devices.

2.3 Accordingly WRC-07 has identified the following additional frequency bands for IMT applications :-

- 450-470 MHz
- 698-806 MHz
- 2.3-2.4 GHz
- 3.4-3.6 GHz

The use of the above frequency bands is subject to protection of existing assignments and Resolution No. 224 (Rev.WRC-07), 223(Rev.WRC-07).

2.4 Earlier to this decision, the following spectrum bands were identified for IMT-2000 applications:-

- 806-960 MHz
- 1710-1885 MHz
- 1885-2025 MHz
- 2110-2220 MHz

[3] IMT- International Mobile Telecommunication

[4] OFDMA - Orthogonal Frequency Division Multiple Access

[5] TDD- Time Division Duplex

[6] WMAN- Wireless Metro Area Network

- 2500-2690 MHz

2.5 DoT in its guidelines for BWA services issued on 21st November 2007s has identified the spectrum bands of 2.3-2.4 GHz, 2.5-2.69 GHz & 3.3-3.4 GHz for BWA services. For 3.4-3.6 GHz band, it has said that "After assessing the compatibility with satellite based services, the allotment of spectrum in the 3.4-3.6 GHz band will be considered. The WPC has also issued orders for the vacation of spectrum in the bands of 2.5-2.69 GHz and 2.3-2.4 GHz.

2.6 When the Authority gave its recommendations on "Allocation and pricing of spectrum for 3G and broadband wireless access services", the spectrum in the bands of 2.3-2.4 GHz and 2.5-2.69 GHz bands was not available for allocation and therefore the Authority had decided that "The Authority recommends allocation of the 200 MHz of spectrum in the 3.3-3.4 GHz and 3.4-3.6 GHz bands to 13 operators in contiguous blocks of 15 MHz each. The Authority will make recommendations about future allocations of spectrum in bands such as 2.3-2.4 GHz, 2.5-2.69 GHz, or 700 MHz as and when these bands are made available." (¶5.53)(Emphasis added).

2.7 Now since ITU-R has identified 2.3-2.4 GHz band also as IMT band (spectrum in the band of 2.5-2.69 band was already identified as IMT-2000 band) and the DoT as per its guidelines on BWA is also considering allotment of spectrum in these bands after vacation, therefore there is a need to decide the pricing and allocation methodology of the spectrum in 2.5-2.69 GHz and 2.3-2.4 GHz bands.

2.8 Regarding the spectrum bands of 2.5-2.69 GHz and 2.3-2.4 GHz, the observations made by the Authority in its earlier recommendations are reiterated below:

- **2.5-2.69 GHz band**

"Many countries, including the United States, Brazil, Mexico, Singapore, Japan, Hong Kong and Canada have identified and allocated the 2.5 GHz band for all types of wireless systems. The ITU's Radio Regulations identify this band as an extension band for IMT-2000 and beyond". (¶ 5.25)

- ***"During the consultation, a number of stakeholders commented that the ITU has identified this band as an extension band for IMT-2000. They expect that the next step in evolution of mobile technologies will first be deployed in this band. A number of stakeholders, including mobile operations and equipment vendors requested that the***

DoT should keep this band reserved for the future growth of IMT 2000 systems since currently available spectrum will not be sufficient for growth. Some stakeholders opined that this band should be technology neutral or that it should be available both for BWA and for IMT-2000 systems. It is pertinent to mention here that the footnote 5.384A of the radio regulations of the ITU, and WRC 2000 Resolution 223 identifies the 2500-2690 MHz band on a non-exclusive basis for IMT-2000. Another respondent informed us that no 3G equipment was expected in this band for the next few years, although an equipment vendor indicated that they were planning to release equipment in this band by end-2007".(¶ 5.27).

- ***"Consequently, the Authority recommends that the DoT should initiate the process to vacate portions of the 2.5 – 2.69 GHz band that might not be in use at this time, or which have marginal uses limited in nature. Specifically, the Authority recommends that the 40 MHz in use for LMDS and MMDS (2.535-2.550 GHz and 2.630-2.655 GHz) be vacated or re-farmed by end-2007, and that an additional 40 to 80 MHz be coordinated with Department of Space (DoS) in the same timeframe. This spectrum should be earmarked for wireless telecommunications systems, and the Authority will recommend the precise allocation at a later stage depending on technological developments and market demand." (¶ 5.29)***
- **2.3-2.4 GHz band**
- In its recommendation the Authority had noted that ***"many developed countries viz. Australia, Singapore, USA, Canada and South Korea have allocated the 2.3 GHz band for use by BWA systems. South Korea has allocated this band to WiBro (Wireless Broadband), which is a portable Internet service with a user data rate of over 1 Mbps for users moving at speeds up to 60 kmph. Since this band is lower than 3GHz, the propagation characteristics makes for lower capital expenditure associated with network deployment. In addition, lower operating frequencies for the mobile terminal result in lower power requirement for a given propagation distance. As a result, this band is more suitable for mobile broadband wireless access than other higher frequency band, e.g. 2.5 GHz or 3.5 GHz" (¶ 5.22)***

- ***"Keeping in mind the suitability of this band for BWA applications and the need for***

additional spectrum later, the Authority recommends that DoT should plan to vacate / refarm this 100 MHz band from the existing users by end -2007 and allocate it for BWA services." (¶ 5.24)

2.9 The Authority in its earlier recommendation had adopted different allocation and pricing methodology for BWA and 3G technologies because the spectrum band available at that time for the BWA technologies was only 3.3-3.6 GHz, which was considered to be more suitable for fixed and nomadic wireless access and at that time the mobile wireless access technologies were still in the nascent stage of development. Therefore the Authority believed that this spectrum band can be better utilized to accelerate the growth of fixed broadband through encouragement of emerging wireless technologies specially in the rural areas which was the need of the hour,

2.10 In view of the above, the Authority had treated the spectrum band of 3.3 -3.6 GHz which was identified for BWA different from the spectrum bands identified for the 3G services. The salient differences in the two were:-

Differences in 3G & BWA recommendations

Point	3G	BWA
Eligibility of bidding	CMTS and UAS licensee	CMTS, UAS licensee and A & B category of ISPs
Maximum amount of spectrum proposed	2x5 MHz per operator	15 MHz per operator
Reserve price for the auction of spectrum	Rs 80, 40,15 Cr for Category 'A','B''C' circles respectively	Rs 10, 5, 2 Cr (for Category 'A','B''C' circles respectively)
Performance Bank Guarantee	No	Half the reserve price
Roll out obligation	As a part of overall roll out obligation in a time bound manner	Different than 3G rollout obligation

2.11 The Authority had given its recommendation on spectrum allocation for BWA, about 18 months earlier, with the idea that immediate deployment of broadband wireless networks using the spectrum in the 3.3-3.6 GHZ band will give the required fillip to the aim of reducing the digital divide. However, the Authorities recommendations are yet to be implemented. In the meantime, due to the technological advancement and increased focus on the BWA technologies has resulted in the potential use of this band for various

applications including triple play. This has increased the perceived value of the spectrum in the 3.3-3.6 GHZ band. **Therefore, the issue for consideration is whether, the reserve price and the method of allocation (one stage sealed bid auction) recommended earlier for this band needs modification.**

2.12 The Authority has earlier recommended a reserve price of 10, 5 and 2 Crores for Metros and A, B and C service areas respectively for the 3.3-3.6 GHz bands. The Authority is inclined to revise the reserve price for acquisition of spectrum in these bands. However, one can also argue that keeping a high reserve price will defeat the Government's main aim of encouraging BWA deployment in rural network. Therefore, the various options available regarding pricing of spectrum in this band are as below:

- The reserve price of this spectrum remains as recommended earlier.
- The reserve price for the spectrum is made equal to 50% of the reserve price recommended for the 3G spectrum.
- The reserve price is made equal to the price recommended for the 3G spectrum.

The successful bidders will also have to fulfill the roll out obligations which were recommended earlier for the BWA spectrum.

2.13 The use of 2.3-2.4 GHZ and 2.5- 2.69 GHz band offers significant scope for innovation with the potential for induction of new technologies, services, applications and devices. With the availability of mobile services in this band, it provides an important opportunity for the introduction of next generation mobile technologies (BWA). Now with the likely vacation of spectrum in these two bands, it needs to be decided whether the allocation and pricing methodology recommended earlier for the BWA technologies should continue to be applicable for these bands or they should be treated at par with the spectrum bands identified for 3G for pricing and allocation. With the identification of these bands in the IMT family there is a strong possibility of availability of equipments for both 3G and BWA technologies in these bands in near future.

2.14 The Authority in its recommendations has noted that "The Authority also recognizes that given the wide range of possible technologies, it is essential that any policy concerned with identification and allocation of spectrum for BWA must be technology-neutral and flexible to permit co-existence of all types of BWA technologies. This approach is similar to that followed by regulators in USA, Australia, UK, Singapore, and Hong Kong. For

example, the Wireless *Broadband Access Task Force of the Federal Communications Commission (FCC) in the USA has recommended the speedy deployment of BWA services in the US leaving technology decisions to the market.*[7] *This Authority similarly believes that the market is the best decision maker about the deployment, success, and spread of different technologies*".(¶ 5.12)

2.15 After the identification of these two bands by the ITU as IMT bands, there is a strong possibility that equipments for different technologies viz. HSPA, LTE or data centric BWA technologies like WiMax etc. will soon be available in these spectrum bands. The Authority in its recommendation on "Allocation and pricing of spectrum for 3G and broadband wireless access services" had also observed that ***"sometimes, in a scenario where multiple operators use various technologies to offer similar services, the issue of identifying particular spectrum bands for particular technologies or other related issues, which in the perception of a particular stakeholder may affect the level playing field, are highlighted and get more attention. All these issues are very important for a healthy competition but the Authority believes that in the process we should not lose sight of the fact that every service provider needs spectrum to offer quality service to customers at an affordable price and to contribute to the growth of telecom services in the country. Different technologies offering similar services may sometimes need spectrum in the same frequency band. From that point of view, the technical and service neutrality aspect of spectrum management is to be emphasized." (¶ 2.10)***

2.16 A technology neutral approach gives freedom to the service providers to select the best suited technology, facilitating the deployment of cost-effective, advanced technologies. Spectrum allocations are typically for a period of 10 to 15 years and it is likely that at some time during this period an operator decide to move to a different technology that better fits its requirements.

2.17 The rapid pace of technological innovation requires an increasingly flexible regulatory approach that provides the service providers the ability to deploy new technologies offering better performance at a lower cost.

2.18 The Authority in line with its earlier stand of technology neutral approach and belief that

[7] http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-256694A1.pdf

like a number of other developed countries, we should also start treating all spectrum in a purely technology agnostic way and auction it to the highest bidder and let the recipient decide the service it wants to provide subject to interference rules and the license conditions. The Authority do not want to differentiate between different technologies for use of these two spectrum bands. However, in view of the compulsion for need for increasing penetration of broadband in the country, limited availability of spectrum in the identified bands of 2.5-2.69 GHz and 2.3-2.4 GHz and more importantly the fact that today no spectrum has been allocated especially for the growth of broadband wireless technologies, one of the view is that in slight variance with the international practices, why not to consider these bands for use of only BWA technologies for the time being. Based on future developments this can be reviewed.

2.19 In view of the foregoing, the limited issues which requires deliberations w.r.t these two spectrum bands are:

- Eligibility for allocation
- Maximum amount of the spectrum to each bidder
- Pricing

Eligibility for allocation

2.20 The Authority in its earlier recommendations had allowed both the CMTS/UAS licensees and the ISP to bid for the spectrum for the BWA technologies (DoT has also reiterated the same in its guidelines).

2.21 The Authority is of the opinion that there is an urgent need to increase the penetration of the broadband in the country through the wireless mode. Further, the goal of connecting rural areas of the country would not be a successful and viable business model unless the related applications which it can provide are also developed. **Therefore, the issue for consideration is what should be the eligibility conditions for bidding for spectrum in these bands?**

2.22 **Maximum amount of spectrum**

In the 2.3-2.4 GHZ band, at the time of the earlier recommendations for spectrum for BWA, a number of captive users like State electricity boards, power utilities, oil

companies, railways etc. were using this band at different places in the country. As per the data available with the Authority, a number of countries have allocated this band for the BWA services. Keeping in mind the suitability of this band for the BWA applications, the Authority had recommended vacation/refarming of this 100 MHz band. It is expected that on account of the vacation/refarming by the earlier users, about 40-50 MHz of spectrum will now be available in this band for allocation. **The Authority reiterates its earlier recommendation for allocation of spectrum in this band for BWA services**.

2.23 Regarding the maximum amount of spectrum required for different applications using BWA technologies, the claims of different vendors/application providers vary from 10MHz to 30 MHz. However, the Authority is of the view that, in the medium term, spectrum of 15 MHz shall be optimal for providing majority of the applications at reasonable speed.

2.24 Regarding the size of the spectrum blocks for auctioning, as the spectrum in this band is being vacated from a large number of users, therefore, there is a strong possibility that the available/vacated spectrum may not be contiguous. However, there are expert opinions which suggest that in case 3 blocks of 5 MHz each are available with each 5MHz block contiguous, then the efficiency of the network will not be affected in a substantial way.

2.25 The issues which need to be considered are:

- **The maximum amount of spectrum which a licensee can bid for**
- **The size of the spectrum blocks for the bidding**

2.26 As discussed earlier, the 2.6 GHz band, in view of its bandwidth and propagation characteristics, is highly versatile and valuable band. It offers significant scope for innovation, with the potential for new applications and devices both for new technologies and the existing technologies and their successor. With the availability of mobile services in this band, it provides an important opportunity for the introduction of next generation mobile technologies (BWA) as well as for the provision of additional capacity for networks using the currant generation of technologies (3G). However, for these competing technologies, the mode of operation is different- e.g. for use in WIMAX, the equipment is primarily available for operation in unpaired mode (TDD) while for 3G technologies, the available equipment requires spectrum in the paired mode (FDD).

2.27 The Office of Communications (Ofcom), the telecom regulator of UK has recently published the document "Award of available spectrum: 2500-2690 MHz, 2010-2025 MHz" wherein it has noted "*As a result of its availability for mobile services in the EU and a number of countries worldwide the 2.6 GHz band provides an important opportunity for the introduction of next generation mobile technologies as well as for the provision of additional capacity for networks using the current generation of technologies. There are two main competing technologies for the provision of mobile services at 2.6 GHz:*

a) WiMAX, developed with a strong input from the internet and IT sectors, which is optimised for data services (with voice over IP being one of the potential data applications) and for which equipment is ready and available now for operation in unpaired (TDD) mode; and

b) 3G mobile technologies which are in use now in the UK and, significantly, their likely successor technologies based on the LTE standard which is also optimised for data and is primarily based on paired (FDD) operation. LTE equipment is likely to be available in the relatively near term, probably around 2010 or possibly before, as standardisation groups and manufacturers accelerate LTE development at least in part in response to the competitive threat from WiMAX.

There are two main types of likely uses for the 2.6 GHz band, reflecting technologies that are available or in advanced stages of development:

- *paired use for FDD technologies which rely on paired blocks of frequencies separated by 120 MHz, one for network base station transmission (and user equipment reception), the other for user equipment transmission (and network base station reception). The two main FDD technologies relevant to 2.6 GHz are LTE and possibly UMTS and its evolutions such as HSPA;*
- *unpaired use for TDD technologies which rely on unpaired blocks in which network base stations and user equipment both receive and transmit at the same frequency, but in different timeslots. The main TDD technology relevant to 2.6 GHz is mobile WiMAX.*

As indicated above, we have decided that the award should be structured so as to allow the market to determine how the band is used as between these two main types of use

(paired and unpaired). In this way the market, rather than the regulator, can determine how competing technologies should access spectrum, as it is necessarily unclear in advance of the award what the optimal balance will be".

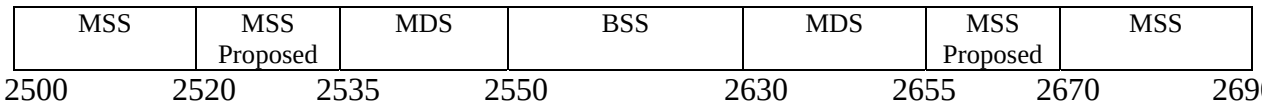
2.28 In the 2.6 GHz band, out of the total spectrum of 190 MHz, the current assignment in the country is as below:

i) 2.500-2.520 GHz paired with 2.670-2.690 GHz is being used for mobile satellite service (MSS)

ii) 2.520-2.535 GHz paired with 2.655-2.670 GHz is proposed for MSS.

iii) 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, and

iv) 2.550-2.630 GHz is being used for broadcasting satellite service (BSS) in India by DoS.



2.29 It is expected that apart from 40 MHz of spectrum which has been earlier allocated for the LMDS and MMDS (2.535-2.550 GHz and 2.630-2.655 GHz), an additional 20-40 MHz allocated to Department of Space (DoS) and was earlier recommended by the Authority for vacation, will be available now for allocation to the telecom service providers.

2.30 In view of the above, the likely amount of spectrum available for allocation in the 2.5-2.69 GHz band will be around 60-80 MHz. As most of this spectrum will be available after vacation by the earlier users, hence there is a strong possibility that the available spectrum may not be in contiguous block. As noted earlier, internationally, this band is being allocated in a technology neutral basis, with provision for technologies using either of the two modes i.e. FDD and TDD. However, in India, presently a fraction of the 190 MHz band is available for allocation and in the absence of contiguous availability; it may not be possible to implement the internationally harmonized plan. Therefore, this give rise to following issues for consideration:

- **In view of limited availability of spectrum in this band and possible conflict between the technologies using FDD and TDD modes, how the spectrum in 2.6 GHz band be allocated?**
- **In case the present available spectrum is allocated for BWA technologies using unpaired spectrum, then, will it be feasible in future, from technical and economic angle, to refarm the allocated spectrum in line with the global practices**
- **Unlike a number of other countries, a major portion of spectrum in this band is yet to be got vacated by WPC. What measures can be taken to accelerate the process of vacation so that the Indian telecom sector is not at a disadvantage in relation to other countries?**

Pricing

2.31 The Authority had earlier recommended a certain reserve price for the spectrum for BWA taking into consideration the market potential of different type of the service areas and the likely usage of the identified spectrum band (3.3-3.6GHz). However, in this consultation paper the Authority has proposed to revisit the reserve price for the spectrum in the 3.3-3.6 GHz band (¶2.12 of this paper). The spectrum in the 2.3-2.4 & 2.5-2.69 GHz bands, being far more versatile, valuable and have the capability to employ most of the advanced technologies, the issue to be considered is **what should be their reserve price for the purpose of auction?.**

2.32 **Maximum cumulative Holding of Spectrum**

In the foregoing, we have discussed the allocative principles and the pricing methodology for the spectrum in the bands of 3.3-3.6 GHz, 2.3-2.4 GHz and 2.5-2.69 GHz along with the maximum amount of spectrum which a licensee can bid for in each of these bands. However, one issue which also needs to be considered is that in case it is decided to allocate spectrum in all the three bands, then in order to ensure level playing field and adequate competition, **is there a need for putting a maximum limit on the cumulative holding of spectrum acquired in these bands by a licensee and what should be that limit?.**

Chapter-3

ISSUES FOR CONSIDERATION

1. What should be the revised reserve price for the spectrum in 3.3.-3.6 GHz band? The various options available are as below:
    - The reserve price of this spectrum remains as recommended earlier.
    - The reserve price for the spectrum is made equal to 50% of the reserve price recommended for the 3G spectrum.
    - The reserve price is made equal to the price recommended for the 3G spectrum
2. What should be the eligibility conditions for bidding for spectrum in the bands of 2.3-2.4 GHz and 2.5-2.69 GHz?
3. In the 2.3-2.4 GHz band, the maximum amount of spectrum which a licensee can bid for?
4. In the 2.3-2.4 GHz band, the size of the spectrum blocks for the bidding?
5. In view of limited availability of spectrum in this band and possible conflict between the technologies using FDD and TDD modes, how the spectrum in 2.6 GHz band be allocated?
6. In case the present available spectrum is allocated for BWA technologies using unpaired spectrum, then, will it be feasible in future, from technical and economic angle, to refarm the allocated spectrum in the 2.6 GHz band in line with the global practices?
7. Unlike a number of other countries, a major portion of spectrum in the 2.6 GHz band is yet to be got vacated by WPC. What measures can be taken to accelerate the process of vacation so that the Indian telecom sector is not at a disadvantage in relation to other countries?
8. What should be their reserve price for the purpose of auction for the spectrum in 2.3-2.4 GHz and 2.5-2.69 GHz?
9. Is there a need for putting a maximum limit on the cumulative holding of spectrum acquired in these bands by a licensee and what should be that limit?