



**Telecom Regulatory Authority of India**



**Recommendations**  
**on**  
**“IMT – ADVANCED MOBILE WIRELESS BROADBAND**  
**SERVICES”**

**19<sup>th</sup> March, 2013**

**Mahanagar Doorsanchar Bhawan, Jawahar Lal Nehru Marg,**  
**New Delhi – 110002**

## **RECOMMENDATIONS ON**

### **‘IMT – ADVANCED MOBILE WIRELESS BROADBAND SERVICES’**

#### **A. Background**

- 1 Telecom Regulatory Authority of India (TRAI) issued a pre-consultation paper on 10<sup>th</sup> February 2010 requesting the stakeholders to suggest likely issues involved in the deployment of IMT- Advanced technologies in the country. Based on the comments received from the stakeholders and in-house study, TRAI issued a Consultation paper on ‘IMT – Advanced Mobile Wireless Broadband Services’ on 19<sup>th</sup> August 2011.
- 2 In the consultation paper, TRAI raised various issues. Some of the issues viz spectrum bands for IMT Advanced services, Block size of spectrum to be put for auction, Minimum number of spectrum blocks required for effective use of 4G technologies, Reserve price per MHz, Spectrum usage charges etc. were regulatory in nature, while some issues viz specifications of the User Equipment, Security issues, delivery of voice services over IMT-A systems, interoperability with legacy systems (2G/3G), QoS parameters and impact of Femto cell/Relays etc on Key Performance Indicators (KPIs) and spectrum policy etc were of technical nature.
- 3 On 2<sup>nd</sup> February 2012, the Supreme Court directed TRAI to make fresh recommendations for grant of licence and allocation of spectrum in the 2G bands. Accordingly, after a due consultation process, TRAI sent its recommendations to the Department of Telecommunications on ‘Auction of Spectrum’ on 23<sup>rd</sup> April, 2012. These recommendations were comprehensive and covered not only the spectrum for 2G services but also for 3G and IMT –Advanced services. Therefore, some of the issues, which were originally raised in the Consultation paper dated 19<sup>th</sup>

August 2011, got covered in the recommendation on 'Auction of Spectrum' dated 23<sup>rd</sup> April, 2012. These issues were:-

- a. Block Size of spectrum to be put on auction.
  - b. Minimum number of spectrum blocks required for effective use of 4G technologies.
  - c. Maximum amount of spectrum which a service provider can obtain through auction.
  - d. Reserve price per MHz in various spectrum bands.
  - e. Eligibility conditions for bidding for spectrum.
  - f. Roll out conditions.
  - g. Spectrum usage charges.
- 4 As mentioned in para 2 above, remaining issues raised in the consultation paper, mainly deals with technical aspects of the IMT-Advance technologies viz. duplexing schemes, specifications of the User Equipment, Security issues, delivery of voice services over IMT-A systems, interoperability with legacy systems (2G/3G), QoS parameters and impact of Femto cell/Relays etc on Key Performance Indicators (KPIs) etc. In the forthcoming paras issue related to Duplexing Scheme and Band plan in the spectrum bands identified for IMT –Advanced have been discussed.

## **B. Duplexing Scheme:**

- 5 Both the IMT-Advanced technologies, 3GPP LTE-Advanced and IEEE 802.16m, support Time Divisions Duplexing (TDD) as well as Frequency Division Duplexing (FDD). Each type of duplexing has certain advantages and disadvantages. Therefore, in the consultation paper, stakeholders were requested to comment whether there is a need to specify the use of particular duplexing scheme based on the band in

which spectrum allocation is done. They were also requested to suggest whether there is a requirement to specify the frame duration and mandate frame synchronization amongst the service providers using one of the specified set of timing sources, and a permissible set of Uplink/Downlink sub-frame schemes compatible with the IMT-A standards in case of TDD.

- 6 Some stakeholders were of the view that the choice of duplexing schemes should be left to the operators. According to these stakeholders, the choice of duplexing mode is dependent on various factors such as integration with existing systems, availability of paired/unpaired spectrum, device ecosystem and operator preference in terms of technology investments and benefits thereof. Considering the economy of scale and worldwide trend and depending upon the market forces, in the opinion of these stakeholders, the concerned operator is the best person to decide the type of duplexing to be deployed.
- 7 On the other hand, many stakeholders were in favour of specifying a particular duplexing scheme in a particular spectrum band, in sync with international practices. Some of these stakeholders were of the view that in order to make efficient use of the spectrum available for mobile services, there is a need to clearly define spectrum planning as it enhances spectral efficiency by minimising interference and decreasing the use of guard bands. Mixing the TDD and FDD in the same band will lead to inefficient spectrum use. Some stakeholders commented that although it may not be appropriate to recommend any one duplexing for IMT-Advanced, it is necessary to have a harmonized approach of duplexing for each band to get advantage of economies of scale and ensure efficient use of the spectrum.

- 8 On the issue of defining sub-frame scheme in case of TDD duplexing, a number of stakeholders suggested that inter-system interference needs to be considered by the operators themselves. These stakeholders commented that TDD parameters may be left for operators who may choose them based on user/market requirements. As per some of these stakeholders, it is necessary that sufficient guard band, as identified globally, be provided between spectrum blocks allocated to different service providers to avoid any mutual interference. On the other hand, few stakeholders advocated for making frame synchronization mandatory and also for specifying sub-frame scheme that should be used by all operators.
- 9 On the issue of bands plans in different spectrum bands, most of the stakeholders were of the view that India should follow internationally harmonized band plans as the ecosystem for network infrastructure elements and the devices will evolve in accordance with plans followed by majority of the countries. Any deviation of spectrum allocation from this will adversely affect the advantage of economies of the scale and it will be difficult to find technology vendors supplying the required equipment.
- 10 Commenting upon the band plan in 700 MHz band (698-806 MHz), most of the stakeholders suggested that India should specify the APT700 FDD band plan. According to these stakeholders, the FDD based APT700 band plan is likely to be adopted by most of the Asia Pacific countries and India should also follow the harmonized band plan to take advantage of the vast eco system that is likely to emerge in this band plan.
- 11 For the 2.5-2.69 GHz bands, some stakeholders submitted that Option 1 given in Recommendation ITU-R M.1036-4 should be preferred in India i.e. 2x70 MHz in FDD mode (2500-2570 MHz /2620-2690 MHz)

and a 50 MHz in TDD mode (2570-2620 MHz) as most markets in Europe and APAC opting for it. Some stakeholder suggested that FDD should be specified for lower frequency bands whereas TDD is the more appropriate technology in higher frequency bands (such as 3.4-3.6 GHz band) and spectrum that cannot be used by FDD (such as centre gap of 2500-2690 MHz band).

- 12 The Authority noted that there are three major digital dividend band plans viz. the European, US and APT band plans. European digital dividend band is 790-882 MHz which is in almost entirely different frequency range to India (698-806 MHz). The US digital dividend band (698-806 MHz) is same as India. Therefore, only alternative to APT700 band plan is US700 band plan. However, the plan implemented in the US is not an efficient use of spectrum because it is highly fragmented and offers far less spectrum for mobile broadband use. It contains interleaved small blocks of spectrum, requiring more guard bands than a single contiguous block. The APT700 band plan offers 2x45 MHz contiguous spectrum as compared to the two separate chunks of spectrum blocks of 2x18 MHz and 2x12 MHz in US 700 band plan. Significantly, the US plan provides only for a maximum 10 MHz channels unlike the APT plan which offers flexibility to go for upto 20 MHz channels.
- 13 The APT700 band plans have been included in the ITU-R Recommendation M.1036-4 (3/2012)<sup>1</sup>. The paired frequency arrangements in the band 698-960 MHz, as mentioned in that recommendations, are shown in the table below, wherein both FDD and TDD based APT700 band plans are indicated as A5 (FDD arrangement) and A6 (TDD arrangement) respectively.

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<sup>1</sup> Recommendation ITU-R M.1036-4 (3/2012) on "Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications (IMT) in the bands identified for IMT in the Radio Regulations (RR)",

**Table 1**

Frequency arrangements	Paired arrangements				Un-paired arrangements (MHz)
	Mobile station transmitter (MHz)	Centre gap (MHz)	Base station transmitter (MHz)	Duplex separation (MHz)	
A1	824-849	20	869-894	45	None
A2	880-915	10	925-960	45	None
A3	832-862	11	791-821	41	None
A4	698-716 776-793	12 13	728-746 746-763	30 30	716-728
A5	703-748	10	758-803	55	None
A6	None	None	None		698-806

- 14 The Authority has also noted that the APT700 plan has been adopted as a standard by the international 3rd Generation Partnership Project (3GPP) as a band for Long Term Evolution (LTE) technology and provides the most efficient use of the spectrum possible. Specifications in the APT700 band by 3GPP were completed in June 2012<sup>2</sup>. In FDD, uplink frequencies are 703-748 MHz and downlink frequencies are 758-803 MHz, which implies duplexer separation of 55 MHz and centre gap of 10 MHz.
- 15 APT's 700 MHz Band Plan (APT700) created a lot of interest in the world both in the Administrations and Industry. A number of countries have announced their commitment or shown interest to adopt the APT plan **(Annexure)**. Many countries in the Asia-Pacific region such as Australia, Japan, Korea, New Zealand, Papua New Guinea, Tonga, Indonesia, Singapore, Thailand, Vietnam, Bangladesh and Taiwan have either adopted or actively considering the adoption of FDD based APT700 band plan. Outside Asia Pacific Region also, there are many countries who have followed suit or are considering it such as Chile,

<sup>2</sup> 3GPP TS 36.101 v11.1.0 for the UE and 3GPP TS 36.104 v11.1.0 for the Base Stations

Columbia, Mexico, Ecuador, Costa Rica, Panama, Peru, Uruguay and Brazil. Many African Telecommunication Union (ATU) members are also keen to adopt it once this band is allocated to Mobile in Region 1. It is expected that the APT band plan ecosystem shall develop rapidly as more and more countries in ITU Region 2 and Region 3 identify and auction spectrum with this frequency arrangement. Clearly, there is more inclination towards adopting FDD based APT 700 band plan.

- 16 Commitment to adopt the FDD based APT700 band plan by many countries has also started the development of Eco system for the equipments and the devices and its rapid adoption and alignment with international band plan will potentially generate even larger cost efficiencies in the network and huge device ecosystems. Therefore, Authority is of the opinion that India should also adopt APT700 band plan with FDD based 2x45 MHz frequency arrangement. Accordingly, the Authority recommends that:

**APT700 band plan should be adopted for the 700 MHz spectrum band (698-806 MHz) with FDD based 2x45 MHz frequency arrangement.**

- 17 The issue of defining sub-frame scheme in case of TDD duplexing is not relevant as the band plan recommended by the Authority is FDD based. Also, as there is no clarity regarding the spectrum availability in other bands viz. 2.6 GHz and 3.4 GHz, the Authority is not making any recommendations on the band plans in these bands.

### **C. Remaining Issues**

- 18 Regarding the remaining issues raised in the consultation paper viz specifications of the User Equipment, Security issues, delivery of voice services over IMT-A systems, interoperability with legacy systems (2G/3G), QoS parameters and impact of Femto cell/Relays etc on Key



Performance Indicators (KPIs) & spectrum policy etc, it may be noted that IMT-A standards are still evolving. Technologies adopted in IMT-Advanced are based on standards adopted by international bodies such as 3GPP and IEEE. These international bodies prepare detailed specifications on various technical issues including specifications for the standardisation of UE, security framework, core and access network etc. These specifications are being updated/modified with different releases of the specifications as per the requirement. Moreover, ITU-T is also actively working on the security related issues. Core technology and common security techniques are being developed by Study Group 17 in collaboration with various industrial bodies such as IETF, ANSI, ETSI etc. Further, the evolution of technology for the use of micro cells/femto cells/relays/SON architecture/MIMO etc and its adoption by the operators shall be driven by technical and commercial considerations over a period of time. Therefore, the Authority is of the opinion that instead of adopting a country specific approach, harmonised implementation of a common standard in IMT- Advanced should be adopted.

In view of above, the Authority is of the view that only after the roll out of these technologies, these issues can be better addresses. Accordingly, the Authority, at present, is not making any recommendations on these issues.

**Countries that have announced their commitment or shown  
interest to adopt the APT plan**

- **Australia:** In June 2010, Australian Government identified the frequency band from 694-820 MHz for Digital Dividend. The Auction date is scheduled for April 2013 in full alignment with APT band plan as per 2X45 MHz FDD arrangement. The Australia Digital Dividend spectrum will become available after the analog TV switch-off on December 31, 2013, and its auction will take place in April 2013 along with the spectrum in 2.6 GHz band.
- **Japan:** Japan allotted three FDD licenses (10MHz x 2 each) in 700 mhz band harmonized with APT700 band plan (718 – 748MHz UL, and 773 – 803MHz DL). In September 2010, the Government has announced that the switchover to digital television will be started in 2012 and completed by December 2013.
- **Papua New Guinea:** Papua New Guinea has adopted the APT 2x45 MHz band plan and allocated 2x22.5 MHz (the lower block) to Digicel PNG in April 2012.
- **Korea:** Allocated 2x20 MHz in accordance with APT FDD band Plan.
- **New Zealand:** New Zealand announced 700 MHz band for mobile services in the year 2011. A complete switch-off of analog services and freeing-up of spectrum will take place by December 2013. There was public consultation on the usage of spectrum available after the switchover, from August to October 2011. The consultation document assumes the implementation of the APT band plan (2X45 MHz FDD) as the most likely outcome.

- **Colombia:** Colombia has changed the primary allocation of this band to mobile services and on May 30, 2012, has announced the adoption of APT700 band plan. The license will be assigned end of 2013 and commercial service is expected in 2014 to 2015.
- **Chile:** In April 2012, Chilean regulator body SUBTEL announced that it will auction 90 MHz of spectrum in 700 MHz band during the second half of 2013 and will adopt the APT band plan. The license will be assigned end of 2013, and commercial service is expected in 2014 to 2015.
- **Mexico:** Mexico has confirmed it is adopting the Asia-Pacific (APT) band plan for the 700 MHz band.
- **Costa Rica:** Costa Rica's regulatory body, SUTEL, has recommended the adoption of the APT band plan.
- **Ecuador:** Ecuador's National Telecommunications Council (Conatel) has decided to adopt the harmonized 700 MHz spectrum band plan for mobile broadband promoted by the Asia Pacific Telecommunity (APT). The recent decision of Ecuadorian telecoms regulator Conatel to align its spectrum plans with APT follows in the footsteps of Chile, Colombia, Costa Rica and Mexico.
- **UAE:** The Telecommunication Regulatory Authority of the United Arab Emirates has published a consultation in which they propose to award the 700 MHz band alongside the 800 MHz band, using the lower part of the APT700 band plan and the full CEPT 800 MHz band plan.