Telecom Regulatory Authority of India

सत्यमेव जयते

Recommendations

On

Issues related to Digital Terrestrial Broadcasting in India

New Delhi : January 31, 2017

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Content

CHAPTER 1

Introduction

1.1 Television broadcasting in India commenced on 15 September 1959 with experimental transmission of terrestrial TV signal and subsequently regular TV broadcast was started in 1965. Major expansion of terrestrial TV services took place around 1982 when national telecasts and color TV were introduced. Subsequently introduction of satellite and cable distribution platforms led to a revolution in the television sector. While different options to provide TV services to customer such as terrestrial TV services, Internet Protocol Television (IPTV) services and Headend-in-the-Sky (HITS) services are available, TV service distribution industry in India is mainly dominated by cable TV services and Direct to Home (DTH) services. OTT TV services have also begun to penetrate the markets.

1.2 There are 899 private satellite TV channels as on 23rd January 2017 permitted by the Ministry of Information and Broadcasting (MIB)[1] and 26 TV channels are being broadcast by Doordarshan (DD). The present TV subscriber base includes about 102 million cable TV subscribers, and 61.9 million pay DTH subscribers. In addition, about 20 million consumers are being served by free-to-air (FTA) DTH service of DD.

1.3 Terrestrial TV broadcasting in India is under the exclusive domain of DD and is mainly in analog mode of transmission. DD has a network of 1412 analog transmitters which provides TV services comprising of national and regional TV channels in free-to-air mode. The terrestrial TV services of DD mainly cater to the requirements of consumers in semi-urban, rural and remote areas.

[1] http://www.mib.nic.in/

1.4 Analog terrestrial TV broadcasting is being phased out world over due to poor quality of reception, inefficient use of spectrum and obsolescence of analog technologies. About 55 countries around the world have already introduced Digital Terrestrial Transmission (DTT) services and many others are in the process of digitization as per the roadmaps laid down by them. In the USA, Europe and many other countries analog terrestrial TV transmission has already been switched off.

1.5 DTT technologies enable efficient use of the TV spectrum and provide better quality of service. A DTT transmitter employing next generation technologies can provide multiple broadcasting services such as TV channels, Mobile TV, Radio and other value added services within the same channel bandwidth of 7 or 8 MHz, which could earlier broadcast only one TV channel in analog mode. Some advantages offered by DTT platform over analog platform are as follows:

- Better quality TV reception - with enhanced quality of picture and sound
- Efficient use of frequency – one DTT transmitter can broadcast multiple TV channels (20 to 30 SD TV Channels in a given slot of 7 to 8 Mhz by using latest compression technologies)
- Frequency reuse possible – a single frequency network (SFN) can be implemented to cover a larger geographical area.
- Improved quality of reception of TV channels in moving environment such as in moving vehicles.
- TV channels can also be received on mobile phones and handheld devices with help of plug in dongles or integrated tuner chipset.
- One single channel bandwidth (7 or 8 MHz) provides flexibility to broadcast SD, HDTV, UHTV, mobile TV, radio services etc.
- DTT platform is flexible and content format agnostic - newer formats of TV content can be easily accommodated
- Lower transmission power requirements

- Facilitates Mobile data offload services from cellular networks for efficient use of resources

1.6 In some countries where DTT services are offered in the form of a package comprising of a rich bouquet of SDTV, HDTV, Radio and other value added services similar to those offered by other platforms, they have gained acceptance as an alternate platform to the consumers along with other platforms such as cable TV and DTH broadcasting services.

1.7 With the advent of digital media and alternate digital distribution platforms, customers today expect high quality content, with lot of options to choose from having better viewing experience even when services are delivered over the terrestrial transmission network. As broadcast content production at present is in digital format and it is consumed also on diverse digital devices, therefore digitization of terrestrial transmission to support seamless digital content flow is an important issue that needs to be examined.

1.8 High penetration of smart phones, and increasing popularity of Video consumption also makes a case for Digital terrestrial transmission. Studies predict exponential growth in demand for bandwidth, largely driven from video consumption and it is estimated that mobile video will generate about three-quarters of mobile data traffic[2] by 2020. This will demand availability of higher bandwidths for video services which appears difficult to be met by cellular networks alone. DTT services can provide an economical and spectrum efficient alternative for distribution of video services in such scenario.

1.9 The spectrum in the VHF Band I (47-68 MHz), VHF Band III (174-230 MHz) and UHF bands IV and V (470-698 MHz) in India is mostly reserved for broadcasting services[3]. It is important to ensure optimum

[2]Cisco VNI Mobile, 2016
[3]National Frequency Allocation Plan (NFAP) 2011

utilization of this spectrum especially in view of proliferation of new services which may require spectrum in above UHF bands due to its better propagation characteristics. If any spectrum reserved for broadcasting applications remains unutilized over a period of time, it not only restricts exploitation of the spectrum for other services but also leads to an irreparable loss as the notional value of non utilization of the spectrum is lost and cannot be realized later. It is therefore important to ensure that available spectrum for providing broadcasting services is either fully utilized for providing of broadcasting services to consumers or allowed to be utilized by other services.

1.10 Implementation of DTT in Indian context is a complex, time consuming and resource intensive process. It involves creation of new ecosystem of transmission infrastructure, services, receiving devices and business models to ensure a speedy transition. The implementation of DTT is to be considered keeping in view the international experiences, investment requirements, and present broadcasting scenario of the country where terrestrial transmission is provided only by public broadcaster and many alternate delivery platforms are available to consumers to access TV broadcasting services.

1.11 The broadcasting sector in India, over last decade has seen tremendous growth with focus on digitization of services. All broadcasting services, except terrestrial broadcasting, will be available in digital format in the country after completion of phase IV of cable digitization process which is targeted to be completed by March 2017. The Telecom Regulatory Authority of India (TRAI) has therefore, *suo-motu* issued this consultation paper[4] on "Issues related to Digital Terrestrial Broadcasting in India" on 24th June 2016 with a view to review the existing terrestrial TV broadcasting scenario for implementation of DTT across the country. The consultation was initiated with the following broad objectives

[4] http://www.trai.gov.in/broadcasting/other-initiatives/terrestrial-tv

i) To examine the viability of DTT platform and services in the presence of the multiple digital TV distribution platforms already available in the country.

ii) To identify approaches and models for digitization including feasibility of participation of the private sector in the growth of terrestrial broadcasting sector.

iii) To look into the existing spectrum utilization and a broad assessment of the requirement of spectrum for DTT broadcasting services.

iv) To suggest a road map for the transition to digital terrestrial TV transmission with the timelines for switching off the existing analog transmission.

1.12 The stakeholders were invited to submit written comments on the issues raised in the consultation paper. These were put in public domain with an objective to enable stakeholders to submit counter comments[5]. Subsequently, Open House Discussion was also held on 19th October 2016 in Delhi to deliberate the issues with the stakeholders. The Authority, after examining various issues emerging from the written comments of the stakeholders, Open House Discussion, and international practices, has arrived at the recommendations on key issues associated with the implementation of DTT and future growth of the terrestrial broadcasting sector in the country. Chapter-2 deals with the present status of terrestrial TV broadcasting in India and summarizes the international scenario. The issues related to introduction of DTT with recommendations thereon have been discussed in chapter-3. Summary of the recommendations is available in Chapter-4.

[5] http://www.trai.gov.in/consultation-paper-issues-related-digital-terrestrial-broadcasting-india

Chapter 2

Overview of Digital Terrestrial TV Broadcasting

Terrestrial TV broadcasting in India

2.1 Terrestrial TV service as regular broadcast was started in India at Delhi in 1965 under aegis of All India Radio (AIR). The service was extended to other cities during the seventies and in 1976, TV broadcasting was separated from AIR forming Doordarshan (DD). The major expansion of terrestrial TV services took place prior to Asian Games held at Delhi in 1982 when color transmission was introduced and a large number of transmitters were set up throughout the country. Today the terrestrial network has 1412 analog transmitters and 16 DTT transmitters.

2.2 Digitization of terrestrial network in India has been under discussion since the year 2000 when such services were implemented in UK and some other countries. In line with the international trend, DD then adopted the prevailing DTT technology (DVB-T) and set up 4 transmitters during 2002 to 2007 in the metro cities at Delhi, Chennai, Mumbai and Kolkata. The experimental services with four to five DD channels were started from these transmitters. Some set top boxes to receive DTT services were also provided to select users to assess the services. At that time set top box cost was significantly higher and the TV receivers sets also did not have any inbuilt DTT tuners. Also, plug-in receivers in the form of dongles etc. were not easily available. Since DTT services were introduced world over around this time only, the receiver ecosystem was not well established.

2.3 In keeping with the emerging developments, TRAI in 2005 had examined whether terrestrial television broadcasting should be opened to participation by private entities. In its recommendations on "Issues

relating to Private Television Broadcasting Service" dated 29th August 2005, TRAI had, *inter - alia*, recommended that[6] :

"*After considering all these factors as well as the fact that private television channels are already extensively available through cable and satellite, it is considered that there should not be any bar on throwing open terrestrial broadcasting to the private sector. The question as to whether this would make business sense in a market with high cable and satellite penetration is of course a relevant issue. However, it is considered that this option should be really left to the market to decide. In addition there are the possibilities thrown open by convergence as well as community TV. As a policy there does not appear to be any reason to bar the entry of the private sector for terrestrial television broadcasting any more.*

Accordingly it is recommended that:

i) Terrestrial television broadcasting should be allowed in the private sector also.

ii) This should be allowed also for community television."

2.4 Meanwhile several other terrestrial mobile TV standards such as DVB-H, *MediaFlo* etc. were also developed for the terrestrial TV broadcasting of TV channels to mobile devices. In view of these developments TRAI, in its recommendations on "Issues relating to Mobile Television Services" dated 23rd January, 2008 recommended to the Government that, apart from DD, private players may also be allowed to provide Mobile TV channels in terrestrial mode and that they may also be assigned at least one frequency slot of 8 MHz bandwidth each in UHF band for mobile TV operation in terrestrial mode. TRAI further recommended that the choice of technology be left to the service provider with an overriding condition that the technology deployed be based on mature and established standards issued by ITU, TEC or any other International Standards Organization such that the chosen technology is a proven one and also that the licensee should ensure interoperability of handsets. It also recommended that sharing of terrestrial transmission infrastructure of

[6]http://www.trai.gov.in/broadcasting/other-initiatives/terrestrial-tv

DD as well as those created by the private service providers be permitted on a mutual agreement basis in a non-discriminatory manner[7].

2.5 The recommendations were considered by the Ministry of Information and Broadcasting which subsequently sought TRAI's views on certain aspects which, *inter alia,* included issues such as spectrum allocation, license area, ownership, one time entry fee, roll out obligations etc. The Ministry had also sought TRAI's views on other related issues such as maintaining a level playing field between mobile TV operators intending to provide mobile TV services through terrestrial mode and telecom service providers. TRAI submitted its views vide letter dated 14th April, 2010.

2.6 Further technological developments resulted in new generation of DTT technologies (DVB-T2) standards and efforts were initiated by European countries, where DTT had already been implemented, to migrate to the new technologies. DD also followed these developments and considered adopting the latest technologies as they were more efficient and were capable of providing multiple services in addition to traditional television broadcasting. The plans for introduction of DTT were accordingly revisited and digitization using the latest technologies was planned under 12th five year plan.

2.7 DD has now initiated digitization of its terrestrial network by deploying second generation DTT technologies (DVB-T2).The plan envisages setting up of 630 DTT transmitters having single Transmitter multiplex. Out of these 16 DTT transmitters have been installed so far which are operational and 3 more are likely to be installed by March 2017. DD plans to setup another 40 DTT transmitters under the first phase of digitization. These DTT transmitters are presently broadcasting experimental services comprising of 5 DD TV channels and two radio channels targeting static and mobile TV receivers. In India, though work

[7]http://www.trai.gov.in/broadcasting/other-initiatives/mobile-tv

for digital migration by DD has already commenced, it is still at nascent stage and a clear roadmap for introduction of DTT services and drawing future landscape for terrestrial sector is yet to be formulated. The progress of DTT implementation is slow and appropriate efforts for development of an enabling eco-system are required to be taken up.

International status of DTT broadcasting services

2.8 The DTT transmission standards and technologies have primarily originated from corresponding analog legacy. In analog domain three analog TV standards namely PAL, SECAM and NTSC were predominantly used world over. When digitization of TV transmission started these standards led to the development of two major DTT standards namely DVB-T and ATSC. The former was mostly driven by European countries and was adopted by countries where erstwhile PAL and SECAM standards were operational. The later was driven by USA and adopted by countries where NTSC based services and networks were deployed. In addition ISDB-T was also developed and deployed in Japan. The DTT standards have been developed as comprehensive set of standards which also include compatible standards for cable and satellite TV broadcasting.

2.9 The DTT technologies began to be introduced and deployed towards the beginning of this century. The DVB-T standard, developed by the DVB Project, was first published in March1997 and world's first DTT network was set up in the UK 1998. The ATSC Digital TV Standard was released in 1995 and DTV service was launched in the United States in 1998. The ISDB-T standards were approved in 2000 and DTT broadcasting services began in December 2003 in Tokyo and few other areas[8].DTT services began to be deployed in several other countries in order to reap the benefits of digitization and saw major growth during the first decade of the century.

[8] Overview of digital television development worldwide, WU et al: proceedings of the IEEE, vol. 94, no. 1, Jan 2006

2.10 International experience shows that DTT services have become popular in presence of other platforms. A recent research report studying 138 countries including India[9], shows that the global digital TV penetration at the end of 2015 stands at 74.6 percent with 1170 million digital TV households in the world. There are 261.9 million analog terrestrial TV and 252 million DTT TV households. DTT households comprise of 239.4 million FTA DTT and 12.6 million Pay DTT Households. Between 2010 and 2015, about 584 million digital TV homes were added, out of which 156 million came primarily from DTT. Trends for DTT and analog Terrestrial TV are depicted in Fig. 1.

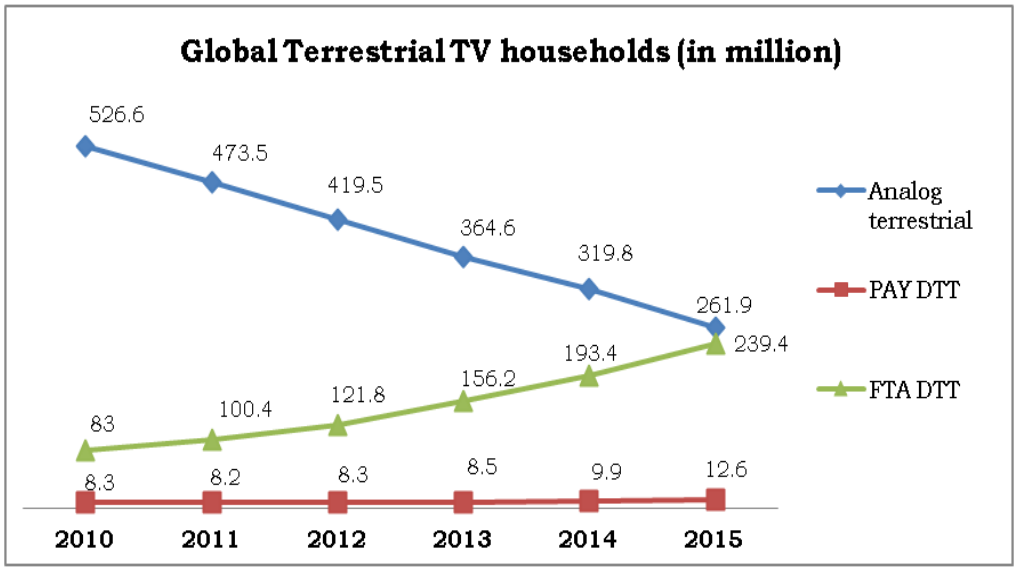

Fig. 1: Terrestrial TV (Analog and DTT) Global Trends

2.11 The global uptake of DTT services despite the existing presence of other digital platforms also indicates positive growth trend as shown in Figure 2. At the end of 2015, DTT constituted the second highest user base worldwide among digital TV broadcast platforms next only to digital cable TV services.

[9]"Digital TV World Databook", Digital TV Research Ltd, Press Release, 12 May 2016

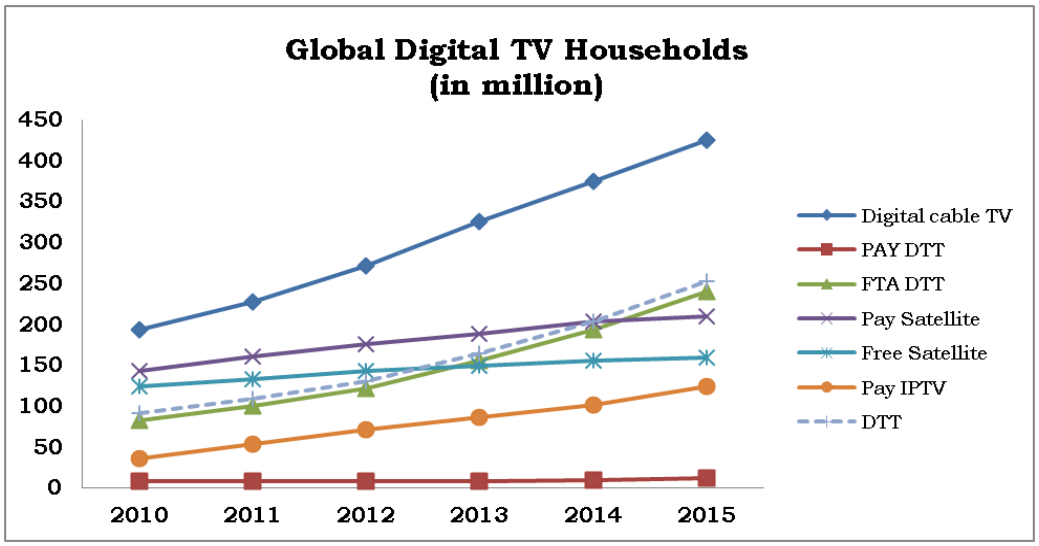

Fig. 2: Global trends for DTT and other digital platforms

2.12 The study further shows that terrestrial TV continues to be second dominant mode of TV reception after cable TV. As indicated in Fig. 3 and 4 below, in case of terrestrial TV, over half of the terrestrial TV homes still remain to be digitized whereas in case of cable nearly one third of the cable homes are yet to be digitized. The process of digitization in case of terrestrial TV is complex and time consuming as compared to cable digitization. It is evident that pace of digitization in case of terrestrial TV is slower than the Cable TV digitization progress.

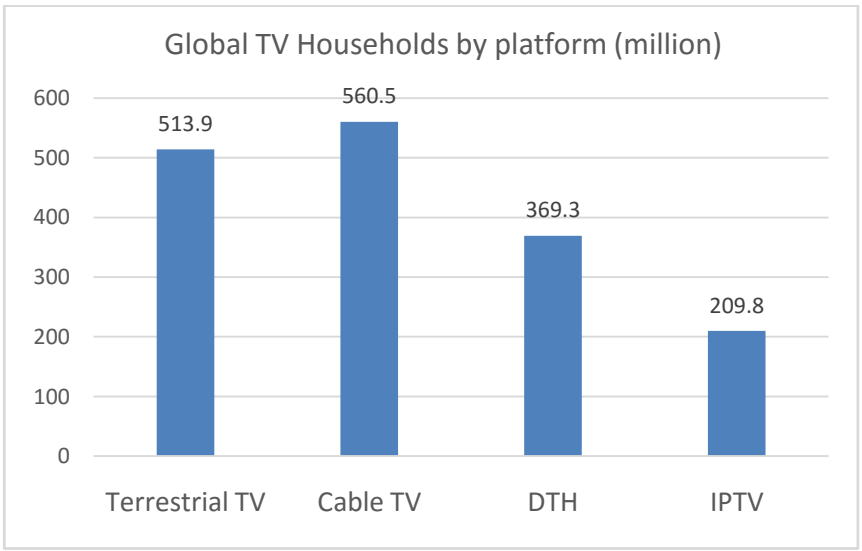

Fig. 3: TV Households by platform

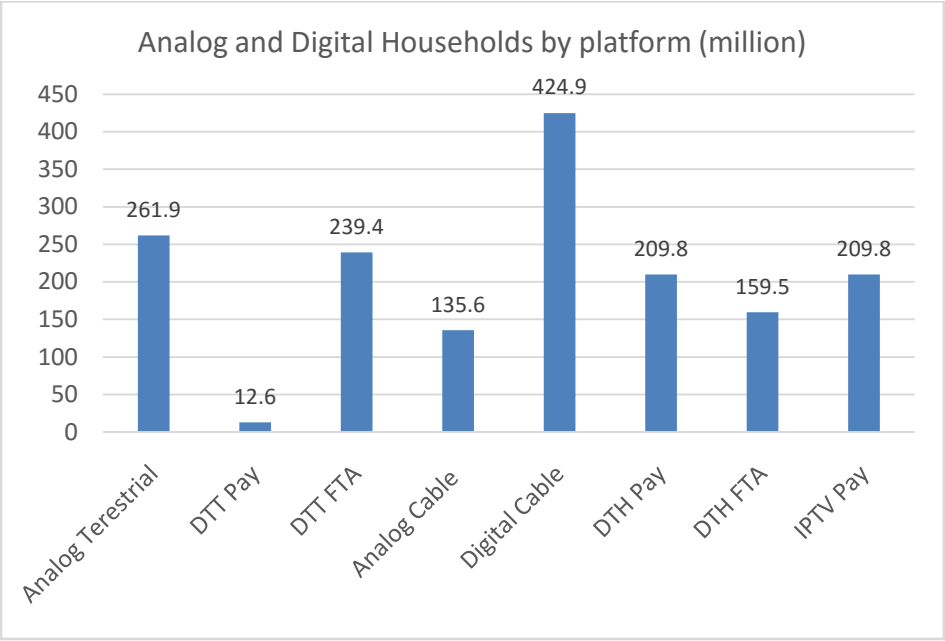

Fig. 4: Analog and Digital TV Households by platform

2.13 In UK, DTT has grown to become the leading television platform. It is used by 75% of households (with 40% of primary TV sets and on secondary sets in a further 35% of homes), and is present in nearly twice as many homes as its nearest rival, pay satellite[10]. It is the leading platform by a wide margin, with 83% share of free-to-air (FTA) households. It accounts for more viewing than any other platform, taking 44% of all viewing hours. Freeview is the United Kingdom's digital terrestrial television platform which offers 70 TV channels, 15 HD channels, and more than 30 radio stations covering 95% of the nation's favorite programmes at no monthly cost. In Australia, more than 25 channels and catch up services are available on DTT platform on free of cost.

2.14 In North America (USA and Canada), at present the penetration of DTT in TV households is close to the penetration of DTH. The number of digital cable TV households is highest at 58.59 million, while DTH and DTT households are at 22.18 million and 20.16 million respectively (figure 5). DTT segment in North America is emerging as one of the

[10] The value of Digital Terrestrial Television in an era of increasing demand for spectrum, By Robert Kenny, Robin Foster and Tim Suter, January 2014

prominent digital TV platform. It is estimated that DTT TV households will grow in the coming years whereas digital cable penetration is likely to remain static.

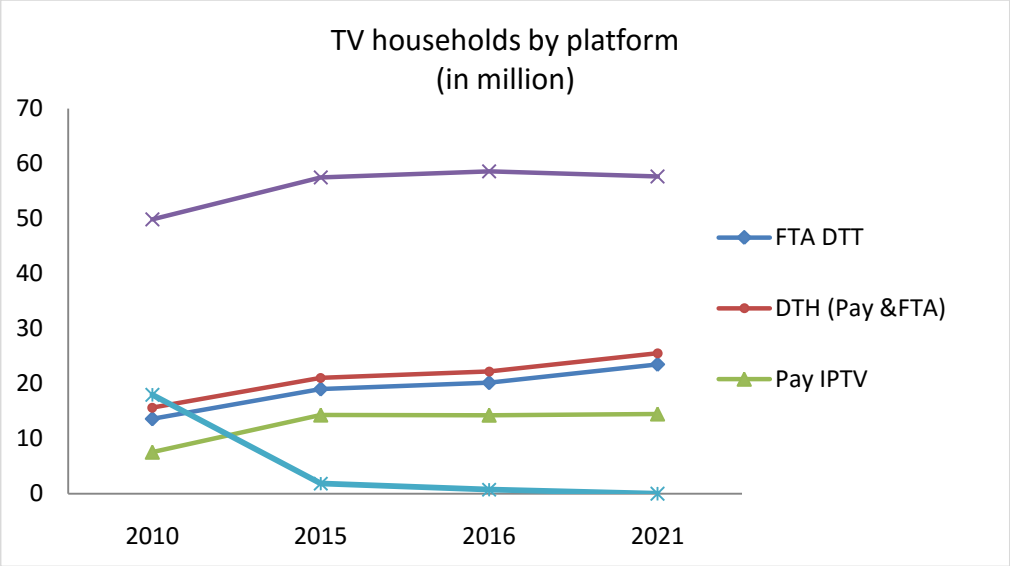

Fig. 5: TV Households by platform (North America)

2.15 In Asia pacific region covering 22 countries including India, at present the number of digital cable TV households is 330 million whereas the number of TV households for DTH and DTT are 147 million and 129 million respectively (figure 6). DTT is expected to witness a positive growth trend in the coming years. It is estimated that around 2019, DTT penetration will surpass the DTH penetration in the region, and by 2021, DTT is estimated to become the second largest digital TV platform to serve the consumer after digital cable TV platform.

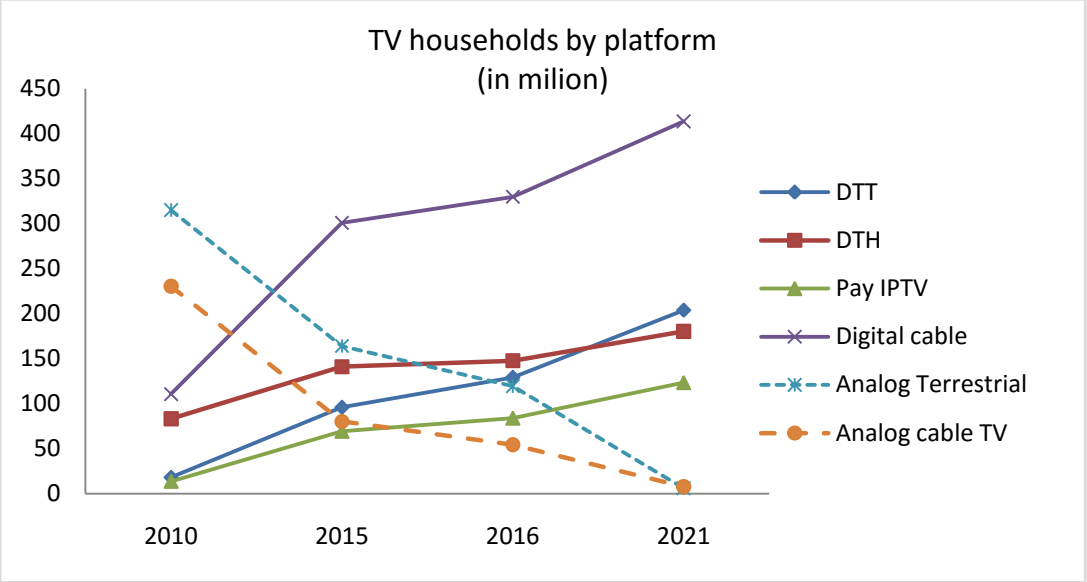

Fig. 6: TV Households by platform (Asia Pacific)

2.16 International scenario therefore reveals that that despite the presence of other digital TV platforms, DTT services continue to provide alternate distribution platform for distribution of TV broadcasting services and in most countries its penetration continues to see positive growth trends. It is also observed that the user base for different platforms varies across countries e.g. Cable TV is prominent platform in the USA whereas satellite services are most popular in Germany, while DTT constitutes the largest user base in the UK.

2.17 The countries world over have undertaken major initiatives to accelerate digital terrestrial migration by formulating national plans towards setting up of DTT infrastructure and switching off analog terrestrial services in a time bound manner. The digital migration path adopted by each country has been influenced by national priorities and plans. In some countries it was a phase wise implementation while in a few others a particular date for Analog Switch off (ASO) has been mandated for the complete transition to DTT. In countries like China, a different switch-off date has been specified for each terrestrial TV channel. In many other countries, simulcast services have been planned wherein a broadcast is simultaneously available to viewers in both analog and digital formats over a certain period and as the DTT transmission gains

popularity, existing analog services are gradually shut down. The plans for migration to DTT have been drawn up keeping in mind associated issues such as infrastructure, spectrum, services and consumer acceptance. The Status of DTT implementation in some of the major countries[11] is as given below :

Countries	**Year of DTT launch**	**DSO date**	**Status**
Brazil	2007	2018	Ongoing
Canada		2012	Completed
Colombia	2012	31/12/2019	Completed
Mexico	1997	31/12/2015	Completed
USA		2009	Completed
Australia	2001	10/12/2013	Completed
Indonesia		2018	Ongoing
Japan	2003	2011	Completed
Republic of Korea	2001	2012	Completed
Malaysia	2016	2018	Not started
Thailand	2014	2020	Ongoing
France	2005	2011	Completed
Germany	2002	2012	Completed
United Kingdom	1998	2012	Completed

2.18 The international experience however needs to be considered keeping in view the present broadcasting scenario and other socio economic factors in Indian context. The issues related to the implementation of DTT, its

[11] http://www.itu.int/en/ITU-D/Spectrum-Broadcasting/Pages/DSO/dashboard.aspx

potential, viability, business opportunities, spectrum requirements and roadmap need to be examined for creating a facilitating environment for digitization of the terrestrial TV broadcasting sector.

Chapter 3

Recommendations on various issues related to digitization of terrestrial broadcasting

This chapter analyses the key issues associated with the implementation of DTT in light of the comments submitted by the stakeholders during the consultation process and recommendations thereon.

Need for DTT services in presence of multiple delivery platforms

3.1 A large number of TV channels are available to the consumers through various delivery platforms such as DTH, Cable TV, IPTV, HITS etc. In addition to these platforms, DD operates a free to air DTH platform which at present broadcasts 59 TV channels and 24 radio Channels. Therefore the first and foremost issue relates to need and viability of DTT services as an alternate platform in the present broadcasting scenario where multiple delivery platforms are available for the consumers to access TV broadcast services.

3.2 The comments received from broadcasters and individual stakeholders have supported the need for introduction of DTT services in presence of other platforms. Broadcasters see DTT as another source for content monetization and opportunity for creation of new content and services. A few DPOs have expressed reservation on the ground that DTT will have to match the bouquet (Large number of TV channels having variety of content) as provided by cable and DTH operators to be a successful alternative platform and that developing such a bouquet would be a challenge. A few stakeholders have submitted that there is a potential for evolution of converged delivery networks where DTT broadcast network and broadband networks may complement each other and offer variety of services to the consumers sharing their infrastructure. In this

kind of scenario, the broadcast and telecom infrastructure and spectrum resources are expected to be better utilized for delivery of various services. It is opined that DTT can be effectively used for providing an alternative access to meet the increasing demand of video by consumers. These stakeholders are largely of the view that due to various advantages offered by DTT platform it could be an effective alternate platform for introduction of different type of services, including local content to different receiving devices in all weather conditions.

3.3 There are however a few contrary views expressed by a few stakeholders. One of them has submitted that DTT may not be economically and operationally viable as it won't be able to take away subscribers who are already using DTH or cable TV services. Another stakeholder has commented that popularity of terrestrial broadcasting platforms in India is on the wane and the precious spectrum in UHF band being held captive by the public broadcaster can be effectively used for IMT applications which will help in mass deployment of cost effective ubiquitous broadband services and fulfill the objectives of Digital India.

3.4 The terrestrial TV coverage in the country at present is limited to DD National channel covering 92.6 % population in 81.0 % land area, and DD News reaching 49% area of the country[12]. These figures are for broader coverage estimations and no data on actual number of terrestrial viewers in the country is available. In comparison there are about 102 million cable TV subscribers and 61.9 million pay DTH subscribers at present. The free-to-air DTH service of DD has reportedly about 20 million consumers and is fast becoming a popular platform.

3.5 At present terrestrial services are offered exclusively by the public broadcaster with the primary focus on public service broadcasting and commercial potential of terrestrial TV has not been fully exploited. Further, the services offer only a few channels which may not be a very

[12] Prasar Bharati Annual Report 2015-16

attractive value proposition to consumers. In case of DTT, a rich bouquet of services can be made available to consumers and it can also provide mobile TV services. The target audience for DTT is therefore expected to be significantly different from the current user base of analog terrestrial TV services. Therefore assessment of the need of DTT platform on the basis of current status of analog terrestrial services and viewership may be incorrect and unjustified.

3.6 The terrestrial platforms world over are predominantly Free To Air, which don't require any recurring subscription to receive the services. The consumers have to procure only DTT compatible STB or DTT enabled receivers to receive DTT services. DTT platform enables creation of a bouquet with proper mix of different type of services that can be broadcast in a robust and reliable manner for reception. DTT broadcast can be received on variety of devices in static, portable or mobile environment. This unique strength of DTT platforms cannot be matched by other platforms providing TV broadcasting services today. Therefore a rich bouquet of DTT services has the potential to offer a value proposition to the consumers even in presence of other platforms.

3.7 Consumption of video services through telecom networks has seen an upward trend due to high penetration of smart phones in the country. The consumers are required to pay for data usages charges in addition to content charges for consuming video on mobile phones through internet and broadband networks. Assuming that a consumer watches video (data rate of 1.4 Mbps HDTV) for one hour daily, the monthly data consumption for watching such video will be about 20 GB. Such data demands by individuals not only cast substantial cost but results in bandwidth requirement which is difficult to be met by cellular networks for large number of users. Further quality of video depends on availability of bandwidth. Higher the number of users in a given area, the probability of availability of sufficient bandwidth to individual users decreases resulting in bad quality of video reception. In case of DTT transmission, quality of service does not depend upon number of users

using the service simultaneously and best quality of service can be ensured irrespective of the number of users.

3.8 The consumption pattern of Indian subscribers is also undergoing changes as they adopt to new digital platforms. The Consumers today wants the content to be made available anytime, anywhere and on any device. Mobile TV services through DTT platform is excellent platform to watch the content anywhere and anytime including on handled devices and in moving environment. The new generation DTT broadcasting standards are moving towards service agnostic spectrum use. It will be important to take note of the development of the FM radio in Indian Scenario. The demand of the FM radio has increased multi-fold with active partnership of private operator and with infusion of high value content. Implementation of DTT can be leveraged for provision of different services including mobile TV at reasonable cost. The eco-system, which may not be fully developed at present, may come-up considering the number of subscribers and popularity of the services. DTT services can also be delivered on Smartphone with the help of some attachments which are readily available in markets.

3.9 India is a large and diverse country with socio-economic and regional variations of language and culture. DTT services, like FM services, cover smaller geographical area. However a network over larger area can also be constructed. This has the potential to provide localized or regional services which may be popular in Indian context. DTT could also act as an excellent platform to disseminate socially relevant information on education, health, and other developmental issues through TV broadcasting services to rural masses in their local language. DTT platform has the potential to offer capacity for providing "Community TV" services to local population on the lines of community FM services. A FTA DTT bouquet may be an effective alternate distribution platform to the rural masses and economically weaker sections of the society for accessing variety of digital infotainment services without any recurring costs.

3.10 DTT is also an important communication tool for disaster management including emergency response due to its localized nature of services and ability to provide reception on portable and mobile handheld devices with good quality service without being impacted by weather conditions. It can be used to gather or receive information from the disaster communication networks connected to the administrative organizations. The information pertaining to the disaster prevention and mitigation can then be delivered through DTT broadcasts to the public. The disaster radio communication may be difficult and ineffective especially in bad weather such as storm or heavy rains. However, disaster alerts and information via DTT broadcasting is useful in providing disaster relief information as it can address to mobile devices which have already widely penetrated and are becoming all pervasive throughout the country.

3.11 TRAI has been making regulatory intervention to encourage digitization in broadcasting sector. It had recommended introduction of digital addressable systems in the Cable TV services in 2010. The Government accepted these recommendations and necessary amendments were brought out in the Cable Television Networks (Regulation) Act, 1995 to facilitate digitalization process. Phase IV of this process is expected to be completed by March 2017. Other broadcasting distribution platforms such as DTH, IPTV, and HITS are already digital. In such a situation, introduction of DTT services in the country is important to create digital environment for broadcasting domain which will bring in synergy amongst various distribution platforms and help harness benefits of digital delivery of services to consumers fulfilling the objectives of Digital India.

3.12 As discussed in Chapter 2, it is evident from international experience that DTT has potential edge on other delivery platforms for providing multiple services to the consumers and DTT has survived in the presence of other delivery platforms.

3.13 Considering various issues as discussed above, the Authority is of the view that despite the presence of multiple distribution platforms for providing TV broadcasting services, the DTT would certainly add a new dimension to the distribution of the television content, especially in far flung and remote areas. DTT can reach these areas with better quality content, rich options, will solve some of the last mile connectivity & bandwidth related problems by delivering much better quality video, more number of channels and without the current levels of compression and quality degradation. A robust DTT platform will enable the Government to meet many of its educational and public awareness initiatives in areas where other mediums are yet to penetrate or have certain limitations or are not effective or are beyond the financial reach of potential audiences. Therefore, the Authority is of the view that even in the presence of DTH and Cable TV and other platforms, a strong DTT platform can provide various value added services such as mobile TV and help in the realization of a wide range of social and cultural benefits and most essentially an all weather reliable platforms for distribution of TV channels and services.

Recommendations:

3.14 **The Authority recommends introduction of DTT services throughout the country in a time bound manner.**

Private Participation in Terrestrial TV Broadcastings

3.15 In majority of countries, where DTT has been implemented, the terrestrial broadcasting space has been shared by private players along with the public broadcaster since analog era. As a result, terrestrial TV broadcasting emerged as a prominent platform in the presence of other distribution platforms. In UK and Australia, "Freeview" consortium of public and private broadcasters have developed DTT as a viable alternate platform with new services and bouquets of SDTV, HDTV, Radio services and value added services etc. In these countries DTT platforms and services are popular which are mainly free to air platform. On the other hand, in India, terrestrial TV broadcasting continues to remain under the exclusive domain of the public broadcaster. During the eighties when there were hardly any alternative platforms available in India for distribution of TV channels, Terrestrial broadcasting was a dominant mode of TV programme distribution. Subsequently, opening up of satellite and cable sector to the private payers witnessed an exponential growth in these sectors. However terrestrial platform has not seen much developments and it lost the edge over other platforms as the services offered by terrestrial service provider remained very limited in numbers and variety of content which could not meet the increasing choices of consumers.

3.16 On the issue of private participation in terrestrial TV sector, stake-holders have stated that the entry of private sector into terrestrial television broadcasting will bring in competition, innovation and investment in the terrestrial broadcasting landscape apart from introduction of variety of programming content. This will be in line with objectives of 'Digital India' initiative.

3.17 Broadcasting sector has seen phenomenal growth ever since private sector was allowed to participate in DTH and FM radio services. The cable sector in the country has been excessively driven by private operators. Entry of private operators in the FM sector has rejuvenated

the scene of radio listening in the country, taking FM services in far flung areas. This success story has therefore been primarily dependent on active participation of private players who offer wider choices to the consumers in a competitive environment. DTT migration world over has also been influenced by private sector as there were private terrestrial TV broadcasters already operating in the analog domain.

3.18 The Authority had earlier examined the issue relating to private participation in the terrestrial television broadcasting vide its recommendation on "Issues Relating to Private Terrestrial TV Broadcast Service" dated 29th August 2005. After considering the issue in detail, the Authority was of the view that there should not be any bar on throwing open terrestrial broadcasting to the private sector. Accordingly, it was, *inter-alia*, recommended that terrestrial television broadcasting in India should be allowed to private sector also. The Authority also laid down broad contours in respect of conditions for commercial terrestrial TV services keeping in view the scenario prevailing at that time which was being driven by deployment the first generation of DTT technologies.

3.19 Further, as these DTT technologies evolved for delivery of broadcasting TV services to handheld devices, the Authority, in its recommendations on "Issues relating to Mobile Television Services" dated 23rd January, 2008 recommended that, apart from DD, private players may also be allowed to provide Mobile TV services in terrestrial mode. These are interventions made by the Authority to ensure timely digitization of terrestrial TV broadcasting sector.

3.20 The Authority is of the view that it is important to expedite the digitization of terrestrial TV broadcasting in the country to ensure that all delivery platforms are digitized and modernized to synergize the broadcasting ecosystem. If this segment fails to follow other platforms, the infrastructure and spectrum shall not be optimally utilized resulting in wastage of resources.

3.21 There are various advantages/reasons in favour of allowing private sector participation in terrestrial TV broadcasting. These are briefly discussed below: -

(i) Since large investment is required for migration to digital TV broadcasting, allowing the private sector in terrestrial TV broadcasting would result in inflow of private capital, speedy transition and overall growth of the terrestrial services.

(ii) Private sector would develop DTT platform as a competitive and viable alternative platform to consumers, as per market demands.

(iii) Private participation would lead to innovation in services and new business models for commercial utilization of DTT platform. Content differentiation between terrestrial and other platform may also improve.

(iv) Currently, the Satellite TV Channels have programmes directed at the national/regional audience. It is expected that private terrestrial television broadcasting will lead to enhanced coverage of local content, issues, events, music and culture.

(v) The public service broadcasting may get strengthened as private service operators may also provide new socially relevant programming in areas such as education, health, development etc.

(vi) Private players will be very helpful to develop ecosystem for success of DTT services.

3.22 It is important that there should be multiple private players in the DTT market besides DD to provide a competitive environment and benefits to consumers for accessing rich content variety. Therefore, the Authority is of the view that private players may be allowed to provide DTT services.

3.23 After considering all these factors as well as comments of stakeholders and the fact that private players are already permitted in the DTH, Cable TV, FM Radio and HITS, the Authority is of the view that that allowing private players in terrestrial TV broadcasting space will ensure plurality and competition, benefiting the consumers.

3.24 **The Authority recommends:**

(i) Private players should be permitted to provide DTT services along with the public service broadcaster.

(ii) The eligibility conditions of private DTT operators, licensing conditions and other modalities for entry of private players would be worked out by the Authority after the Government has taken a policy decision in this regard.

Spectrum needs for DTT services

3.25 Consultation was also held with the stakeholders on the requirement of spectrum for the DTT services in the country. The quantum of spectrum required for DTT services would primarily depend on appropriate DTT architecture (MFN/SFN/Hybrid) to be used for the DTT implementation as well as number of DTT Transmitters to be included in the DTT multiplex to be planned at different locations in the service area.

3.26 On the issue of requirement spectrum for DTT, stakeholders have stated that quantification of spectrum is a complex issue as it involves decision on network topology, technology, number of multiplexes and the services to be offered through DTT. The number of TV channels to be carried on DTT bouquet and provision of other services such as radio channels, Mobile TV also depend upon availability of spectrum in the desired band. For DTT to be competitive with respect to other platforms and to ensure that it provides a better value proposition to the consumers, a bouquet of services comprising multiple TV channels including SDTV and HDTV channels, and other services should be made available to the consumers. Further, DTT can also be used exclusively to deliver multi-media content to mobile devices. Therefore, service planning is an integral part of DTT implementation and infrastructure cannot be created independent of the planning of services proposed to be provided through DTT.

3.27 The Authority agrees with the stakeholders that identification of spectrum is a complex issue as it depends on various factors. In DTT network, both Multi Frequency Network (MFN) and Single Frequency Network (SFN) architecture can be implemented. In case of MFN, a single frequency channel is used at one location which cannot be repeated for transmission by another transmitter in adjacent areas. This means that more frequency channels are required to cover a larger area. In case of SFN, a single frequency band of 7 or 8 MHz can be used to set up a large network, say on regional basis. Implementation of SFN is

however complicated and requires synchronizing all the transmitters working in the SFN. It also puts restriction as same content shall be transmitted from all transmitters working in the SFN. Thus, localized broadcasting will be difficult to implement in SFN model. International experience shows that most of the countries have adopted MFN with local/regional plan for SFN for implementing DTT. Since the Authority has already recommended for private participation in the DTT services, flexibility for local content is an important factor to be kept in mind. The spectrum requirement for expansion of DTT network may be lesser if SFN approach is followed. It is therefore important to examine the probable use of MFN and SFN for DTT and also number of transmitters required to be installed at one location in a multiplex to provide bouquets of multiple TV channels and other services. It is also equally important to indentify optimum size of a multiplex at a given location and number of proposed multiplexes per DTT operator to have broader assessment of spectrum requirement.

3.28 Majority of stakeholders submitted that hybrid network topology may be suitable so that there is flexibility among service providers to choose their best case. One stakeholder submitted that Hybrid MFN, with main transmitters in MFN and associated gap fillers in SFN may be suitable for implementing DTT in the country. Another stakeholder is of the view that since DD has already planned for MFN mode, the same should be examined; however in hilly or inaccessible areas SFN may be considered. A few stakeholders have suggested for mix of MFN and local SFN considering India's demographic pattern with diverse culture and languages.

3.29 India being a large country and with diverse culture and different languages, there will be a demand for local content. Therefore, the topology for DTT services should be such that it should also take care of the availability of local content on DTT services. Therefore, hybrid model, a mix of MFN & SFN transmitters having main transmitters in

MFN and gap fillers in SFN is appropriate topology for implementing DTT services.

3.30 The requirement of spectrum for DTT broadcasting may also increase during the transitionary phase of migration from analog to digital. During initial period both analog and DTT services may have to be provided in simulcast for a predefined period, say 3-6 months, to facilitate migration of viewers from analog to digital.

3.31 The next issue to be examined is identification of spectrum requirement. Stakeholders generally are of the view that there should be at least 4 to 6 transmitters in the multiplex in each location for providing attractive and competitive DTT services. One stakeholder has suggested that in metro cities there may be 4 to 5 transmitters in such multiplex due to high demand, at least 3 transmitters per multiplex for major cities and urban areas and 2 transmitters per multiplex for rural areas. Another view point is that two transmitters per multiplex at each of the locations is adequate to provide a reasonable bouquet of channels having mix of DD and private channels. Another stakeholder has suggested that to make it a competitive platform and to meet the future requirement of consumers and broadcasters, it would be appropriate to plan for 5 DTT transmitters in a multiplex per location in longer term.

3.32 The Authority is of the view that the number of transmitters in a DTT multiplex cannot be worked out independent of services to be offered and the business models. International experience shows that 6-8 transmitters can provide competitive alternate DTT platform for the consumers. For example, BBC has been using 8 transmitters multiplexes including 2 transmitters multiplexes for HDTV. However, in Indian context, such requirement may be different and may depend upon various factors such as business viability, spectrum availability, number of operators in an area, etc.

3.33 In order to assess the requirement of spectrum for DTT, the Authority has sought data from the Ministry of Information & Broadcasting on analog transmitters of DD that are operating in the UHF band and current status of DTT implementation of DD. The Ministry of Information & Broadcasting informed that at present 405 analog transmitters are operating in the UHF band and DD has set up 19 UHF DTT transmitters. In addition to this, 23 DTT transmitters are under various stages of implementation. DD has planned to set up 630 transmitters for digitization of its networks which are envisaged to be implemented in a phased manner using UHF Band IV and Band V. It has also been informed that a multiplex of 5 transmitters at each location shall be required in order to provide a rich terrestrial bouquet comprising of DD channels and private TV channels and all are planned in UHF band IV and V (470-646 MHz).

3.34 At present DTT services are provided by DD in a limited manner. Success of DTT services will depend on development of the ecosystem and also in provision of rich bouquet of services. Private participation will be necessary to ensure growth and popularity of DTT services. The Ministry of Information and Broadcasting has so far granted permission for 820 SD channels and 79 HD channels. On an average, private distribution platform operators are offering approximately 300 channels. In order to provide a meaningful alternative, sufficient number of DTT transmitters per multiplex have to be planned without which provision of DTT services will be meaningless as it will not take off at first instance. Considering various requirements and being conscious of the importance of spectrum usages in Band IV and Band V, the Authority is of the view that multiplex of at least 7 DTT transmitters needs to be provided for formation of rich bouquet to provide DTT services at any location. Out of these, two transmitters can be utilized by DD for its public service broadcasting and one exclusive transmitter for mobile TV services. In order to have adequate competition in a particular service area, the Authority is of the view that four transmitters may be allocated to private players depending upon the availability of spectrum

so that consumer will get wider choice of channels. One transmitter may be kept for providing other value added services.

3.35 Here it is important to note that while higher participation of private players will add value, help development of ecosystem and provide better mix of DTT services, the spectrum availability is limited. Adequate competition in the market can be ensured with four private players and one public broadcaster Prasar Bharati. Since most of DTT players are expected to operate in Free to Air mode, business viability of more number of players in DTT field may be difficult. Accordingly, the Authority is of the view that maximum four private players may be permitted to provide DTT services along with Prasar Bharati. The mode of allocation of spectrum, terms and conditions of license to provide DTT services and other modalities will be recommended by the Authority once Government accepts these recommendations.

3.36 Let us now concentrate on available frequencies for provision of DTT services and probable allocation plan. As per the National Frequency Allocation Plan (NFAP)-2011, VHF Band I (47-68 MHz), VHF Band III (174-230 MHz), UHF Band IV (470-585 MHz) and UHF Band V (585-698 MHz) spectrum is available for TV broadcasting. As per foot note IND 36, requirements of fixed and mobile services will also be considered in the frequency band 470-520 MHz and 520-585 MHz on case-by-case basis. Further, as per foot note IND 37, the requirement of Digital Broadcasting Services including Mobile TV may be considered in the frequency band 582-698 MHz subject to coordination on case to case basis.

3.37 Since terrestrial TV broadcasting space in the country was completely under the domain of Prasar Bharati, there has not been any examination of optimal utilization of spectrum for existing terrestrial TV services and future expansion. In other countries private players exists along with the public service broadcasters in terrestrial TV Broadcasting domain. These private operators, along with public broadcaster, have

developed terrestrial TV platform as alternate delivery platform in presence of Cable and satellite (DTH). Thus, broadcast spectrum has been utilized effectively and there is a demand for additional spectrum for various other terrestrial services such as mobile TV, HD TV, 4K, etc. In India at present two national TV channels are carried over terrestrial networks. The broadcast spectrum therefore remains largely underutilized. Like in other countries, terrestrial TV space in India can offer variety of services. However due to lack of timely policy intervention and absence of business models, the terrestrial sector could not grow in India. There is a need to prescribe clear roadmap for implementation of DTT services including the spectrum band for its use.

3.38 UHF Band IV (470-585 MHz) and UHF Band V(585-698 MHz) spectrum is largely available for Digital Broadcasting Services including Mobile TV subject to coordination on case to case basis. This spectrum of 228 MHz can be exploited for expansion of DTT services in the country. It is pertinent that in order to attract private operators in the DTT domain adequate spectrum is required to be made available to offer competitive bouquet of services. The Authority is also aware that when FM sector was opened up for private participation, similar spectrum planning was carried out to earmark spectrum for All India Radio (AIR) and other private operators. Out of the FM band (88-108 MHz), contiguous band of spectrum was earmarked exclusively for use of AIR and the remaining was allocated to private operators and other services such as Community Radio and IGNOU FM radio service.

3.39 Planning of a terrestrial TV broadcasting RF network theoretically requires three times frequency channels in MFN approach if a single transmitter network is to be created. Therefore, if a multiplex of 7 transmitters requiring 7 frequency bands of 8 MHz each (56 MHz) is to be replicated over large area, theoretically total 21 frequency bands (8 X 21 = 168 MHz) would be required. Therefore, the theoretical spectrum requirement for deploying a DTT network of seven DTT transmitters per

multiplex is about 168 MHz which is to be met from UHF band IV and V (470-698 MHz). This is a theoretical assumption under ideal conditions and the actual spectrum requirement would be higher due to other network planning considerations and simulcast operation during transition from analog to DTT. Further, if there is an additional demand for Mobile TV, HDTV, UHD TV and radio services more spectrum band would be required for increasing the multiplex size at the location. It is pertinent to add that provision of TV channels for Mobile TV requires different format. Consumers prefer short format on mobile devices and composite programs in itself. For this purpose, separate editing and formatting is required for mobile TV channels. Therefore, format of delivery for mobile TV and liner TV channels on DTT platform is likely to be very different both from content point of view and from farm factor point of view. This may therefore, necessitate allocation of separate spectrum for linear TV channels and Mobile TV for provision of DTT.

3.40 Wireless Planning and Coordination (WPC) Wing in Department of Telecommunications is responsible for allocation of spectrum for various users in the country. Though UHF Band IV (470-585 MHz) and UHF Band V (585-698 MHz) are available for Digital Broadcasting as per NFAP 2011, these bands are shared bands and there could be other users. Moreover, DD is currently utilizing spectrum in these bands for analog transmitters and some of DTT transmitters which have already been installed in a non contiguous manner. Though MIB has informed that spectrum requirement of DD for DTT services for setting up of DTT multiplex comprising of 5 DTT transmitters at 630 locations would be met from UHF Band IV & V (470 – 646MHz), no detailed planning for frequency channel allocation is available for the proposed plan. Therefore, considering the complexities associated with the identification of spectrum for rolling out DTT services in the country, the Authority is of the view that there is a need to carry out comprehensive frequency planning exercise by Ministry of Information and Broadcasting in coordination with Wireless Planning and Coordination (WPC) Wing of DoT for rolling out DTT in a similar manner as done in case of FM Radio

while taking into account the network topology, analog switch off approach, number of transmitters in a multiplex and number of operators in an area for earmarking of spectrum for DTT services. Such exercise should also study actual utilization of spectrum by DD and its future requirements so as to identify and earmark spectrum for private players. This exercise is necessary to consider opening of terrestrial TV sector to private players so as to enable them to work out possible business models for introduction of DTT services in the country.

3.41 **Accordingly, the Authority recommends:**

I. Implementation of DTT services in the country in Hybrid mode having main transmitter in MFN and gap fillers in SFN. This will facilitate provision of local content as well as rich bouquet of services.

II. Public broadcaster may be permitted to operate maximum three transmitters (8 MHz X 3) at a given location out of which one (8 MHz) may be exclusively used for provision of mobile TV services.

III. Private broadcasters may be permitted to operate maximum four transmitters (8 MHz X 4) at a given location subject to availability of spectrum.

IV. Maximum number of DTT providers may be capped at five (one public broadcaster and four private broadcasters) as per availability of spectrum.

V. Ministry of Information and Broadcasting in consultation of WPC of DoT and other technical agency such as BECIL may carry out comprehensive frequency planning for roll out of DTT services in time bound manner, such exercise should be completed within a period of six months to ensure that the roadmap for digitization of terrestrial network and introduction of DTT services as suggested by the Authority could be planned and implemented.

VI. The term and condition regarding allocation of spectrum to DTT operators, frequency slots for auctions, Reserve price

etc. will be given by the Authority once these recommendations are accepted by the government.

VII. Allocation of spectrum should be done in time bound manner so that spare and unutilized spectrum in band IV and band V can be put to effective use.

Models for DTT implementation

3.42 The consultation paper deliberated on following three models for establishing DTT network and services, These models are briefly explained below:

(i) **Integrated Broadcasting Model (IBM):** In this model, it is envisaged that both DTT infrastructure and DTT services are provided by a single entity in a particular location which will plan, set up and operate the DTT network and provide DTT services in its area of operation.

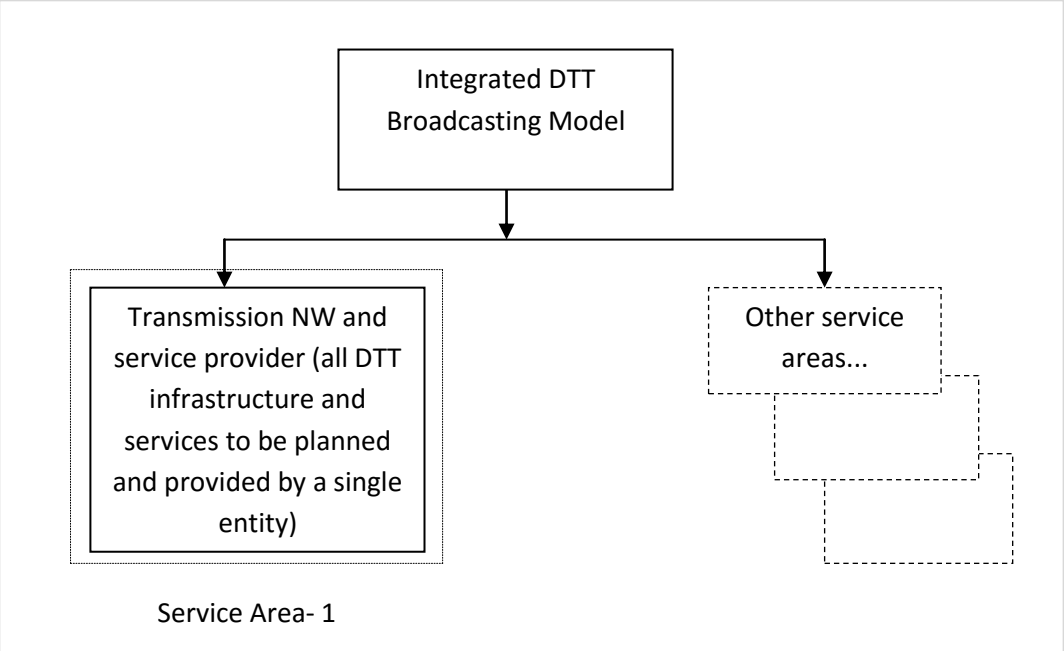

Fig. 7: Integrated DTT Broadcasting Model

(ii) **Common Transmission Infrastructure (CTI) Model**. The CTI model envisages setting up of a common DTT network at a location and all necessary DTT infrastructures such a Tower, building, antenna, transmitters and utilities etc. are to be provided by an entity is a particular service area. This entity will provide both passive and active infrastructures for the DTT transmission and services. The DTT service providers can seek capacity for providing DTT services. In this scenario, there will be two distinct categories

of operators viz. (i) DTT network operators and (ii) DTT service providers. While DTT network operator will be responsible for setting up of the infrastructure and its management, the DTT service provider will wholly concentrate on service provisioning only. QoS in this case will broadly be ensured by DTT network operator.

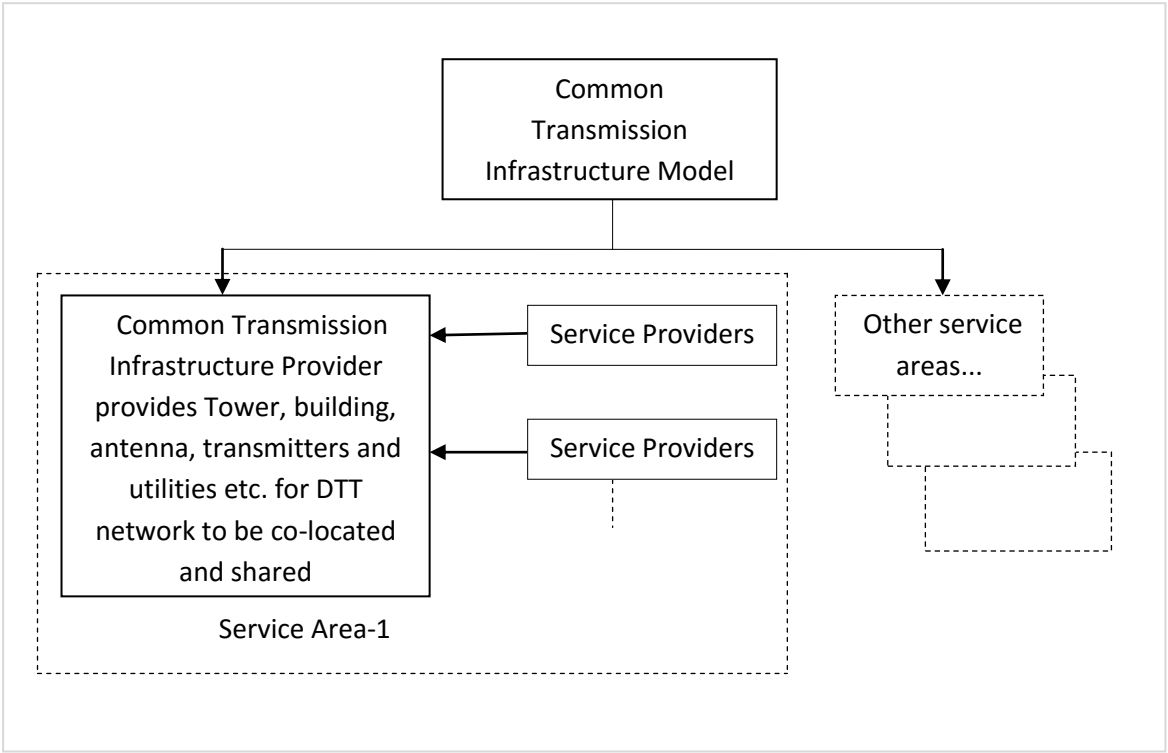

Fig. 8: Common Transmission Infrastructure Model

(iii) **Transmission Network Model**: In this model, an entity will provide necessary passive infrastructure at a particular location to the DTT service providers which will provide DTT services using their own DTT multiplex.

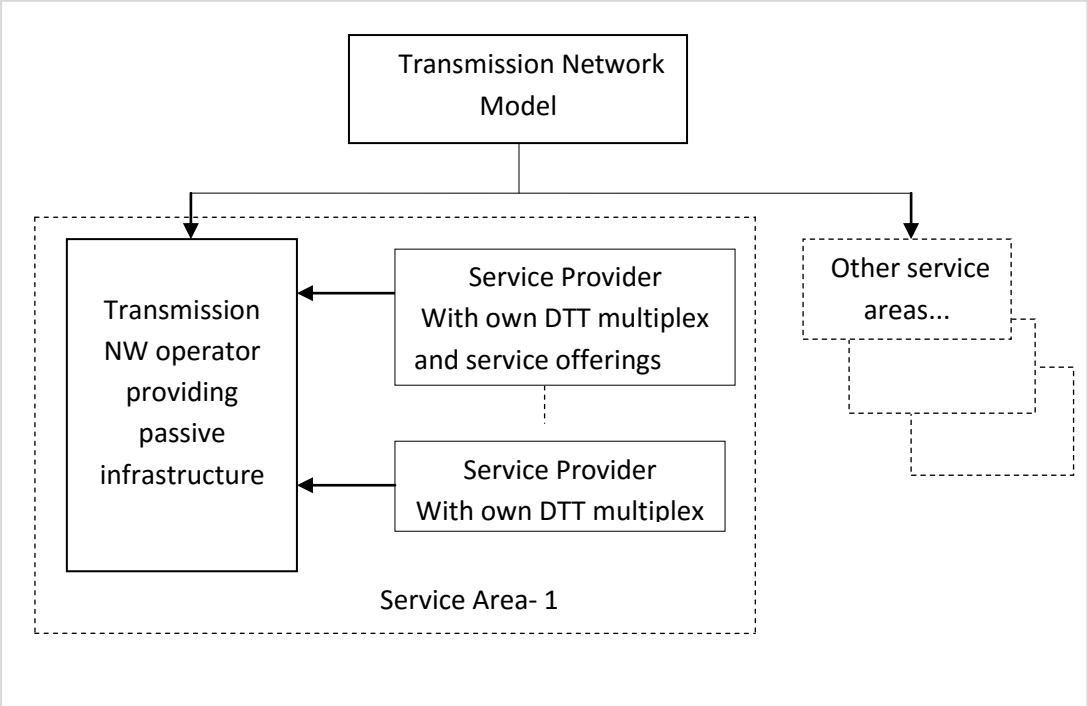

Fig. 9: Transmission Network Model

3.43 The stakeholders have submitted divergent comments on the probable models for DTT. Some stakeholders have suggested that CTI model which has been successful in case of FM expansion may be suitable. Few other stakeholders have favored Transmission Network Model as the most suitable model. They were of the view that in Indian context, it will tackle the problem of providing large network in the entire country and also discourage monopolization of the DTT broadcasting network. One stakeholder has stated that in transmission network model there is a possibility of providing a converged platform for providing telecom and terrestrial services. While another stakeholder has submitted that there is a need to have more data in terms of size, investments, costs and benefits among others under each of the models to evaluate the best option for DTT. Another stakeholder has suggested that PPP model may be used to implement DTT in the country and auction of the spectrum should not be followed as it will only encourage big players and keep out innovation. One stakeholder emphasises that the appropriate model for implementation of DTT needs to be finalized keeping in consideration the initiatives already taken by the public broadcaster. Prasar Bharati has submitted that DTT network should be established by them. This

will help them to generate revenue by way of leasing out the channel capacity which can be auctioned in advance and the revenue realized may be used for time bound expansion of DTT network.

3.44 The Authority has examined the progress of current DTT implementation. DD has initiated digitization of its terrestrial network by deploying second generation DTT technologies (DVB-T2) in 2012. It is planned to set up 630 digital transmitters in phases, out of which 16 have already been installed and another 3 are likely to be set up by March 2018. DD has not provided any clear cut road map for the complete digitization of its network. Considering the current pace of digitization and investment required, the Authority is of the view that DTT implementation by DD alone may take several years to complete. The first generations of DTT technologies were deployed in many countries and have been in operation for last several years. These technologies have evolved over the years and may either have already upgraded to second generation of DTT technologies or are implementing the migration. As the technology evolution is taking place rapidly, deployment of these technologies has to be equally fast in India, otherwise there is a danger of such technologies becoming obsolete prior to completion of digitization if digitization takes a long time. Any business model therefore has to be futuristic and it should consider developments likely to take place in near future in DTT sector. Therefore, there is a need to expedite DTT implementation in the country for which devising a suitable DTT model is essential.

3.45 It is pertinent to mention here that DD already has large passive infrastructure which can be very effectively used for implementation of DTT services quickly. The existing terrestrial infrastructure of DD needs to be leveraged and used for DTT roll out as it will reduce both time and cost of DTT implementation. The choice of technology is one of the most important factors for creating a proper eco system for DTT. Though multiple DTT standards (DVB, ATSC, ISDB, CMMB, DMB-T, as referred to in Annexure I) are available, most countries are following single

standard for DTT to eliminate interoperability issues and benefit from economy of scale.

3.46 In the Integrated DTT Broadcasting Model, the operator can plan the DTT network and services as per its business requirements. Hence the single entity will be responsible for creating necessary eco system for devices and new services. This model supports technology neutrality and state of art technology adoption. However, considering the fact that DD has already initiated the process of DTT, it may not be feasible for a new entity to set up new terrestrial networks and provide services as it involves creation of infrastructure like buildings and towers for setting up new DTT transmitters which is highly capital intensive and time consuming process. Financial viability is an important factor for a new entity to consider setting up complete DTT network afresh. Therefore, this model pre-supposes that only DD is in a position to set up Integrated DTT Broadcasting network. However, going by the current progress of DTT implementation, if a single entity has to set up network and services it is likely to take several years to complete the digitization. Therefore, Integrated DTT Broadcasting Model may not be a feasible model for rolling out DTT services in the country in a time bound manner.

3.47 The CTI model is very similar to the teleport model where DTT service providers can seek capacity from a common DTT network and infrastructure provider to provide DTT services. In this model technology choice will be made by network and infrastructure operator, which means device and service eco system creation is to be done by such CTI operator. Innovation is limited in this model since DTT service providers do not have freedom to choose the technology as per business requirement. There could be multiple CTI operators in different areas of the country and these operators would need to be allocated spectrum for setting up their networks. Since monetization of such common network and infrastructure will be totally in the hands of DTT service providers, it will create a vacuum and common network and infrastructure

providers may not show keen interest in purchase of the spectrum for DTT roll out impacting the implementation. Further, coordination among different Network and infrastructure operators will be difficult to ensure interoperability of devices. This may require further coordination for adoption of same technology creating further complications. Here harmonization of technologies may be a challenge. Since DD has already set up its DTT infrastructure in some parts of the country, new entities may not be interested in creating such infrastructure where business viability is not very certain. Owing to these reasons, CTI model may be difficult for DTT expansion in the country.

3.48 Transmission Network Model (TNM) is easy to implement since basic passive infrastructure required for DTT is already available with DD at most of the locations in the country. The roll out in such condition is likely to be fast if we consider the example for FM radio roll out. This model will reduce the cost of setting up of infrastructure for private operators by avoiding investment in passive infrastructure like tower, building, etc. Sharing of passive infrastructure by the DTT service providers will reduce cost for DTT service providers. They can therefore invest more in the content creation. DD has huge infrastructure such as land, building, towers, networks, etc. Therefore, existing DD infrastructure wherever available can be optimally utilized for setting up of active infrastructure such as transmitters, antennae by other operators for DTT services. This will also provide DD good source of revenue for development of their services. It will be win-win situation to both the entities. The passive infrastructure can be created by other entities wherever DD infrastructure is not available. While private entrepreneurs may be interested to take up such provisioning of active infrastructure and services as long as business viability for such operators is ensured, it is hoped that as the planning and rollout of DTT services will pickup, there will be more clarity and more entrepreneurs may come forward to offer their DTT services. In this model DTT service providers would also need to be allocated spectrum as in the case of FM for setting up of their own active infrastructure like the transmitter and

for offering DTT services. Hence, considering the existing terrestrial TV network scenario, TNM model would be a feasible model to implement DTT in a time bound manner

3.49 In countries like UK, Australia, passive DTT infrastructure and DTT services are separated as in case of TNM model. Freview UK is the United Kingdom's digital terrestrial television platform. It is operated by DTV Services Ltd, a joint venture between the BBC, ITV, Channel 4, Sky and transmitter operator Arqiva. DMOL UK (DTT Multiplex Operators Ltd.), a company owned by the operators of the six DTT multiplexes (BBC, ITV, C4, and Arqiva) is responsible for technical platform management and policy, including the electronic programme guide and channel numbering.

3.50 Freeview Australia comprises free-to-air licences such as Australian Broadcasting Corporation, Special Broadcasting Service, Seven Network, Nine Network, Network Ten, Prime Media Group and Southern Cross Broadcasting. Freeview New Zealand is a joint venture between the country's major free to air broadcasters – government owned Television New Zealand and Radio New Zealand, government subsidised Māori Television, and the Australian owned Iron bridge Capital company MediaWorks. New Zealand (operators of TV3, FOUR and The Edge TV). DTT services are offered by Freeview consortium and DTT networks are operated by another consortium of these service providers.

3.51 In view of above the Authority is of the view that TNM model shall be an appropriate and easily implementable model for rolling out DTT services in the country. TNM model will provide adequate flexibility to stakeholders to promptly roll out DTT services while ensuring effective utilization of existing resources as well.

3.52 **The Authority recommends :**

(i) Transmission Network Model is an appropriate model for implementing DTT service in the country.

(ii) The Authority will come out with the detailed guidelines for sharing of infrastructure, and other implementation modalities once a policy decision is taken by the Government in this regard.

Roadmap for Digitization of Terrestrial TV Broadcasting

3.53 Having discussed the major issues involved in the implementation of DTT services in the country, we now consider the aspect of drawing up a road map for DTT implementation.

3.54 The transition to digital terrestrial television broadcasting can take many routes, each with its own advantages and disadvantages in terms of rapidity, the players involved, and the degree of government intervention. Often influenced by the local broadcasting legacy, countries have followed its own switchover path, based on technical and economic analysis, the availability of relevant devices & equipments. Internationally, concerted efforts are being made for up-gradation to a fully digitized terrestrial TV system. Many countries including UK, Netherland, Spain, France US, Canada, Japan and Australia have migrated to digital. DTT implementation is progressing in Russia, China, Hong Kong, Malaysia, and Singapore. The ITU GE-06 agreement sets the date of 17 June 2015 as the end of analog TV transition period in UHF band in Europe, Middle East, Africa and Iran. Most countries in Asia Pacific and Latin America have plans to complete the transition by 2020. In India, DD has also planned to complete the digitization process by 2017 and implement switch off by 2020.

3.55 In the Indian context, there is no clear road map available for the implementation of DTT services in the country. The digitization of terrestrial TV networks was considered by 'Going Digital' sub group constituted by erstwhile Planning Commission[13]. The sub-group has recommended a planned implementation of DTT in the country in a phased manner with a target date of completing digitalization by 2013. It had recommended following roadmap for commencement of digital terrestrial broadcast in selected cities.

[13] Report of the Sub Group On Going Digital under the Chairmanship of Member Secretary Planning Commission, October,2006

Step I - Delhi – 2010

Step II - All mega cities – 2011

Step III - All Tier II & Tier III cities – 2012

Step IV - All other areas – 2013

3.56 The stakeholders feel that there should be a clear cut road map for rolling out of DTT and analogue switch-off should be implemented in a phased manner. Generally stakeholders have indicated a time frame of 8-10 years for complete switch-off for the analogue terrestrial TV broadcasting. One stakeholder indicated that DTT should be implemented by 2022 and another one has suggested a time frame of 2025-2030 for the DTT transition. One stakeholder suggested that phase wise transition of DTT may be followed. Another suggestion is that move to DTT being complex and long process, right incentives needs to be established to speed up the transition process. One stakeholder is of the view that simulcast period of at least 6-12 months may be required before switching off analog transmitters. A firm analog switch off date may also be required to be mandated to ensure that the stakeholders are able to plan and create necessary eco system for introduction of DTT services. Prasar Bharati has also planned to complete the digitization process by 2017 and implement switch off by 2020. However the existing pace does not appears to match with the set goals.

3.57 As per the available information, around 16 DTT transmitters have been installed by Prasar Bharati and 3 more are in the process of installation. Analog transmission in these places is still continuing as services to be broadcast over DTT platform are yet to be finalized. Also, the availability of DTT STBs is limited with no focused attention for development of the eco-system. In absence of appropriate services and adequate availability of set top boxes (STBs), these DTT transmitters have not contributed towards the digitization process. Further, going by the progress made so far, it is likely to take several years to merely replace existing 1412 analog transmitters. It may not be out of place to mention that mere

creation of such DTT transmitter will not serve the purpose unless people in mass are able to use these services. Having regard to existing status of the implementation of DTT, the country is not likely to achieve analog switch off target of 2020. There is therefore an immediate need to review the current digitization efforts and to lay down a roadmap for digitalization of terrestrial TV networks and to decide sunset date for analog terrestrial TV services.

3.58 The Authority observes with concern that it has been almost fifteen years since the effort for digitization of terrestrial TV networks began in India. However, the network still continues to be analog. There has been a sea change in terrestrial TV broadcasting world over during this period while India continues to lag far behind. It is noticed that though the delay might be attributed to several factors such as availability of funds, lack of planning and timely policy intervention, etc., the country has failed to capitalize on economic and social benefits that would have accrued from the digitization. While other broadcast service delivery platforms in the country are by and large digital and making efficient use of resources, the analog terrestrial network continues to drain public recourses for providing outdated analog services. It appears that lack of competition in terrestrial sector has been one of the key reasons for failure of the growth of the sector.

3.59 While it may be argued that DD being public broadcaster is solely dependent on funds provided by the Government for its operation and expansion. Therefore, the delay for introduction of DTT services may not be entirely attributed to DD. However, the Authority observes that Government has not formulated any well defined DTT policy indicating a clear roadmap for implementation of DTT services in the country and even today the stakeholders have no idea about future of DTT in the country. Vital spectrum, which is precious country resources has neither been optimally used nor made spare to be effectively used for other services. The value attached with spectrum used is lost with every passing day and cannot be subsequently compensated. Therefore,

everyone must clearly recognize its importance and due care must be taken for its efficient use. The Authority is therefore strongly feels that given enormity of the network, it would be impossible for a single entity to plan and roll out nationwide DTT network and services. The Authority had in 2005 recommended to open terrestrial TV broadcasting to private operators. It further recommended opening of terrestrial sector for Mobile TV Broadcasting in 2008. Timely consideration of these recommendations and issue of appropriate policy framework would have helped the terrestrial TV sector in India to progress in tandem with international trends. The Authority is therefore of the view that it is high time proactive measures are taken towards digitization of terrestrial TV sector to realize the overall objectives of Digital India.

3.60 In order to ensure effective implementation of DTT in the country, we must focus on previous lessons for drawing a DTT implementation roadmap. Different approaches have been adopted world over for digitization of analog terrestrial TV broadcasting while the simulcast approach has been preferred by most countries. The cost of simulcast approach is higher as it involves operating both analog and digital network requiring more resources during the transition period. It may also be possible to switch off analog services immediately with the launch of DTT if proper eco-system is developed timely. This would however require necessary eco system for DTT services such as TV receiver, STBs and services etc are put in place by the stakeholders well in advance so that consumers are not put to any inconvenience. The Ministry of Information and Broadcasting may devise a policy framework for creation of DTT ecosystem in coordination with the Ministry of Electronics and Information Technology and equipment manufactures for the smooth DTT rollout.

3.61 In case digitization happens and analog switch off does not take place, the spectrum will not become available even after digitization. Though DTT implementation has been initiated in the country, but detailed analog switch off plans for the areas where DTT services have been

introduced or planned are yet to be formulated. This is adversely affecting the process of digitization.

3.62 It is pertinent to mention that in case of Cable TV Services, India has achieved a significant digitalization which is expected to be completed by 31st March 2017 with completion of Phase IV. This exercise was planned in phases and for each phase analog switch off date was mandated. This clear roadmap has helped the stakeholders to plan and create required eco system for smooth digitization of cable TV sector. A similar approach may be useful to ensure that digitization of terrestrial TV sector takes place in a time bound manner. It is therefore essential that a roadmap for DTT implementation formulated on any criteria may also mandate analog switch off date(s).

3.63 International scenario for the DTT implementation reveals that most of the countries have taken 5-10 years for the complete switch over from the analogue to DTT regime. 'Going Digital' sub group in 2006 made its recommendation for DTT implementation by 2013. Such long time duration was proposed by the subgroup in view of the complexities involved in its implementation. India is a vast country with varied geographic and demographic profile. Therefore phased wise approach would ensure DTT implementation in a smooth manner. While providing any roadmap for analog switchoff, due care must be taken to ensure that the target is achievable and takes into consideration ground realities. Considering the length and breadth of the country, the roadmap for digitization of terrestrial network may be done in three phases with complete switch off of analog terrestrial TV service by December, 2023. While recommending switch off dates, the Authority has given due importance to the time frame prescribed by 'Going Digital' sub group and has recommended a time frame of 8 years for complete analog switch off as counted from now.

3.64 The Authority is aware that DD has already set DTT transmitters in the metro cities and commenced DTT services on pilot mode. Therefore, the

Authority is of the view the DTT may be implemented across country in three phases. In the first phase, DTT services may be rollout in all metro cities by 2019 and analog terrestrial transmission should be switched off. A minimum overlap of three months must be provided as simulcast period for migration and analog to DTT platform. Accordingly DTT services must be implemented in all metro cities by September 2019. The implementation of DTT will be meaningful only if necessary eco-system is created for availability of STBs, Mobile Phones and Integrated TV receiver. In Phase II, all cities having population more than 10 lakh as per Census 2011 may be completed by 2021 and the rest of India by 2023.

3.65 Implementation of DTT is a mammoth exercise requiring the involvement of various stakeholders such as Government, broadcasting companies (content producers, broadcasters and network operators), manufacturers and viewers. Therefore there is a need to have a well coordinated approach and planning for execution of this project in a time bound manner. The Authority is of the view that a Coordination Committee may be set up by the Ministry of Information and Broadcasting for spearheading this exercise as a mission mode project to ensure creation of a facilitating environment. Representatives from Department of Telecommunications, Wireless Planning and Coordination Wing, Ministry of Electronics and Information Technology, Prasad Bharati, Broadcast Engineering Consultants India Ltd., broadcasters, content owners, equipment manufactures and Domain experts may be included in the Committee so as to bring in synergy in the development and implementation of DTT.

3.66 **The Authority recommends:**

(i) **Digital Terrestrial transmission may be implemented in the country in three phases with complete migration and analog switch off by December 2023.**

(ii) **Phase wise DTT migration and analog switch-off may be done as per the timelines prescribed below:**

Phases	Timeframe
Phase-I (Metro cities)	**31st December, 2019**
Phase-II (Cities having more than 10 lakh population as per Census 2011)	**31st December, 2021**
Phase-III (Rest of India)	**31st December, 2023**

(iii) **A minimum overlap of three month must be provided as simulcast period for migration from Analog to digital platform before analog switch off.**

(iv) **In order to create a supportive eco-system, Ministry of Information and Broadcasting along with Ministry of Electronics and Information Technology may devise policy framework to make available DTT complaint devices.**

(v) **A Coordination Committee may be set up by the Ministry of Information and Broadcasting to steer implementation of DTT as a mission mode project to ensure creation of a facilitating environment and timely completion.**

Chapter 4

Summary of Recommendations

1) **The Authority recommends introduction of DTT services throughout the country in a time bound manner.**
2) **Private players should be permitted to provide DTT services along with the public service broadcaster.**
3) **The eligibility conditions of private DTT operators, licensing conditions and other modalities for entry of private players would be worked out by the Authority after the Government has taken a policy decision in this regard.**
4) **Implementation of DTT services in the country in Hybrid mode having main transmitter in MFN and gap fillers in SFN. This will facilitate provision of local content as well as rich bouquet of services.**
5) **Public broadcaster may be permitted to operate maximum three transmitters (8 MHz X 3) at a given location out of which one (8 MHz) may be exclusively used for provision of mobile TV services.**
6) **Private broadcasters may be permitted to operate maximum four transmitters (8 MHz X 4) at a given location subject to availability of spectrum.**
7) **Maximum number of DTT providers may be capped at five (one public broadcaster and four private broadcasters) as per availability of spectrum.**
8) **Ministry of Information and Broadcasting in consultation of WPC of DoT and other technical agency such as BECIL may carry out comprehensive frequency planning for roll out of DTT services in time bound manner such exercise should be completed within a period of six months to ensure that the roadmap for digitization of terrestrial network and introduction of DTT services as suggested by the Authority could be planned and implemented.**
9) **The term and condition regarding allocation of spectrum to DTT operators, frequency slots for auctions, Reserve price etc. will be given by the Authority once these recommendations are accepted by the government.**

10) **Allocation of spectrum should be done in time bound manner so that spare and unutilized spectrum in band IV and band V can be put to effective use.**

11) **Transmission Network Model is an appropriate model for implementing DTT service in the country.**

12) **The Authority will come out with the detailed guidelines for sharing of infrastructure, and other implementation modalities once a policy decision is taken by the Government in this regard.**

13) **Digital Terrestrial transmission may be implemented in the country in three phases with complete migration and analog switch off by December 2023.**

14) **Phase wise DTT migration and analog switch-off may be done as per the timelines prescribed below:**

Phases	Timeframe
Phase-I (Metro cities)	31st December, 2019
Phase-II (Cities having more than 10 lakh population as per Census 2011)	31st December, 2021
Phase-III (Rest of India)	31st December, 2023

15) **A minimum overlap of three month must be provided as simulcast period for migration from Analog to digital platform before analog switch off.**

16) **In order to create a supportive eco-system, Ministry of Information and Broadcasting along with Ministry of Electronics and Information Technology may devise policy framework to make available DTT complaint devices.**

17) **A Coordination Committee may be set up by the Ministry of Information and Broadcasting to steer implementation of DTT as a mission mode project to ensure creation of a facilitating environment and timely completion.**

List of Acronyms

Abbreviation	Description
ADBT-T	Advanced Digital Television Broadcasting - Terrestrial
ASO	Analog Switch Off
ATSC	Advanced Television System Committee
DD	Doordarshan
DMB-T	Digital Multimedia/TV Broadcasting- Terrestrial
DPOs	Distribution Platform Operators
DTH	Direct to Home
DTMB	Digital Terrestrial Multimedia Broadcasting
DTT	Digital Terrestrial Transmission
DVB	Digital Video Broadcasting
ETSI	European Telecommunications Standards Institute
FTA	Free-to-air
HD	High Definition
HITS	Headend-in -the-Sky
HPTs	High Power Transmitters
IMT	International Mobile Telephony
IPTV	Internet Protocol Television
ISDB-T	Integrated Service Digital Broadcasting Terrestrial
ITU	International Telecommunication Union
LCOS	Local Cable Operators
LOS	Line of Sight
LPTs	Low Power Transmitters
MFN	Multi Frequency Network
MIB	Ministry of Information and Broadcasting
MSOs	Multi-System Operators
NFAP	National Frequency Allocation Plan
NTSC	National Television System Committee
OTT	Over the top
PAL	Phase Alternating Line

PB	Prasar Bharati
PLPs	Physical Layer Pipes
PPP model	Public Private Partnership Model
SD	Standard Definition
SECAM	Sequential Couleur Avec Memoire (Sequential Color Memory)
SFN	Single Frequency Network
STB	Set top box
TEC	Telecom Engineering Centre
TRAI	Telecom Regulatory Authority of India
UHD	Ultra High Definition
UHF	Ultra high frequency
VHF	Very high frequency

Annexure- I

Digital Terrestrial Television Broadcasting Standards

1. ***Digital Video Broadcasting (DVB-T) standards*:** These standards were developed by the Digital Video Broadcasting (DVB) Group formed by the European broadcast industry. It replaced the PAL and SECAM analog standards which were earlier used in Europe and some other countries. The first generation digital video broadcasting standard for terrestrial transmission (DVB-T) was developed in the 1990s. DVB-T was an open standard wherein several television channels are bundled to form a programme multiplex which is then fed to a DVB-T transmitter working on a unique frequency band as used in analog broadcasting including 7 and 8 MHz bandwidth. The total data capacity of DVB-T allows broadcasting of a multiplexed signal that may contain 4 to 6 standard definition TV television channels. The capacity can also be utilized to broadcast 1 or 2 multiplexed TV channels in HDTV quality. Introduction of HDTV services over DTT proved to be a major attraction for making DVB-T services popular which then resulted in increased demand for such services.

2. Though DVB-T was not specifically designed to cater for mobile and handheld reception, a DVB-T transmission can be configured to make it robust, thereby making it an apt choice for mobile TV. The DVB group in 2004 also developed a specific transmission standard for mobile TV known as DVB-H, Digital Video Broadcasting for Handheld devices. It was specifically oriented towards taking into account the challenges such as difficult receiving conditions, limited power availability, smaller resolution etc. to provide mobile TV services on smaller hand held devices. The standard was designed in such a manner that it was compatible with DVB-T and a DVB-T transmitter could broadcast both static and mobile TV channels if need be. DVB, in 2011 also came up with the DVB-SH standard for Digital Video Broadcasting Satellite services to handheld devices (SH) below 3 GHz. The DVB-H and DVB-SH

systems did not gain much popularity as they necessitated the setting up of new infrastructure, integration of DVB-H chipset in mobile receivers and required new business models to make it commercially viable.

3. ***Second Generation DVB-T2 Standard:*** An ever increasing demand for capacity to provide more HD quality services triggered the development of the next generation of a digital terrestrial system standard called second generation DVB-T2. The DVB-T2 specification was published by ETSI in September 2009. This standard uses the latest compression technologies in order to achieve higher data rates, thereby providing even greater capacity. It is the world's most widely adopted and deployed digital terrestrial television (DTT) system standard that offers even greater robustness and flexibility with 50% higher efficiency than any other DTT system. It also supports SD, HD, UHD, mobile TV, radio, or a combination of any of these thereof. One excellent feature of DVB-T2 is that it allows for a separate adjustment of the robustness of each delivered service within a common frequency channel of 7/8 MHz in order to meet the required reception conditions (for example in-door or roof-top antenna) by dividing it into Physical Layer Pipes (PLPs). It also allows receivers to save power by decoding only a single service rather than the entire multiplex of services thereby making it suitable for reception on smaller handheld devices. In 2011, DVB added another extension known as T2-Lite to the DVB-T2 profile in order to support mobile and portable TV and further reduce the cost of implementation[14]. Elements relevant to mobile and portable reception have been included in the T2-Lite subset and the data rate is restricted to 4 Mbps per PLP while the implementation (chipset) complexity has been reduced by half. So far, over 70 countries have already deployed DVB-T services and 69 countries have adopted or deployed DVB-T2. DD has adopted this standard for its DTT implementation.

[14] http://www.dvb.org

4. ***Integrated Service Digital Broadcasting Terrestrial (ISDB-T):*** The ISDB-T system was developed in Japan to provide flexibility, expandability, and commonality for multimedia broadcasting services using terrestrial networks. ISDB-T system adopted band segmented transmission wherein the standard Channel bandwidth is divided into 14 segments. The segments can then be combined and configured to offer different kind of services targeting different devices while catering for differing receiving conditions. The Japanese digital terrestrial broadcasting system was standardized in 2001. ISDB-T services are already operational in Japan since 2003. In 2007, an enhancement to ISDB-T was developed and standardized, called ISDB-T international which uses the latest compression standards and has also been adopted by ITU. The standard has now been adopted by 18 countries and services already deployed in nine countries[15].

5. ***Advanced Television System Committee (ATSC):*** American ATSC is a digital extension of the analog NTSC standard. This broadcasting system for digital television transmission was developed in the early 1990s aiming at transmission of HDTV and SDTV formats. It is significantly different from DVB-T and ISDB-T standards which have some similar features. International adopters of the ATSC standard include Canada, Dominican Republic, El Salvador, Guatemala, Honduras, Mexico, and South Korea. Currently ATSC 1.0 digital TV standard is implemented and the next generation standard referred as ATSC 3.0 is close to being finalized[16].

6. ***Digital Terrestrial Multimedia Broadcasting (DTMB):*** It is a Chinese standard for terrestrial digital television broadcasting. Ratified in 2006 it became the mandatory Chinese national standard in 2007. DTMB is a combination of a single carrier system known as the Advanced Digital Television Broadcasting-Terrestrial (ADBT-T) and the multicarrier modulation system known as the Digital Multimedia/TV Broadcasting-

[15] http://www.dibeg.org
[16] http://www.atsc.org

Terrestrial (DMB-T). The DTMB standard simultaneously provides terrestrial TV channels and portable services including multimedia services and displays similarities with both DVB-T and ATSC. The next generation of DTTB system with higher data rates and better performance to support both existing services and UHDTV is on the horizon.

7. ***Mobile Terrestrial TV Broadcasting Standards:*** Mobile TV is the transmission of TV programmes or video for the devices such as cellular phones, PDAs, and wireless multimedia devices. Several standards were developed for reception of broadcasting services on mobile devices. These included DVB-H, DMB, MediaFLO, ISDB-OneSeg, and ATSC-M/H. Among them, commercial service of Terrestrial DMB (T-DMB) was launched in Korea for the first time to provide mobile multimedia services in 2005. These technologies were broadly of two types one based on the legacy DTT technology such as ISDB-OneSeg and ATSC-M/H, and the other such as DVB-H and MediaFlo were new dedicated broadcast technologies specifically developed for receiving broadcast TV on mobile phones and hand held devices. DVB-H and MediaFLO were launched commercially in several countries. But the challenges mobile broadcast TV faced have exceeded the benefits. There was no global standard for mobile broadcast TV; instead regions adopted different broadcast technologies, which in turn required different mobile handset specifications which made mobile device makers less inclined to develop compatible handsets. This is also limited the addressable audience for each technology, making it harder to offer products at scale. T-DMB and OneSeg broadcast mobile services however remain popular in South Korea and Japan.