TELECOM REGULATORY AUTHORITY OF INDIA

Draft Recommendations

On

Growth of Broadband

17th September , 2007

Mahanagar Doorsanchar Bhavan
Jawahar Lal Nehru Marg
New Delhi-110002.

CONTENTS

PREFACE

Broadband is high speed; always-on Internet access, which is widely recognized as catalyst for economic and social development of a country. Broadband not only enables people to surf Internet, but also provide access to enormous knowledge bank, to do business more efficiently, be better educated, have access to e-health services, benefit from better governance and enjoy enhanced entertainment. Availability of Broadband services at affordable tariff can have significant impact on Gross Domestic Product (GDP) and attract new investment as well as generate more employment in addition to increase in productivity.

The Authority recognising the importance of broadband forwarded its recommendations on "Accelerating Growth of Internet and Broadband penetration" in April 2004 to Government. Some of the recommendations were accepted by the Government and based on these recommendations Government announced Broadband Policy in November 2004, which also envisaged broadband subscribers growth pattern.

The Authority observed that even after taking various initiatives to increase the growth of broadband, the expected growth of broadband did not take place. The Authority felt an urgent need to identify various impediments affecting growth of broadband and to adopt a forward looking approach. Various methodologies to provide broadband have been analysed keeping in view the constraints and present regulatory framework. Efforts have been made to identify all possible options to boost the broadband growth.

In order to achieve higher growth of broadband, the Authority has undertaken an in-house study and has framed its draft recommendations to promote broadband penetration. These recommendations are available on our website (www.trai.gov.in). All the stakeholders are requested to offer their comments on the draft recommendations. The written comments of the stakeholders are invited by 28th September 2007. In case of any clarification/information please contact Sh. S. K. Gupta, Advisor (Converged Network), Tel.No.+91 11 23217914, Fax: +91 11 23211998 or email at skgupta@trai.gov.in or guptask61@gmail.com .

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Chapter 1

Background

1.1 Internet Services in India were launched on 15th August 1995 by Government of India through Videsh Sanchar Nigam Limited (VSNL). The government recognized need for encouraging spread of Internet in the country. In November 1998 the Government opened the sector to Private Operators for provisioning of Internet Services. The License conditions for providing Internet services were liberal with no License Fee and allowed unlimited number of players for delivering this service. ISPs could decide their own tariffs plans and can even setup their own International Gateways.

1.2 More than 95% subscribers were using dialup access at that time. The speed of such dialup connection was limited to approximately 56 Kbps only. Initially the subscriber base grew more than 200 percent per year, from 0.28 millions in March 1998 to 3.04 millions by March 2001 due to supportive government policy and entry of large number of private players resulting in lower Internet tariffs boosting subscribers' growth. However, from April 2001 onwards, the growth rate started declining and reduced to just 7% at the end of March 2003.

1.3 Meanwhile, ISPs were allowed to offer IP telephony Services with effect from April 1, 2002. Some other applications like music & video download, online gaming also became popular. Such applications required more bandwidth that could not be catered by dialup access. Therefore service

providers started providing always on high-speed Internet access (more than 64 Kbps connection) using technologies like DSL, Cable TV, Wireless, and Ethernet LAN etc. With the induction of always on high-speed Internet access services annual growth rate increased to 25% by the end of March 2004. The Authority recognised the increasing penetration of high-speed Internet access world over.

1.4 TRAI circulated consultation on "Accelerating Growth of Internet and Broadband Penetration" to encourage broadband growth in the country in November 2003. TRAI sent its recommendation on "Accelerating Growth of Internet and Broadband Penetration" to Government on 29th April 2004. Subsequently, Department of Telecom issued Broadband Policy in October 2004. The Broadband Policy announced by the government has taken into consideration most of the recommendations sent by TRAI. The detailed status of TRAI's recommendations is attached at annex I.

1.5 The Broadband Policy announced by Government of India has defined the Broadband as **" An `always-on' data connection that is able to support interactive services including Internet access and has the capability of the minimum download speed of 256 kilo bits per second (kbps) to an individual subscriber from the Point of Presence (POP) of the service provider intending to provide Broadband service where multiple such individual Broadband connections are aggregated and the subscriber is able to access these interactive services including the Internet through this POP. The**

interactive services will exclude any services for which a separate license is specifically required, for example, real-time voice transmission, except to the extent that it is presently permitted under ISP license with Internet Telephony'. The projected growth for Broadband and Internet subscribers in the country was envisaged as under:-

Year Ending	Internet Subscribers	Broadband Subscribers
2005	6 million	3 million
2007	18 million	9 million
2010	40 million	20 million

Table-1: Broadband targets

1.6 Department of Telecommunications (DoT) also set a target for Broadband coverage for all secondary & higher secondary schools, all public health care centers by the year 2007 and coverage of all Grampanchayats by the year 2010.

1.7 Growth of Internet and Broadband Penetration has not been as per the expectations. As on 31st December 2005 the total Internet users in the country were 6.70 million including 0.9 million Broadband subscribers. Thus, the target for Internet users was achieved but the target for Broadband subscriber could not be achieved. Further at the end of March 2007, the Internet subscribers are 40.57 million and broadband subscribers are just 2.34 million.

1.8 The details of Internet and broadband subscribers are shown in table-2 below:

Subscribers	As on Dec. 2004	As on March 2005	As on March 2006	As on March 2007
Internet	5.45 million	5.55 million	6.94 million	9.27 million
Broadband	0.05 million	0.18 million	1.35 million	2.34 million
Wireless Internet (through mobile handsets)	--	--	--	31.30 million

Table-2: Internet and Broadband Subscribers

1.9 Table-2 indicates an annual internet subscribers' growth of around 20-30% in previous two years excluding wireless internet users. It may be important to mention that 31.30 million subscribers are accessing Internet through wireless networks (GSM/CDMA) of Unified Access Service Providers (UASPs) and Cellular Mobile Service Providers (CMSPs). Therefore the growth of Internet subscribers is satisfactory but we are seriously lagging behind on broadband front. The broadband subscriber growth initially (during 2005-06) was high (more than 600 %) but subsequently declined to an annual growth of just 60-70%. The high growth rate was largely due to very few broadband subscribers i.e. a narrow base. The targets fixed for the Broadband Policy are unlikely to be achieved. There are critical issues inhibiting broadband expansion in urban as well as rural areas. They need to be addressed urgently to facilitate expansion of broadband services in urban as well as rural areas.

1.10 The urgency to provide impetus to the growth of Broadband is recognised at the highest level and the Government has declared Year 2007 as 'Year of Broadband'.

1.11 In order to fuel the growth of Broadband in the country, the Authority identified certain impediments affecting growth of broadband and sent its recommendations to Department of Telecommunications. Some of the steps already taken by the Authority for increasing growth of broadband are following :

1.11.1 TRAI recommended in March 2003 that ISPs should be allowed to use any media (including fiber, radio and copper cable), for establishing last mile to their customers.

1.11.2 Recognising the need to reduce Internet bandwidth cost, TRAI fixed ceiling tariffs for Domestic Leased Line and International Private Leased Circuits (IPLC). Cost of IPLC is one of the major inputs for providing Broadband and impacts broadband tariff.

1.11.3 The Authority recognised high cost of International Internet bandwidth as one of the impediment and sent its recommendations on 16th December 2005 on Measures to Promote Competition in IPLC.

1.11.4 The Authority sent recommendations on "Terms and conditions of Resale in IPLC" on 23rd March 2007 and also issued Regulation on "International Telecommunication Access to Essential Facilities at Cable Landing Stations" on 7th June 2007. This is crucial as decrease in international Bandwidth charges will bring down the Broadband charges as international bandwidth charges account for approx. 65% of total cost for providing Broadband services.

1.11.5 The Authority in its recommendations on "Allocation and pricing of spectrum for 3G and broadband wireless access services" dated 27th September 2006 recommended the mechanism and pricing of Spectrum for Broadband Wireless Access. As per the recommendation, government has been requested to allocate 200 MHz of spectrum in 3.2 to 3.4 GHz band to facilitate wireless operation of 12 ISPs in a circle. One slot has been reserved to be allocated to smaller ISPs on city basis with intention to give boost to broadband penetration in smaller cities/ rural areas.

1.11.6 The Authority has also sent its Recommendations on "Improvement in the effectiveness of NIXI" on 20th April 2007. The initiative would substantially bring down ISP's expenditure on bandwidth, which is likely to reduce content download charges resulting in net reduction in Internet and broadband usage charges. It is hoped that implementation of these recommendations will enable ISPs to effectively use NIXI platform for exchange of domestic traffic encouraging web hosting services in India. It will also result in better Quality of Service (QoS) of Internet and broadband services in India.

1.12 The Authority notes with concern that many of the suggested measures are yet to be implemented. The growth of broadband remains sluggish. Only 0.47 million broadband subscribers have been added in first six months of 2007, which is far below the growth trend required to achieve broadband policy targets. This necessitated an analysis of regulatory & policy frameworks and to formulate new approach necessary for rapid rollout of Broadband in

urban and more so in less remunerative rural areas. A forward looking approach to provide impetus to growth of broadband in the country is critical. Various methodologies to provide broadband have been analysed keeping in view the present constraints. Efforts have been made to identify all possible options to boost the broadband growth.

1.13 The in-depth examination of the subject and recommendations have been structured in chapters two to five. Chapter 2 on "Present Status" provides overview of the existing broadband scenario. Chapter 3 on "Recent Developments" discusses technological and policy developments. Chapter 4 on "Technologies for providing Broadband" provides status of existing technologies. Chapter 5 deals with impediments to growth of broadband in Rural & urban areas and steps required to overcome these impediments. Chapter 6 is compilation of recommendations to provide impetus to the broadband penetration in the country.

1.14 It is hoped that TRAI's call for emergent measures will generate time bound action program and policy & licensing issues, which are obstructing broadband growth, will be addressed on priority.

Chapter 2

Present Status

2.1 The number of Broadband subscribers was 2.34 millions on 31st March 2007. Out of these 1.94 million are DSL; 0.24 million Cable Modem; 0.08 Ethernet LAN; 0.02 Fiber; 0.02 Radio based customers. Following chart (fig.- 1) provides various Technology trends for Broadband access: -

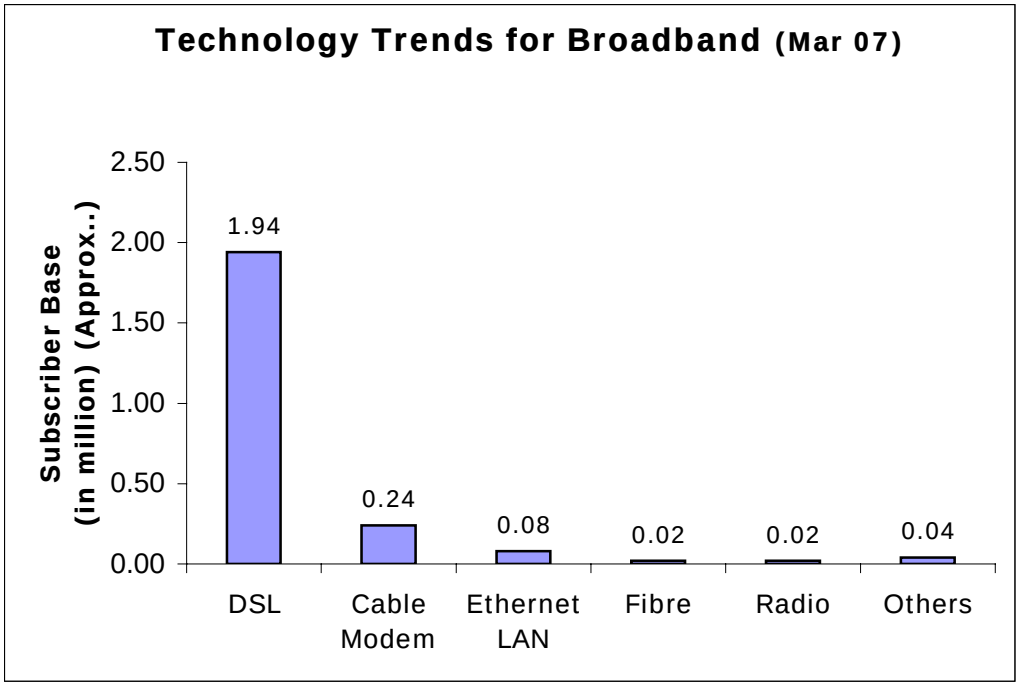

Figure 1: Technology trends for Broadband

Indian broadband market is dominated by DSL technology with 83 % share as compared to 10% of Cable, 3.4% of Ethernet LAN and 1% of Fibre.

2.2 Figure 2 below provides international trends for Broadband access technologies:

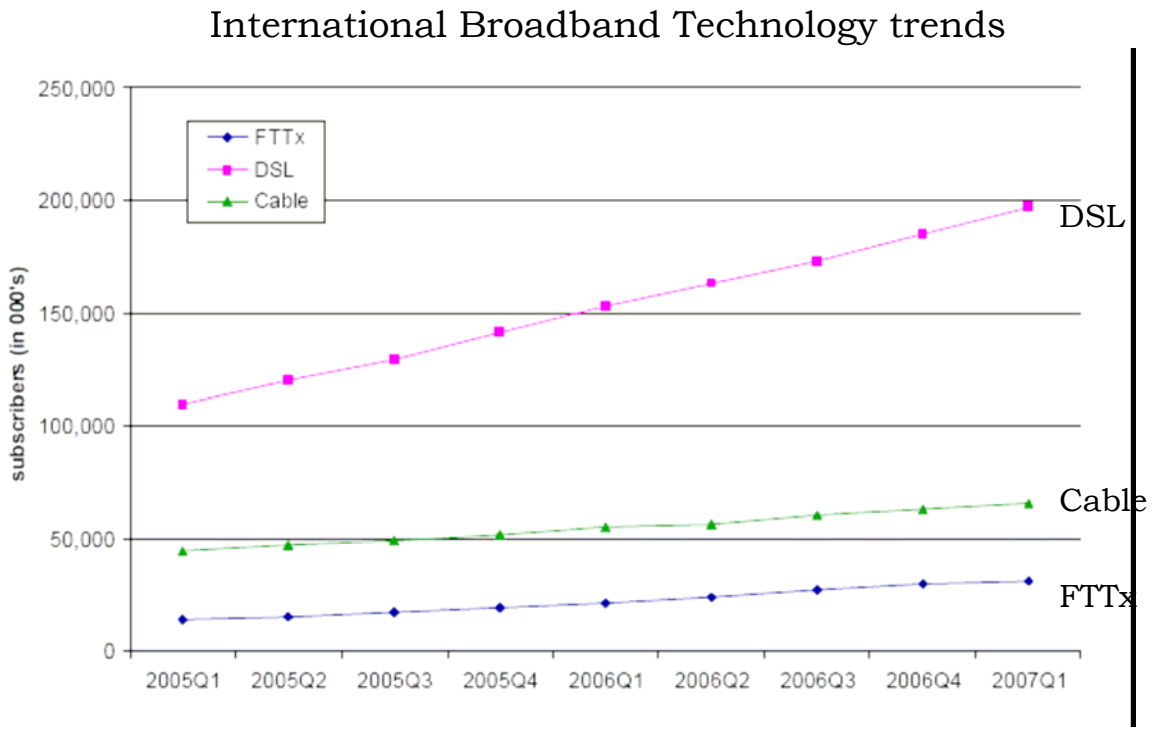

Figure 2: **International Broadband Technology trends**

International Broadband Technology trends indicate that overall market share of DSL is 66.1% compared to 20.3% of cable modem and 10.7% of FTTx while other technologies account for 2.9% market share. This clearly indicates that DSL over copper loop is the dominant technology worldwide for providing broadband. In India also the share of DSL is quite large as compared to other technologies. However, the development of cable modem and fibre network for broadband is very small.

2.3 TRAI in its recommendation on "Accelerating Growth of Internet and Broadband Penetration" dated 29th April 2004 recommended for unbundling of local loop. This recommendation has not been accepted by the Department of Telcom.

2.4 The Broadband Policy-2004 had estimated that there are more than 40 million cooper loops in the country with BSNL and MTNL. Out of which 14 million loops are in rural areas. The cooper cable network of these operators is a combination of old and new cables. Therefore, it is estimated that initially around 25-30% of the 26 million-cooper loops in urban area (Approx. 8 million) could be leveraged for providing broadband services by both the incumbents i.e. BSNL and MTNL.

2.5 BSNL and MTNL were supposed to provide 1.5 million broadband connections by the end of year 2005 (50% of overall target) whereas actually they could provide only 0.5 million i.e. only 33% of the target fixed for them. Even at the end of March 2007 BSNL and MTNL together have provided just 1.45 million broadband connections using DSL technology. As such available copper loop to provide broadband connections have not been effectively utilised.

2.6 At present BSNL and MTNL are having almost 60% market share but they are much behind overall targets as stipulated in the Broadband Policy.

2.7 As already mentioned approx. 8 million cooper loops available with incumbents in urban areas could be leveraged for broadband services. TRAI in September 2006 has written to all service providers to maintain waiting list of subscribers who want broadband connection. It is learnt that many subscribers have already registered to get broadband services from the incumbent. However, broadband could not be provided either due to shortage of ports or non availability of services in their area. The delay

in deploying/rolling out broadband by BSNL and MTNL is mainly due to nonavailability of equipments.

2.8 The tariff for broadband services has come down drastically from Rs.1500/ per month in 2004 to Rs. 200/- a month in 2007. Most of the operators are charging broadband rental between Rs 200/- to Rs 600/- and providing various options for content downloading. Except unlimited packages the download charges range from Rs.0.70 to Rs.1.50 per MB. Some of the companies are already offering broadband services having zero rental schemes. However, in such schemes per MB download charges are comparatively high i.e. ranging from Rs.1.50/- to Rs.2/- per MB. Inspite of affordable tariff, the growth has been poor.

2.9 There are 5.58 million dialup internet subscribers at the end March 2007, out of which 4.7 million are the subscribers of integrated service providers (UASLs and BSOs having ISP license). Since dialup cost is comparatively high, such subscribers should have migrated to broadband. As the service providers are also providing broadband services using DSL, the 4.7 million dialup subscribers can easily be migrated to broadband by integrated service providers. However, the migration is negligible, perhaps mainly due to non-availability of broadband service in these areas.

2.10 Cable modem is another technology for providing broadband and there are only 0.25 million broadband connections over cable TV at the end of March 2007. The number is meager looking at the present 71 million Cable

TV subscribers in India, out of which 10% i.e. 7 million can be utilised for broadband access. This also indicates under utilisation of available cable TV network for providing broadband service.

2.11 International trends indicate that broadband over fiber is growing rapidly. However in India growth of broadband over fiber is very limited and there are only 0.02 million subscribers using this technology at the end of March 2007. Due to high cost of leasing fiber, it is mainly used for high capacity Internet bandwidth requirements.

2.12 Wireless technologies can also provide broadband but spectrum has not been allocated either for 3G or CDMA Rev. 1. Therefore the speed provided by wireless networks at present is less than 256 kbps and such wireless subscribers are not counted as broadband subscribers.

Chapter 3

Recent Developments

3.1 **Wireless Fidelity (WiFi)**

3.1.1 Wireless fidelity is a term used for certain type of wireless local area networks, which use specifications in the 802.11 family. The term WiFi was created by an organization called WiFi Alliance. A wireless local area network (WLAN) uses electromagnetic waves to transmit and receive data over short distances by establishing an Access Point. Wireless LAN's are most commonly used in last mile to provide coverage for few hundred meters as diffusers of a broadband connection. WiFi technology can also be used for providing broadband access over longer distances in rural areas by increasing power levels of the equipment.

3.1.2 IEEE 802.11b is the most popular WLAN technology for public hotspot access in the world. It can operate in the unlicensed 2.4 GHz radio bands with maximum 11 Mbps speed. In addition to 802.11b, the 802.11 product family now also includes 802.11a which operates in 5 GHz band with maximum data speed of 54 mbps. A new technology in 802.11 family is 802.11g which can support speed upto 54 Mbps but operates in 2.4 GHz frequency, making it backward compatible with the enormous 802.11b installed base. WiFi Alliance, a nonprofit international association, test and certify the interoperability of WLAN products based on IEEE 802.11 specification.

3.1.3 Primarily, WiFi was used in office environments and corporate campuses to provide connectivity to portable devices such as laptop computers all across the campus. Recently it is being utilised as commercial hotspot solutions that offer wireless connectivity in public locations, such as airports, train stations and convention centers as well as commercial locations such as coffee shops and hotels.

3.1.4 WiFi mesh networks are being implemented to offer portable and nomadic broadband services. Mesh connectivity can provide high speed, good quality coverage. The rollout time for such networks is also low.

3.1.5 Cities of Philadelphia, Chicago and San Francisco in USA, are deploying WiFi mesh networks for providing wireless connectivity across the city. In India also cities of Bangalore and Pune have prepared plans to become WiFi enabled.

3.1.6 For implementing WiFi in access networks backhaul is a major bottleneck. WiMAX can be utilised as a suitable technologies for back haul. However, the availability of spectrum for WiMAX is both uncertain and limited.

3.1.7 Interference can also be an issue while using unlicensed band of 2.4 GHz for WiFi devices as it is also used by many other devices like cordless phones, microwave ovens and wireless local loop (WLL) radio systems. WiFi allows for a throughput speed of 11 Mbps under optimal conditions. When the amount of interference or distance between

radios increases, the maximum connection speeds also decrease.

3.1.8 Security is one of the main concerns for wireless networks, since radio signals traveling through the open atmosphere and can be intercepted by individuals. Therefore strong customer management (user ID and password) and encryption management are necessary for operation of successful wireless networks. Most enterprise-level WiFi networks enable 802.1x features that automatically secure the network.

3.1.9 The WiFi Alliance, the IEEE 802.11 standards committee and many WiFi members are working to develop new security standards such as 802.11i and 802.1x. These new security standards use advanced encryption technologies such as AES and TKIP, as well as secure key-distribution methods to secure such networks.

3.2 **Worldwide Interoperability for Microwave Access (WiMAX)**

3.2.1 WiMAX (Worldwide Interoperability for Microwave Access) is a high speed wireless technology that supports fixed, nomadic, portable and mobile access.

3.2.2 WiMAX is based on the IEEE 802.16 standard and on ETSI HiperMAN. Fixed WiMAX is based on an older version of IEEE 802.16 standard, (802.16-2004 previously known as Revision D, or 802.16d), that was ratified in July 2004. It is claimed that WiMAX can provide speeds upto 14.4 Mbps and likely to support much higher speeds with further advancement. WiMAX as claimed can provide a coverage

upto 50 Kms in line of sight (LoS) environments and 15 Kms in non line of sight environments. Due to support for higher speeds, wider coverage and ease of installation, WiMAX is considered one of the promising technology to provide high speed internet.

3.2.3 There is a newer version of WiMAX optimized for dynamic mobile radio channels called mobile WiMAX, which is based on the IEEE 802.16e standard and provides support for handoffs and roaming. It uses Scalable Orthogonal Frequency Division Multiplexing Access (SOFDMA), a multi-carrier modulation technique that uses sub-channelization. Service providers that deploy 802.16e can also use the network to provide fixed service.

3.2.4 WiMAX as a technology is capable to provide complete solution for broadband services (i.e. access as well as backhaul). WiMAX has two different versions

i) 802.16d used for backhaul
ii) 802.16e used for access network

3.2.5 The WiMAX Forum is an industry-led, not-for-profit organization formed to certify and promote the compatibility and interoperability of broadband wireless products based upon the harmonized IEEE 802.16/ETSI HiperMAN standard. WiMAX Forum goal is to accelerate the introduction of these systems into the marketplace. WiMAX Forum Certified products are fully interoperable and support broadband fixed, portable and mobile services. To date, approximately 30 fixed wireless broadband network products have attained certification.

3.2.6 WiMAX technology is gaining attention initially to augment fixed broadband (DSL and cable) with wireless capabilities for nomadic and portable operations, and as a means for providing broadband service in areas where it is expensive and uneconomic to implement wired solutions. The technology is also being incubated as a backhaul technology for mobile networks and point-to multipoint broadband connectivity.

3.2.7 For providing broadband, combination of WiMAX in backhaul and WiFi in access an option. However, very limited spectrum is made available for WiMAX at present.

3.2.8 The Government has recently de-licensed 50 MHz spectrum in 5.825-5.875 GHz band for WiMAX giving boost to WiMAX deployments. Some of the service providers have already initiated action to provide broadband using this spectrum.

3.3 **Direct to Home (DTH)**

3.3.1 Another technology that can also be utilized as the medium for last mile access for broadband connections is by using Direct to Home (DTH) TV transmission. DTH is presently meant for broadcasting of TV channels only. However it can be utilised for downlink path for providing broadband connections also. Uplink (connectivity to the ISP equipment/ node) in this type of service would be an independent connection most likely through dial-up/GPRS/EDGE connection. Such connections will generally require allocation of fixed IP address and are capable to provide sufficiently high downlink bandwidth. Figure 3 shows typical setup for provisioning of broadband through DTH:

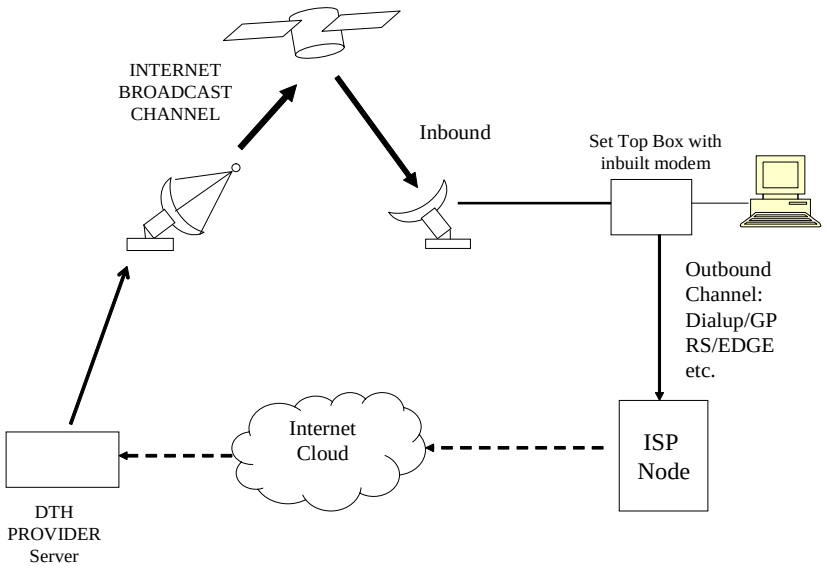

Figure 3: Broadband through DTH

3.3.2 Broadband through DTH is a viable option for both urban and rural areas if broadband uplink cost is reasonable. Some telecom service providers are planning to provide broadband through DTH in near future. Cost of uplink (dialup, GPRS, EDGE) is the main issue to determine success and popularity of this option.

3.3.3 Availability of transponders in the identified Geo stationary satellite area is also one of the constraints to provide broadband using DTH. High attenuation during rain impacts QOS. These issues need to be considered while DTH option is explored to provide broadband

3.4 **Broadband Initiatives by USO**

3.4.1 Apart from technological developments as discussed above, various government agencies have also taken initiatives to increase broadband penetration.

3.4.2 First such initiative came from government in 2006 when it amended Indian Telegraph Act to extend USO Fund support for rolling out broadband services in rural areas.

3.4.3 The plan envisages provision of Broadband connectivity to villages in a phased manner. For this purpose service providers may deploy Pilot projects for Induction of new technological developments in the telecom sector in rural and remote areas. Such projects will be submitted to USO Fund Administrator for evaluation and if found suitable may be supported with the approval of the Central Government.

3.4.4 It has been envisaged that broadband can be provided using 3G, other wireless technologies, existing copper or optical fiber network. With USO fund assistance, 10000 towers are being established for provisioning of mobile services. Three service providers have already been identified to ride in 81 selected clusters to provide 2G services. These towers can be effectively utilized to provide broadband services also.

3.4.5 USO Fund administrator has already initiated discussions to provide broadband in all blocks. All options to provide broadband (DSL, cable, wireless etc.) are being considered.

3.4.6 The plan also envisages broadband coverage of all secondary and higher secondary schools, public health care centers and Village Panchayats by the year 2008. Broadband connectivity would be provided to 100,000 Community Service Centers (CSC) covering 20000 CSCs by ADSL by September 2007; 1000 blocks by wireless broadband by December 2007 and the remaining 5000

blocks by wireless broadband with USO support by June 2008.

3.5 National e-Governance Plan

Department of Information Technology (DIT) has drawn up a National e-Governance Plan (NeGP) for delivering Government and private services at the doorstep of the citizen. The plan has been drawn up covering 26 Mission Mode Projects and 8 support components to be implemented at the Central, State and Local Government Levels. Planning Commission has allocated funds as Additional Central Assistance (ACA) to all the States for taking up Capacity Building measures as a first step towards NeGP. Three core infrastructure components are identified under the plan.

3.5.1 **State Wide Area Networks (SWANs)**: Scheme for the establishment of State Wide Area Networks (SWANs) has been approved in 22 States/UTs with total outlay of Rs.3,334 crore over a period of 5 years, extending data connectivity of 2 Mega bits per second up-to the block level in all States and Union Territories in the country.

Following implementation strategies for SWAN have been suggested:

(i) Using the NIC to establish the SWAN by suitably extending the existing NICNET upto Block level.

(ii) To engage a competent private/ public sector agency through an appropriate competitive bid process under

a suitable service level agreement (BOO/BOOT etc.) to establish and run the SWAN.

(iii) To establish and own the SWAN infrastructure directly by the State and use a private service provider for operations and facility management.

(iv) Any other Public Private Participation (PPP) model considered appropriate by the State.

Various state governments have adopted different approaches for SWAN deployment. Such networks as claimed are also capable to provide broadband upto block headquarter and village level.

3.5.2 **Common Services Centres (CSCs):** The Government has approved a Common Services Centres (CSCs) Scheme for providing support for establishing 100,000 Common Services Centers in 600,000 villages of India. The Scheme, as approved by the Government of India, envisions CSCs as the front-end delivery points for Government, private and social sector services to rural citizens of India , in an integrated manner. The Scheme has been approved at a total cost of Rs 5742 Cr. over 4 years, of which the Government of India is estimated to contribute Rs 856 Cr. and the State Governments Rs 793 Cr. The balance resources would be mobilized from the private sector. The Common Services Centres would be designed as ICT-enabled Kiosks having a PC along with basic support equipment like Printer, Scanner, UPS, with Wireless Connectivity as the backbone and additional equipment

for education, entertainment, telemedicine, projection systems, etc., as the case may be.

3.5.3 **State Data Centres (SDC):** It is proposed to create State Data Centres (SDC) for the States to consolidate services, applications and infrastructure to provide efficient electronic delivery of Govt. to Govt. (G2G), Govt. to Citizen (G2C) and Govt. to Business (G2B) services. These services can be rendered by the States through common delivery platform seamlessly supported by core Connectivity Infrastructure such as State Wide Area Network (SWAN) and Common Service Centre (CSC) connectivity extended up to village level. State Data Centre would provide many functionalities. Some of the key functionalities are Central Repository of the State, Secure Data Storage, Online Delivery of Services, Citizen Information/Services Portal, State Intranet Portal, Disaster Recovery, Remote Management and Service Integration etc.

Chapter 4
Technologies for providing Broadband

4.1 Broadband as per present definition is high speed Internet access (256 Kbps and above) and can be provided using various technologies.

4.2 Some of the commonly used technologies for providing broadband access are:

i) DSL/ ADSL over Copper loop
ii) Cable TV network
iii) Satellite
iv) Fibre
v) Wireless

4.3 Digital Subscriber Line (DSL) over Copper loop

4.3.1 Existing PSTN infrastructure having copper loops to subscriber provides most cost effective option for Broadband delivery. Digital Subscriber Line (DSL) has become an important technology option in public telephone networks for provisioning of Broadband services through the copper loop of Public Switched Telephone Network (PSTN). DSL speeds are influenced by the distance between the subscriber and the local exchange, the gauge of the phone wire, and the type of DSL technology, while offering a dedicated amount of bandwidth that does not vary with the number of subscribers logged on in an area.

4.3.2 Different types of DSL technologies are described below:

4.3.2.1 **Asymmetric DSL** (ADSL, G.DMT, ITU-T.G.992.1) – ADSL is a form of DSL where more bandwidth is allocated to download than to upload. It provides maximum speeds of 8-10 Mbps downstream and a maximum of 1 Mbps upstream. ADSL can provide satisfactory services at a distance of 3-4 km from the local exchange. It is well suited to residential use because it shares a single twisted copper pair with voice, allowing users to use the telephone and surf the Internet simultaneously on the same line.

4.3.2.2 **ADSL** (G.lite, ITU-T G.992.2) – Originally, ADSL installations required a physical splitter to separate out voice and data traffic forcing these installations to be performed by technicians. G.lite allows for a splitter-free connection that simply requires the modem to be plugged in, thus drastically reducing the expense and difficulty of rolling out ADSL service. G.lite also extends the reach of ADSL by sacrificing speed – it can reach 5.4 km but maximum download speed will be limited to 1.5 Mbps while upload will be limited to 512 kbps.

4.3.2.3 **SHDSL** (Single Pair High-Speed DSL) – SHDSL uses a copper pair to send and receive data through two bands, allowing for speeds approximate up to 2 Mbps in each direction. By including a second copper pair, SHDSL speeds can reach approximate 4 Mbps in each direction. These speeds are possible upto a distance of 3 km, but decreases with increase in distance.

4.3.2.4 **Symmetrical DSL (SDSL)** – SDSL is a proprietary standard mainly used in North America. SDSL offers symmetric traffic flow in each direction like SHDSL and cannot share the line with analogue signals. The capacity of SDSL is adjusted according to signal quality, and distance ranging from 160 kbps upto 7 km to 1.5 Mbps upto 3 km.

4.3.2.5 **ADSL2, ADSL2 plus** - ADSL2 is the sequel to the original ADSL recommendation, enabling improved speed, reach, power consumption and other technical elements. ADSL2 can deliver 8-12 Mbps while further extending the distance coverage. This standard also allows the use of filters instead of splitters at both ends of the connection. Further, the voice channels are realigned and often provide the ability to combine multiple ADSL2 lines for higher bandwidth to certain customers. In addition, ADSL2 systems can enter an "all-digital" mode where voice channels are reassigned to data, similar to SHDSL. ADSL 2 plus (ADSL2+) builds further on ADSL2 by increasing the bandwidth through extending the usable frequencies on the line. These increases download bandwidth from 8 Mbps with ADSL2 to 16 Mbps with ADSL 2 plus. These speeds are possible approximately upto 1.5 km.

4.3.2.6 **Very-High-Data-Rate DSL (VDSL)** – This is the latest form of DSL and offers the fastest DSL speeds to date, though over short distances (52 Mbps over a standard twisted pair cable). This makes VDSL the optimal choice for providing broadband over short distances.

4.4 Cable TV Network

4.4.1 New technological developments in Cable TV networks have made it possible to send data in both directions via usage of different channels on separate blocks of 6 MHz frequencies, making Internet access over cable TV a viable solution. One channel sends data from the Internet to users (6 MHz of frequency corresponds to roughly 30 Mbps) while another channel receives. Cable subscribers in a small area share the same channels to send and receive data, therefore the bandwidth which a users receive is dependent on number of users utilising the service at given point of time.

4.4.2 Figure 4 shows typical setup for provisioning of broadband through Cable TV network:

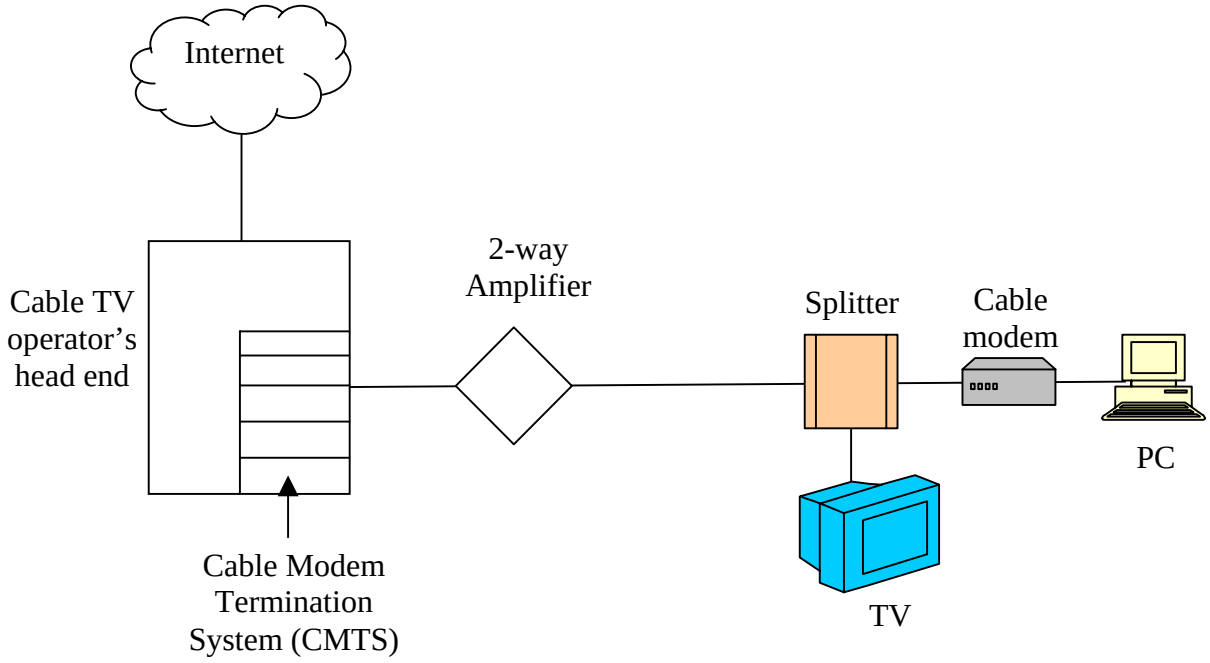

Figure 4: Broadband through Cable TV Network

4.4.3 Cable modem speeds range from 500Kbps to 30 Mbps. Cable modem specifications are governed by a set of standards called DOCSIS (Data Over Cable Service Interface Specification). The current version DOCSIS 2.0 has incorporated improved QoS, security features and symmetric data rates. The signals are modulated using QPSK (Quadrature Phase Shift Keying) or 16 QAM (Quadrature Amplitude Modulation) in upstream and 64 QAM or 256 QAM in downstream. The upstream band is limited to 5-65 MHz, while the downstream band is between 47-862 MHz.

4.4.4 Presently there are 71 million Cable TV subscribers in India. This last mile infrastructure reaches more people than even the copper loop infrastructure (40 million), and can be leveraged in providing cable operators with a new business model while giving a stimulus to broadband penetration. In some countries, particularly USA and Canada, the cable network is the dominant form of access for broadband services.

4.5 Satellite

4.5.1 Use of satellite technology for Broadband offers significant advantages in terms of ubiquitous coverage, simplicity in network design, reliability and rapid deployment and is very effective to serve rural and inaccessible hilly areas where wired access is difficult to lay.

4.5.2 Keeping in view the size of antenna to be installed at subscriber premises, only satellites operating in the Ku frequency band (10-18 GHz) are useful. It is expected that next generation satellite will expand into the Ka frequency

band (18-31GHz). Satellite transponder in Ku band typically has capacity of 72 MHz. Half transponder of 36 MHz can easily serve 10,000 to 20,000 subscribers for provision of broadband service.

4.5.3 Though satellite connections have traditionally been more expensive, they can still offer some cost effective options like point-to multipoint (broadcast or multicast) applications that do not require huge bandwidth. VSATs (the small fixed earth stations used to setup satellite based communications network) have been fairly successful in the Indian market. The major users have been banking sector, lottery, distance education, fast moving consumer goods industry and the government. Figure 5 shows typical setup for provisioning of broadband through satellite:

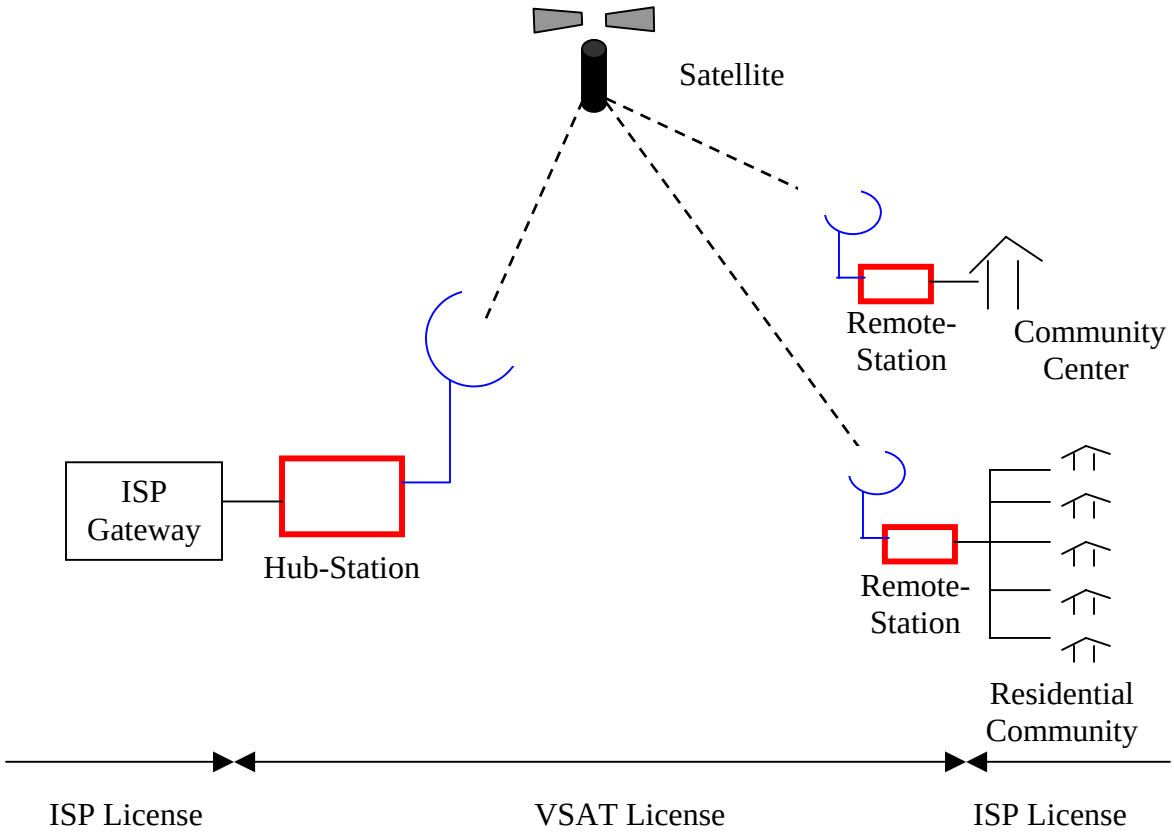

Figure 5 – Broadband through VSAT

4.5.4 Provisioning of Broadband through satellite requires main hub and remote stations. The cost of a main hub and remote station is high. As a result the broadband connections provided using satellite medium is not cost effective. Satellite is useful to provide broadband mostly in areas which are inaccessible and not feasible to be covered by using other methods to provide broadband.

4.5.5 In addition, there is a case for using Direct to Home (DTH) reception system, which is primarily used for receiving video broadcasts for downloading broadband content. The uplink in this arrangement, which is normally required to be narrow band, can be from conventional terrestrial media (dialup, EDGE, GPRS etc.).

4.6 Fibre Network

4.6.1 Fibre optic cable uses lasers or light emitting diodes (LED's) to transmit pulses of light through fibre cable. Fibre optic cable can carry thousands of times more data than either electric signals or radio waves because light uses higher frequencies. The infrared laser light that is typically used in telecommunications has a frequency of roughly 100 MHz. Currently, most fibre optic cables transmit light only at one frequency, but, as technology improves, the bandwidth on fiber optic lines can be increased by simply adding more frequencies multiplying the capacity to carry data information.

4.7 Wireless Network

4.7.1 Wireless technologies usually provide wider broadband access solution in areas having limited communications

infrastructure. Wireless is suitable for harsh landscapes and lightly populated areas, but can also be deployed to provide specialized services in urban areas. Amongst the various technologies available for broadband, wireless has a great potential because of ease of its installation, operation & maintenance, flexibility for the service providers and convenience to the end users. Moreover, penetration of copper loops is not widely spread. Therefore, wireless based access could be one of the ideal solutions for widespread last mile coverage through a combination of different technologies like WiMAX, WiFi etc. These technologies have the added advantage of interoperability and economy of scale due to international standardisation. For the deployment of any wireless technology, suitable & sufficient spectrum availability and its efficient utilisation is a must.

4.7.2 Presently available wireless technologies are:

- WiFi
- WiMAX
- 3G & CDMA

4.7.3 WiFi

WiFi is a matured technology, which is most commonly used as last mile (100 meters) to provide Internet access. Several factors have contributed to the phenomenal growth of WiFi: affordable CPE, the mobility benefits of wireless connectivity, off-the-shelf availability, and easy installation. Mesh connectivity can provide high speed and good coverage. In a wireless mesh network mesh maintains radio connectivity between the various access points to

create a seamless path for data to travel through designated gateway cell. At least one wireless device (or node) is connected to an internet connection using appropriate backhaul and each data packet is routed through designated gateway but not necessarily using the same sequential path of nodes.

A list of different types of Wireless LAN systems (WiFi) is given below.

- 802.11b (WiFi)
- 802.11a (WiFi5)
- HiperLAN2 (High Performance Radio Local Area Network)
- 802.11g

Details of these technologies have already been discussed in chapter 3.

Backhaul is a major drawback for using WiFi devices. Backhaul for WiFi devices can be provided using cable, optical fiber or leased line wherever these are available. The wireless backhaul will be useful when other modes to provide backhaul are not available. This will require identified spectrum for such backhaul. At present available spectrum for suitable technologies for backhaul like WiMAX is very limited.

4.7.4 WiMAX

4.7.4.1 Worldwide Interoperability for Microwave Access (WiMAX) is a wireless digital communications system, based on IEEE 802.16 standards. WiMAX is intended for wireless metropolitan area networks in licensed or license exempt bands, delivering point-to-multipoint

fixed, nomadic, portable and mobile access. WiMAX is one of the Broadband Wireless Access (BWA) Technologies, which is suitable for access as well as backhaul. WiMAX is very promising to provide higher coverage and capable of giving download speed in the range of 14.4 mbps. To meet the requirements of different types of access, two versions of WiMAX have been defined: fixed WiMAX (802.16d) and mobile WiMAX (802.16e). The radio frequency allocations for WiMAX are in the 2.3 - 2.5 GHz, 3.3 - 3.5 GHz and 5.8 GHz bands. Fixed WiMAX has been deployed and tried in 3.3 GHz, 3.4 GHz, 3.5 GHz and 5.8 GHz and Mobile WiMAX trials are being conducted in 2.3 GHz - 2.5 GHz and 3.3 – 3.6 GHz. TRAI has recommended to allocate 3.3 and 3.4 GHz bands for BWA applications.

4.7.4.2 Details of WIMAX technology have already been discussed in chapter 3.

4.7.4.3 The commercial deployments of WiMAX are taking place and are at initial stage. In India the operators have already started trials of WiMAX in cities like Pune, Bangalore etc. Following observations are important to note:

i) For providing broadband, combination of WiMAX in backhaul and WiFi in access is a good option.
ii) WiMAX Backhaul equipments are available but commercial deployment is still not extensive.
iii) Presently WiMAX is used for fixed wireless access. However trials are also going on for mobile WiMAX.
iv) Access equipments are under trial.

v) Presently WiMAX CPEs are under trial and likely to be very costly to start with.

4.7.5 3G & CDMA

4.7.5.1 Third Generation (3G) is the term used to describe the latest generation of mobile services which provide advanced voice communications and high-speed data connectivity, including access to the internet, mobile data applications and multimedia content. IMT-2000 is the name given to third-generation (3G) wireless mobile standards defined in the International Telecommunication Union's Radio-communication Sector (ITU-R) Recommendation M.1457. The two most widely deployed standards are based on code division multiple access (CDMA) technology and are referred to as CDMA-Direct Spread (CDMA-DS), known as WCDMA, and CDMA-Multi Carrier (CDMA-MC), known as CDMA2000. Both have the capability to support voice and broadband data traffic, with newer revisions providing even greater data rates. A third standard, TD-SCDMA, is also based on CDMA and is being developed in China, but is not yet commercially deployed. 3G technologies provide operators with the capability to offer broadband data connections to fixed, nomadic or mobile users.

4.7.5.2 Globally, WCDMA networks have been deployed in 2.1 GHz and 850MHz bands and developments are in progress for 900 MHz deployments, as well. EV-DO systems have been deployed in the 800 and 1900 MHz bands, though some deployments are in 450 MHz, 1700

MHz and 2100 MHz also exist. The frequency bands being considered in India for 3G services (2.1GHz, 800 MHz, and 450 MHz) are in line with ITU recommendation.

4.7.5.3 3G handsets have been a barrier in the past due to high cost, but they are now comparable with 2G in terms of size, weight, reliability, choice and provide superior features. Cost of 3G handsets is still higher when compared to 2G/2.5G, but are likely to fall significantly.

Chapter 5

Impediments to the Growth of Broadband

5.1 Broadband in Urban areas

5.1.1 Slow growth of broadband is a serious concern. In spite of good growth potential for broadband, the slow growth requires in depth analysis of all impediments and discussions on various options to boost broadband penetration. This chapter will concentrate on all the options and likely actions to accelerate broadband penetration.

5.1.2 Presently most of the broadband proliferation is taking place in the urban areas. However, it is far less than the desired level. On an average 80000 broadband subscribers were being added per month during last one year. To achieve the broadband policy target much higher growth rate is required. There is need to identify the major impediments for this abysmal growth.

5.1.3 It is important to note that availability of individual PC is increasing in the metro and major districts. Many applications like Railway tickets/ Air tickets, educational material, e-commerce, and e-governance (filing of IT returns etc) are becoming popular. Hence broadband in urban areas will be driven by individual demand. The maximum number can go equal to the number of PCs/ laptops or equivalent devices available with the users. The present penetration of such devices is much higher (approx 10%) than the broadband and therefore not a limiting factor at present.

5.1.4 Broadband through DSL in urban areas

5.1.4.1 Presently DSL is the most preferred technology for broadband access. At the end of March 2007, out of 2.34 million broadband subscribers, 1.9 million subscribers (approx. 83%) were using this technology. Out of this BSNL & MTNL have provided only 1.45 million connections. As already discussed in chapter-2, approximate 8 million copper loops are available in urban area with incumbents, which can be utilized for provisioning of broadband. Even then growth of broadband connections provided by incumbents is very slow. Since there is high growth potential and in most cases local loop is available with incumbents broadband could not be provided either due to shortage of DSLAM ports or Customer Premises Equipments (CPEs) or non roll out of broadband in that area. This indicates that there is a scope to improve local loop utilisation efficiency to provide broadband using copper loop by incumbents.

5.1.4.2 One way of effective utilisation of copper loop is unbundling of local loop. However, the suggestion for unbundling of local loop has not been approved by DoT.

5.1.4.3 The other way to effective utilise local loop for providing broadband services is to adopt franchisee model, which will be more effective in the current scenario and can be encouraged. There is complete flexibility for provision of equipments either by franchisee or the local loop owner in such model; hence the shortage of equipments can be solved to a great extent by adopting this model. The

incumbents will issue all bills and do all subscriber management; therefore franchisee model will be able to encourage effective utilisation of copper loop in comparison to unbundling of local loop. The issues like collocation of equipments, QoS etc can easily be managed by local loop owner and still provide more broadband connections. This should be immediately adopted to boost broadband penetration.

It is therefore recommended that:

- **Government should increase the target fixed for BSNL and MTNL for provision of broadband connections during 2007-08. For this purpose BSNL and MTNL should be encouraged to appoint franchisees for providing broadband services to supplement their efforts. There should be total flexibility in developing a commercial model. Any procedural restrictions/ limitations should be addressed immediately.**

5.1.5 Shortage of Customer Premises Equipments (CPEs) for Broadband

5.1.5.1 One of the main impediments for slow progress of incumbents in providing broadband connections is the shortage of CPEs (modems). Usually CPEs are provided by service providers while installing broadband connections. Though these CPEs are also available in the market, their cost is higher than what charged by the service provider. Most of the subscribers are not aware about the availability of these CPEs in the market and

therefore entirely depend on the service provider for procurement of CPEs.

5.1.5.2 Presently most of the CPEs for broadband are imported and very few CPEs are manufactured in India. In order to enhance the availability of CPEs, Indian manufacturers should be encouraged to produce more CPEs. For this purpose Manufacturer's Association of Information Technology (MAIT), Telecom Equipment Manufacturers Association (TEMA) should be encouraged.

5.1.5.3 The customers are not sure about the interoperability of the CPEs, which are available in the market. As a result, such CPE can not be used to provide broadband unless they are tested and interface approval given by designated body. A list of CPEs standardised such bodies should be displayed in the public domain, so that subscribers can directly purchase these CPEs from the market. TEC can play very effective roll in this respect.

In view of the above it is recommended that:

- **Government should encourage Indian manufacturers to produce more CPEs used to provide Broadband using DSL technology.**
- **Standardisation of DSL CPEs used to provide broadband should be done by TEC immediately in time bound manner and information of all CPEs conforming to specifications should be displayed on TEC website for the information of customers.**

5.1.6 Broadband through Cable TV Network

5.1.6.1 Presently there are 71 million Cable TV households in India. The available data suggest that only 10% of this i.e. 7 million can be utilised for broadband access at present. However, only 0.25 million broadband connections over cable TV have been reported by March 2007. For providing broadband over cable TV network, upgradation cost of cable TV network per line is approx. USD 200. Stakeholders contend that providing only broadband services over cable TV network may not give commensurate rate of return on investments. This seems to be one of the reasons for slow upgradation of Cable TV network to provide broadband.

5.1.6.2 Cable TV operators want additional services like IPTV, Internet telephony and other bundled services, which they cannot provide presently under ISP license. Migration to UASL is costly and therefore Cable TV network is not emerging as one of the alternative to provide broadband. TRAI in its recommendations on "Unified License" dated 27th October 2003 recommended provision of UASL without spectrum. This will enable Cable TV operators to move to UASL and provide various services. This needs to be looked into on priority basis to encourage upgradation of cable TV network capable to provide broadband, which will ultimately boost broadband penetration.

5.1.6.3 Low utilization of capable cable TV network to provide Broadband is also an issue of great concern. The cable operators feel that cost of International Internet

Bandwidth and high competition do not make a suitable business model. TRAI has taken number of steps like recommendations on “Terms and conditions of Resale in IPLC” and “Improvement in the effectiveness of NIXI” and regulation on “International Telecommunication Access to Essential Facilities at Cable Landing Stations” to reduce International Internet bandwidth charges. It is hoped that with these initiatives, the cost of International Internet Bandwidth and Domestic Leased Circuits (DLC) will reduce. This will encourage better utilization of cable network capable to provide Broadband services.

5.1.7 Broadband through DTH

5.1.7.1 Direct to Home (DTH) is proliferating quickly in urban areas and is presently meant for broadcasting of TV channels only. It can be utilised for downlink path for providing broadband connection with a download speed upto 1.5 mbps. DTH uses Ku band (10-18GHz) to maintain smaller disc size (40-60Cm) at customer premises. Presently limited Ku band transponders are available from satellites collocated in the similar Geo stationary orbit, which may limit the growth of DTH services to provide broadband as additional transponders will be required for expansion. Indian Space Research Organisation (ISRO) is planning to launch two more satellites with Ku transponders in near future. In addition ISRO is also is in negotiations with Malaysia for leasing transponders from Malaysian satellite MEASAT. Such activities need to be expedited.

5.1.7.2 Broadband through DTH will be a viable option for both urban and rural areas provided broadband uplink cost is reasonable. Presently Cost of accessing internet through dialup is Rs. 30 per hour (Rs 24/- for dialup access and Rs 6/- for Internet access), whereas cost of accessing internet through wireless networks (GSM & CDMA) is approx. Rs 36/- per hour, which also includes access and internet browsing charges. The tariffs mentioned above include both uplink and downlink data traffic, whereas in case of broadband connection through DTH only uplink connectivity will be required. Therefore it is expected that tariff for uplink access would be much lower and affordable.

5.1.7.3 A very important issue at this stage is whether uplink communication through telecom networks be encouraged to facilitate Broadband services on various one way platform like DTH, one way cable network. This will also encourage number of other interactive multimedia applications. The Authority hope that service providers will consider this option and come up with appropriate plan. Stakeholders may also give feedback of usability of such platform to encourage Broadband.

5.1.7.4 The Authority will monitor industry response to provide uplink facilities to encourage non conventional platforms to provide broadband and may interfere if felt necessary.

5.1.7.5 Some telecom operators are also in the process of obtaining DTH licenses and are planning to provide Broadband over DTH. However, they may provide Broadband service to their DTH subscribers only.

It is recommended that:

- **In order to enable the expansion of DTH services in the country, Govt. should ensure availability of more number of Ku band transponders. This will also encourage the service providers to roll out broadband through DTH platform.**

5.1.8 Broadband through Optical Fibre

5.1.8.1 Fibre is a very good option for providing broadband services requiring high bandwidth. This technology has no limit as far as upstream and downstream bandwidths are concerned. Though the technology is prima facie mature and established, it has a much lower installed base compared to DSL/cable. But fibre-Ethernet will certainly remain the key `wired' network of the future. However, availability of fibre in local access network is limited. Availability of fiber to curb or house (FTTx) in metros is limited. Fiber mainly available in long distance network (approx. 7 lakh Route Km).

5.1.8.2 Most of the Access Providers and National Long Distance Operators (NLDOs) are laying very limited fiber in access network and mainly concentrating on wireless, as cost of Right of Way (RoW) is very high. Due to high cost of leasing a Fiber, it is mainly used for high capacity bandwidth requirements. The telecom industry is passing through new revolutions where value added services will play major role. These services are bandwidth hungry and their demand will increase day by

day. Hence in times to come wireless may not be able to support huge bandwidth requirements. Therefore urgent actions have to be taken immediately to encourage penetration of optical fibre in urban area. RoW is one of the very important impediments in laying of cable which needs to be considered on priority basis.

5.1.9 **Streamlining Right of Way (RoW):**

5.1.9.1 RoW is one very important factor which dissuades service providers to venture into creation of new infrastructure for telecom services/broadband services. Obtaining right of way clearances has proven to be a major hurdle in rolling out new infrastructure which requires laying of cables & optical fibers and thereby restricting provisioning of advanced broadband services in a time bound manner.

5.1.9.2 The major problems are lack of uniformity in decision making processes of public and private right of way owners, availability of detailed GIS maps, and the need to create new ducting infrastructure to carry data cables, even in areas of recently completed civic projects. Major problems for obtaining RoW in this category Following are

- Very high RoW charges
- Longer time for providing RoW
- Clearance form several other agencies is required even if clearance of respective municipality is obtained.
- Ban on open trenching in all the seasons even for fault repairing

5.1.9.3 The RoW to all operators should be available on similar terms and conditions or on restoration basis as otherwise it may not be economically viable to roll-out new telecom services. Expeditious approvals for right-of-way clearances to all service providers are critical for timely implementation of telecom networks. The Central/ State Government / Local bodies / Ministry of Surface Transport etc. should take necessary steps to facilitate the same.

5.1.9.4 A committee should be formed at district level to study RoW requirement, which will obtain a firm demand from all operators for laying OFC. A time frame should be fixed for all the operators to coordinate and lay their cables. The uniform restoration charges should be prescribed. All such coordination should be done on single window clearance basis in a well defined time bound manner.

5.1.9.5 There are three possible options for streamlining RoW:

i) All the service providers should form a consortium and jointly construct the duct by sharing the construction cost.

ii) Infrastructure Provider category-I (IP-I) should be encouraged to build ducts in the districts after obtaining firm requirement from service providers. All the operators may be mandated to share such ducts.

iii) Municipalities may build ducts itself and expenditure of laying ducts may be shared among the operators either by outright purchase or by rentals as per business model.

5.1.9.6 Service providers also lay cable along the highways and at present no RoW charges are fixed. The clearance procedure is lengthy and time consuming. National Highway Authority of India should obtain firm demands from service providers for specified period say 5 years and build ducts along the highways. The cost of such construction should transparently be informed to service providers and taken either on outright upfront basis or as rentals as per the business model.

5.1.9.7 TRAI had recommended some measures for streamlining RoW procedure in its recommendations on 'Growth of Internet and Accelerating Broadband penetration in India'.

5.1.9.8 In order to encourage service providers for rolling out new infrastructure and providing advanced broadband services in a timely manner it is recommended that:

- **A committee needs should be formed at district level to study RoW requirement, which will obtain a firm demand of OFC ducts from all operators. The local authorities should evolve a duct sharing mechanisms among service providers. Expenditure of laying ducts may be shared among the operators. Alternatively Infrastructure Provider category-I (IP-I) can be**

encouraged to build ducts in the districts after obtaining firm demands from service providers.

- **The Central Government may consider mandating the state governments to adopt uniform RoW procedures and streamline/ rationalise RoW cost, which may primarily be limited to cost of re-instatement only. RoW costs should be non-discriminatory, reasonable. RoW procedures should be transparent and publicly available.**

5.1.10 Broadband through Wireless in urban areas

5.1.10.1 There are approximately 31.30 million wireless Internet subscribers at the end of March 2007 who are accessing Internet through the wireless networks of Cellular Mobile Service Providers (CMSPs) and Unified Access Service Providers (UASLs). These subscribers cannot be treated as broadband subscribers at present, as access speed in such cases is less than 256 Kbps. The penetration of wireless handsets capable to support high speed Internet is increasing day by day. It is expected that 10-20 % of present wireless internet subscribers will have 3G enabled handsets, which can easily switchover to broadband with the rollout of 3G services. Cost of 3G handsets is also decreasing, which will enable more subscribers to use 3G services and hence more number of broadband subscribers. However, spectrum for 3G services is not allocted at present.

5.1.10.2 Another wireless technology WiMAX has the potential to provide both fixed and mobile high speed internet services in urban area. Fixed WiMAX is based on IEEE 802.16-d standards, while mobile WiMAX is based on IEEE 802.16e standards and operate in the 2.3 GHz, 2.5 GHz, 3.3 GHz, 3.4-3.8 GHz spectrum bands. Although 2.4 GHz and 5 GHz non-licensed bands are also available for WiMAX deployment, their usage could be limited to trials because of the risks of interference preventing QoS commitments. So far WiMAX Forum has certified 30 products for fixed WiMAX. Certification of mobile WiMAX equipments are going on and the first certified products expected in near future.

5.1.10.3 Cost of WiMAX mobile CPE is high at present due to fewer equipments available. The cost is likely to come down with increasing availability.

5.1.10.4 In addition to the use of WiMAX in access (point to multipoint), it can also be used for the backhaul (point to point) purposes. Combination of WiFi in access and WiMAX in backhaul is a good option to provide broadband in urban as well as rural areas. Municipal corporations of Pune and Delhi are planning to deploy citywide wireless network using this combination.

5.1.10.5 Non-availability of spectrum for 3G and WiMAX is the major impediments for their deployments. In order to expedite the provision of broadband using these technologies there is an urgent need for allocation of spectrum for 3G and WiMAX.

5.1.10.6 The Authority in its recommendations on "Allocation and pricing of spectrum for 3G and broadband wireless access services" has already recommended the mechanism and pricing of Spectrum for 3G and Broadband Wireless Access. These recommendations are still pending with the Govt. and need immediate action.

It is therefore recommended that:

- **Government should expedite decision on TRAI's recommendation regarding mechanism and pricing of Spectrum for 3G & Broadband Wireless Access.**
- **Spectrum for 3G & WiMAX should be made available at the earliest to boost the deployment of broadband using these technologies.**

5.1.11 Broadband enabled buildings

5.1.11.1 Presently in Metro and nearby suburban areas construction of multiple dwelling units (MDUs) like apartments, housing societies, and shopping malls is on the rise. Lot of new multimedia applications like VoIP, IPTV, e-commerce, online gaming, video and audio on demand, e-education, online booking of Railway & Air tickets, e-filing of Tax returns will drive residents of such buildings to go for broadband connections.

5.1.11.2 Number of bandwidth hungry applications are increasing day by day, which will drive subscribers to go for very high bandwidth in years to come. Therefore

there is a need to take action to encourage broadband enabled buildings/dwelling units in metros and major cities.

5.1.11.3 Presently in MDUs no centralised infrastructure is provided for providing broadband connection. A service provider has to lay cable till the subscriber's house, which is very cumbersome and is not so cost effective.

5.1.11.4 Broadband in residential MDUs will become the next utility after gas, water and electricity. These buildings can be made broadband ready by internal wiring. Service providers can provide broadband service to all the occupants by connecting at single point of appropriate bandwidth to such buildings. Such connectivity can be provided through fibre or wireless. This makes a viable business case for service providers to provide affordable broadband connections in such buildings and very convenient to the users. Much better QoS can be ensured in such well planned environments.

5.1.11.5 In order to encourage broadband enabled buildings, Municipal committees may be asked to include a clause for making such buildings broadband ready by providing internal wiring while giving clearance for the construction of all such buildings in future. This will provide a boost to broadband growth in the country for a longer duration and ensure readiness of such houses to have high capacity broadband in near future. It will not be out of place to mention that such practices are being followed in many countries abroad.

It is recommended that:

DoT should encourage through state governments that all Municipal committees include a clause for making Multiple Dwelling Units/ buildings broadband ready by internal wiring while giving clearance for the construction of all such buildings in future. This will help to create infrastructure to provide broadband in future and will be very convenient to users.

5.1.12 **Other Initiatives**

5.1.12.1 There are 1.3 million always on Internet subscribers using technology, which can support broadband but use access speed less than 256 kbps due to high cost of internet bandwidth. If the cost of inputs like international internet bandwidth and domestic bandwidth can be further reduced to make broadband more affordable, these subscribers can switch over to broadband.

5.1.12.2 TRAI has already sent its recommendations on "Terms and conditions of Resale in IPLC" on 23rd March 2007 and "Improvement in the effectiveness of NIXI" on 20th April 2007. These initiatives would substantially bring down ISP's expenditure on domestic and international bandwidth and will further reduce the Broadband charges as bandwidth charges amount for approx. 65% of total cost for providing Broadband services.

5.1.12.3 These recommendations are still pending with the Govt. and need expeditious action.

It is recommended that:

- **Govt. should expedite the action on TRAI's recommendations on "Terms and conditions of Resale in IPLC" and "Improvement in the effectiveness of NIXI". This will reduce internet bandwidth cost and will encourage customers to switch over to broadband.**

5.2 Broadband in Rural areas

5.2.1 The skewed development of Broadband is bothering the planners as well as service providers to revisit the broadband deployment strategy otherwise digital divide between urban and rural will further increase. It is also an accepted fact that present state of other infrastructure in rural areas, except a few progressive States, is far from satisfactory. Broadband growth cannot be taken as complete unless rural areas also get the benefit of broadband and contribute to its growth.

5.2.2 Presently broadband penetration in the rural areas is very limited. To achieve the targets of Broadband Policy, there is a need to proliferate broadband in rural areas. Some of the limitations for broadband growth are as follows:

i) Backhaul cost is very high
ii) Absences of good business model, as operators are not sure about minimum number of subscribers and financial returns per month.
iii) Low PC penetration
iv) Low English literacy

5.2.3 While deciding technology alternatives, it is necessary to understand that initially concept of community center will pickup in rural areas. Therefore to start with, efforts must be made to provide broadband connectivity to community centers in villages at affordable cost. The problem of erratic power supply, which is a serious impediment, can also be solved if we concentrate only on community centers.

5.2.4 **Broadband through DSL in rural areas**

5.2.4.1 Though DSL can also be used to provide broadband, penetration of copper loops is not widely spread in rural areas. Today, the main advantage of DSL and cable will be the cost of ownership. The CPE and overall cost of DSL is low and hence affordable, and ripe for mass consumption.

5.2.4.2 BSNL has very extensive network with 20000 rural exchanges connected through optical fiber. It can be utilised to provide broadband using DSL within 3-4 Km area around such exchanges. However, there is a huge delay in implementation by BSNL as procurement of equipments is time consuming. There is a need to expedite provisioning of broadband in these areas in time bound manner.

5.2.5 **Broadband through Satellite**

5.2.5.1 Creating infrastructure to provide connectivity to remote and difficult terrain will be very difficult and requires substantial cost. Satellite is a very effective media to

provide broadband connectivity to such areas. Satellite is also good option for providing broadband in hilly areas like Northeast, J&K, HP, Uttrakhand etc. However, high cost of providing broadband over satellite indicates that it is not a viable business case and needs to be subsidised for providing broadband services in rural, hilly terrains and remote areas that have no other real broadband options. Suitable incentive schemes need to be worked out so that broadband can be provided in rural, remote and Far Flung areas. USO fund may be utilised to provide subsidy for provisioning of broadband services through satellite in remote and hilly areas. The amount of subsidy may be limited to the difference of cost of providing broadband through satellite and through other prevailing technologies.

5.2.5.2 In USA, Australia and Canada subsidy is being provided to service providers for provisioning of broadband services in remote and rural areas.

5.2.5.3 DTH can also be utilised for providing broadband connectivity in rural areas. As already discussed in chapter 3 uplink connectivity can be provided through EDGE/GPRS and Govt. is envisaging rollout of mobile services in rural areas with USO Fund support. Therefore broadband through DTH will make a viable business model in rural areas also.

In view of the above it is recommended that:

- **USO fund may be utilised to provide subsidy for provisioning of broadband services through satellite**

in remote and hilly areas. The amount of subsidy may be limited to the difference of cost of providing broadband through satellite and through other prevailing technologies. Public private partnership be encouraged to provide advantage of such facilities to rural masses by encouraging various value added applications.

5.2.6 **Broadband through Wireless in rural areas**

5.2.6.1 Wireless technologies usually provide a competitive broadband access solution in areas with no communications infrastructure, or where the existing infrastructure cannot be easily and economically upgraded. Wireless is suitable for harsh landscapes and lightly populated areas. Wireless access technologies allow for direct connections between the subscriber and the access hub without the need for wire lines (whether fibre, coaxial cable or twisted pair cable).

5.2.6.2 **WiFi**

WiFi is a cheaper technology and can provide good coverage in villages with few access points. This will be very effective to increase broadband penetration. 2.4 GHz band has already been de-licensed and therefore can be used effectively for this purpose.

IIT Kanpur has undertaken a project, called Digitial Gangetic Plains, for connecting infokiosks in Kanpur and Unnao districts of Uttar Pradesh to IIT Kanpur using WiFi. Directional parabolic grid antennas (2.4GHz 24dBi) are used to establish point to point links.

Presently only low power outdoor usage of WiFi is permitted. The request to permit some increase in power radiation in rural area for this purpose can be considered in a limited way. Some selected sites may first be permitted for deployment and based on the experience; decision for its generalization can be taken.

5.2.6.3 **WiMAX**

WiMAX is a very good option for backhaul in rural areas, as it can be utilised for access as well as backhaul purpose.

WiMAX can provide speeds upto 14.4 Mbps and likely to support much higher speeds with further advancement. WiMAX as claimed can provide a coverage upto 50 Kms in line of sight (LoS) environments and 15 Kms in non line of sight environments. The WiMAX Forum has estimated that new WiMAX equipment will be capable of sending high speed data over long distances (40 Mbps over 10 kilometres in a line-of-sight fixed environment). At these distances, WiMAX equipment could play a key role in helping bridge the digital divide as long-distance wireless links could help deliver higher-speed access to areas traditionally out of reach of fixed-line networks.

India has total geographical area of 3.28 million square km. If it is assumed that 10,000 towers at suitable locations are identified, which have good backhaul bandwidth, then whole country can be covered if each such tower provide the radial coverage of just 16 km. With the field results given by WiMAX deployment, it

may be very suitable technology for provision of broadband in rural areas.

It is believed that WiMAX could slash the cost of bringing broadband to remote areas, and potentially open the doors to new broadband competition, leading to lower prices and faster consumer adoption. The main requirement for the rural areas today is to break the digital divide. Technologically, WiMAX systems have the capability of providing connectivity from existing Points of Presence on a village-by-village basis today. This is achieved via the superior line-of-sight propagation capabilities of these systems. However, the applications and content, which are relevant for the communities, must also be available on such networks to be effective in helping rural population. Further, the local distribution within the village will be addressed by a cost effective technology today and may migrate to WiMAX with the reduction in the cost of technology ownership.

Presently cost of WiMAX CPEs is high, which likely to come down with advancement of technology and large scale deployment.

For providing broadband in rural areas combination of WiMAX in backhaul and WiFi in access is a very good option. However, spectrum for WiMAX is not allocated so far.

Though broadband in rural areas has been covered under USO fund, for identifying broadband providers using other technologies like WiMAX, no plan has been worked out. If allocation of WiMAX spectrum is to be done on auction basis, it is to be ensured that selected

service provider who get spectrum are only considered for USO fund subsidy on the basis of prescribed guidelines.

5.2.6.4 **3G**

3G will be able to providing high speed data connectivity for enabling easier and affordable access to e-governance, e-learning and e-commerce programs in rural areas. These have often failed in the past due to the unreliability and high cost of niche wireless connectivity options and low fixed-line penetration.

Government recognising the importance of 3G in spreading high speed internet connectivity in rural areas has decided to subsidise the provision of broadband using 3G in rural areas. However, non availability of spectrum is the main constraint in rolling out the services.

5.2.7 **Sharing of Backhaul**

5.2.7.1 Technological options like combination of WiFi & WiMAX or 3G will be very useful. The cost of creating backhaul infrastructure in rural areas is substantial, which acts as a deterrent for a new operator. There is need to encourage new entrants in rural areas for installing their backhaul by providing incentives.

5.2.7.2 The broadband penetration in rural area will be initially dominated by CSC, Schools, Panchayats etc. and therefore viability of such projects will directly be related to operational cost. The high leased line cost for backhaul is working as deterrent and needs to be

subsidized to support Broadband penetration in rural areas.

5.2.7.3 TRAI has recommended in October 2005 that backbone sharing in rural area be mandated. The operator using the backbone shall pay only 70% of the cost of the link based on the tariff fixed by TRAI. The link provider shall get 10% incentive over the TRAI fixed rate for mandatory sharing. 40% of the cost of such links based on TRAI fixed price shall be reimbursed from the USO fund. This will increase the availability of the back haul and help in increase the penetration of the broadband in rural areas. Since broadband penetration in rural areas is very low and 65% operational expenses will be in terms of Bandwidth requirement, initially subsidy upto 40% will be desirable including cost of International Internet Bandwidth.

It is recommended that:

USO fund may be utilised to subsidise backhaul charges including International Internet Bandwidth upto 40% to initially support the rollout efforts to provide broadband service.

5.2.8 **USO support for Broadband**

5.2.8.1 With an aim to provide impetus to growth of broadband in rural areas, Govt. has decided to cover broadband under Universal Service Obligation fund (USOF) scheme. Support from USO Fund will be provided for broadband connectivity. It has been envisaged that broadband can be provided using 3G, other wireless technologies,

existing copper or optical fiber network. With USO fund assistance, 10000 towers are being established for provisioning of mobile services. Three service providers have already been identified to ride in 81 selected clusters. This infrastructure can effectively be used to provide broadband also.

5.2.8.2 USOF Administrator is already exploring the possibilities to provide Broadband using different technologies. Selection of the service provider and technology will be important to roll out Broadband services effectively in time bound manner. The roll out of services will depend on availability of the spectrum. Hence while selecting the service provider, it must be considered that adequate spectrum is available with the service provider to roll out services as spectrum is proposed to be allocated based on auction process.

5.2.8.3 Concerns are also raised from time to time regarding number of operators to be identified in a particular area and whether preference should be given to any particular technology. The broadband business in rural and remote areas is going to be very limited at least to start with. Hence it will be argued that only one service provider should be selected to provide broadband in such identified area and subsidy be provided from USO Fund. This will at least give him some business scope to develop and sustain in times of come. The counter argument will be that selection of just one service provider may create monopoly in the area and development efforts may not penetrate to rural areas in

real sense. In fact whole plan to cover rural areas may get upset due to failure of this identified service provider. It is therefore suggested to prescribe some roll out obligation and USO subsidy to be provided in a phased manner linked with roll out obligation.

5.2.8.4 In view of above discussions and considering the past experience identification of at least two service providers per area will be desirable. This will not only increase competition but also facilitate launch of new services to increase popularity of Broadband. As far as technology options are concerned, TRAI is technology neutral and therefore any technology suitable to provide broadband should be permitted. The choice of technology should be left to the service providers, considering their own business model.

It is recommended that:

- **As TRAI has already recommended allocation of spectrum for various wireless technologies capable to provide broadband on floor price or through auction, a precondition for selection of service provider identified for USO Fund subsidy to provide broadband should have spectrum for suitable technology.**
- **In order to increase the competition, two service providers seeking minimum subsidy should be identified. Some roll out obligation can also be prescribed to ensure the establishment of network and USO subsidy to be provided in a phased manner based on roll out aspect.**

5.2.9 **Other Initiatives:**

5.2.9.1 **Community Info Centers (CICs)**

In order to extend e-governance, e-learning and other IT enabled services to North Eastern states (NE) Department of Information Technology (DIT) has initiated Community Info Center (CIC) project in association with National Informatics centre (NIC) and the state governments of the NE. Under the project at least two CICs have been provided per block to accelerate socio-economic development of the region with projected outlay of Rs 242 Crores. Approximately 500 CICs have been set up so far.

Based on the experiences and performance of the CIC project in the North Eastern States similar projects have also been launched in Jammu & Kashmir and Andaman & Nicobar Islands. In the State of Jammu & Kashmir the scheme has been taken up for setting up of 135 CICs at the Block Headquarters with projected outlay of Rs 40.67 Crores. The scheme has also been extended for setting up of 41 CICs in the Government Schools of Andaman & Nicobar Islands and 30 CICs in the Government Schools of Lakshadweep Islands with projected outlay of Rs 22.25 Crores.

5.2.9.2 **Community Service Centers (CSCs)**

The Government has approved a Community Services Centres (CSCs) Scheme for providing support for establishing 100,000 Community Services Centers in 600,000 villages of India. The Scheme envisions CSCs as

the front-end delivery points for Government, private and social sector services to rural citizens of India , in an integrated manner. The scheme has been approved with a total outlay of Rs 5,742 crore and is being implemented in Public Private Partnership (PPP) model. The CSCs are one of the infrastructure pillars of the National e- Governance Plan and would serve as the physical front for delivering government and private services at the doorstep of the citizen.

5.2.9.3 **Inter-Ministerial Group to plan rural broadband rollout**

The Government has formed an Inter-Ministerial Group comprising Ministries of Health, Home, Human Resource Development, Panchayati Raj and Communication & IT for planning the rollout of broadband infrastructure in rural areas with support from the Universal Services Obligation (USO) fund. The group will discuss how the various Government Departments and agencies spread across the country can promote the usage of broadband.

The major reason for the operators / ISPs not venturing into the rural areas for broadband provisioning is lack of established demand and also poor availability of power. Recognising this Govt. has also asked the various Ministries to indicate their requirement for broadband infrastructure, which in turn will enable telecom operators to build their business plan while bidding for the USO fund-initiated rural broadband project.

5.2.9.4 **Linking NeGP Initiatives with Rural Telecom connectivity programs**

Presently various agencies including DoT , DIT and state governments are implementing different projects for creating networks for rural connectivity.

Several state governments have initiated the deployment of SWANs. Initially the networks like SWAN were supposed to provide connectivity till village for the purpose extending e-governance facilities. However, such networks are now also being designed to provide commercial voice, video and data services. They are also obtaining licenses for providing these services. AP Broadband network is one such example.

As such there is no such clear demarcation between the rural connectivity programs of different agencies. This is creating confusion and there will be serious conflicts in such organizations developing e-governance network and telecom providers if timely action is not taken.

In order to avoid any such conflict Govt. should clearly define the scope of networks established under DoT's rural connectivity program and DIT's e-governance program.

Chapter 6

SUMMARY OF RECOMMENDATIONS

6.1 Broadband in Urban areas

6.1.1 Broadband through DSL

- **Government should increase the target fixed for BSNL and MTNL for provision of broadband connections during 2007-08. For this purpose BSNL and MTNL should be encouraged to appoint franchisees for providing broadband services to supplement their efforts. There should be total flexibility in developing a commercial model. Any procedural restrictions/ limitations should be addressed immediately.**

- **Government should encourage Indian manufacturers to produce more CPEs used to provide Broadband using DSL technology.**

- **Standardisation of DSL CPEs used to provide broadband should be done by TEC immediately in time bound manner and information of all CPEs conforming to specifications should be displayed on TEC website for the information of customers.**

6.1.2 Broadband through DTH

- **In order to enable the expansion of DTH services in the country, Govt. should ensure availability of more number of Ku band transponders. This will also**

encourage the service providers to roll out broadband through DTH platform.

6.1.3 Streamlining RoW procedures

- **The Central Government may consider mandating the state governments to adopt uniform RoW procedures and streamline/ rationalise RoW cost, which may primarily be limited to cost of re-instatement only. RoW costs should be non-discriminatory, reasonable and publicly available.**

- **A committee needs should be formed at district level to study RoW requirement, which will obtain a firm demand of OFC ducts from all operators. The local authorities should evolve a duct sharing mechanisms among service providers. Expenditure of laying ducts may be shared among the operators. Alternatively Infrastructure Provider category-I (IP-I) can be encouraged to build ducts in the districts.**

6.1.4Broadband through Wireless

- **Government should expedite decision on TRAI's recommendation regarding mechanism and pricing of Spectrum for 3G & Broadband Wireless Access.**

- **Spectrum for 3G & WiMAX should be made available at the earliest to boost the deployment of broadband using these technologies.**

6.1.5Broadband enabled buildings

- **DoT should encourage through state governments that all Municipal committees include a clause for making Multiple Dwelling Units/ buildings broadband ready by internal wiring while giving clearance for the construction of all such buildings in future. This will help to create infrastructure to provide broadband in future and will be very convenient to users.**

6.1.6 Other initiatives

- **Govt. should expedite the action on TRAI's recommendations on "Terms and conditions of Resale in IPLC" and "Improvement in the effectiveness of NIXI". This will reduce internet bandwidth cost and will encourage customers to switch over to broadband.**

6.2 Broadband in Rural areas

6.2.1 Broadband through Satellite

- **USO fund may be utilised to provide subsidy for provisioning of broadband services through satellite in remote and hilly areas. The amount of subsidy may be limited to the difference of cost of providing broadband through satellite and through other prevailing technologies. Public private partnership be encouraged to provide advantage of such facilities to rural masses by encouraging various value added applications.**

6.2.2 Sharing of Backhaul

- **USO fund must be utilised to subsidise backhaul charges may be upto 40% to initially support the rollout efforts to provide broadband service.**

6.2.3 USO support for Broadband

- **As TRAI has already recommended allocation of spectrum for various wireless technologies capable to provide broadband on floor price or through auction, a precondition for selection of service provider identified for USO Fund subsidy to provide broadband should have spectrum for suitable technology.**
- **In order to increase the competition, two service providers seeking minimum subsidy should be identified. Some roll out obligation can also be prescribed to ensure the establishment of network and USO subsidy to be provided in a phased manner based on roll out aspect.**

Annex I

Status of TRAI's recommendations on "Accelerating Growth of Internet and Broadband Penetration"

Recommendations Accepted by Govt.:

i) Broadband definition, Goals for Internet and broadband subscriber base and penetration.

ii) Allowing Internet service provision to multiple distinct customers using VSAT infrastructure suitable amendment to clauses 2.2 (iii) and 2.3 of VSAT license.

iii) Streamlining the clearance process from WPC and SACFA

iv) Waiving off the requirement for SACFA and WPC clearance for receive-only VSAT installation.

v) Waiving off the requirement for SACFA and WPC clearance for DTH installation with Receive Only Internet.

vi) De-licensing of bands 2.4 – 2.48 GHz for low power outdoor use and 5.15 – 5.35 GHz band for the low power indoor use of WiFi systems.

vii) De-licensing of 5.725-5.85 GHz band to facilitate deployment of Wireless access for broadband.

viii) Allowing provision of Internet services via DTH platform.

Recommendations which were not accepted:

i) Recommendations pertaining to Local Loop Unbundling.

ii) Removal of restriction on minimum size and throughput for VSAT services

iii) Concessions of 2% in license fee to the VSAT and DTH operators.

iv) Reduction of WPC charges from 4% to 1% of AGR and excluding sale of VSAT hardware from the licensee fee.

v) Exempting from spectrum royalty fees for DTH operators for up linking from within India.

vi) Recommendations pertaining to Streamlining Right of Way (ROW).

vii) Mandating Access Providers to provide local links to backhaul operators in a time bound manner subjected to technical feasibility.

viii) Waiving off of license fee and bank guarantee for infrastructure provider category II (IP-II) and waiving off of Portion of license fee on lease line revenues of BSOs/USAL, NLDOs and ILDOs.

Annex II

International Experience

1. Australia

The Australian Government announced the Australian Broadband Guarantee program in March 2007 by committing $162.5 million to provide subsidised Internet access for Australians currently unable to gain a reasonable access to broadband service at their principal place of residence or small business.

Under this program consumers are required to check the availability of suitable broadband services in their area through the program's Broadband Locator, available at the website of Dept of Communications, Information Technology and the Arts (DCITA). If there is no service available to their premises they can receive a subsidised service.

Internet service providers can apply to register under the Australian Broadband Guarantee subject to certain conditions, and once registered, will receive a payment for every eligible premise connected to one of their registered Australian Broadband Guarantee services.

There are two levels of payments

- High cost payments set at $2500 for satellite services only.
- Low cost payments set at $1000 for terrestrial services.

Australian Broadband Guarantee services are price-capped and providers are required to perform at a guaranteed minimum level of service.

The first phase of the program will end on 30 June 2008 when it will be reviewed. If required, the program will continue in remote areas where

high quality broadband services might still not be available and Govt. will provide funds from its $2 billion Communications Fund from 1 July 2008.

The Guarantee is part of the transition to the $600 million Broadband Connect Infrastructure Program, which is aimed to establish an efficient, sustainable broadband infrastructure base across regional Australia to enable the roll-out of higher speed broadband.

2. USA

The US Department of Agriculture (USDA) initiated programs under Rural Utilities Service (RUS) to provide grants to improve rural infrastructures providing broadband service.

One such program is Rural Broadband Access Loan and Loan Guarantee Program, which provides loans for the construction, improvement, and acquisition of facilities and equipments for broadband service in eligible rural communities. A wide variety of entities are eligible to obtain loans to serve small rural communities. Priority is given to applications that are proposing to serve areas where no residential broadband service currently exists.

Since its inception, the program has approved 70 loans in 40 states, totaling over $1.22 billion. The broadband loans serve 1,263 communities with a total of 582,000 household subscribers. Approximately 40 percent of these communities were unserved at the time of the loan approval, and an additional 15 percent had only one provider.

Another program, the Community Connect Program provides grants to deploy transmission infrastructures to provide broadband service in communities where no broadband services exist, and requires grantees to wire specific community facilities and provide free access to

broadband services in those facilities for at least 2 years. Grants can be awarded to entities that want to serve a rural area of fewer than 20,000 residents. Approximately $9 million was appropriated in 2004 as well as in 2005 for this purpose.

3. Canada

The National Satellite Initiative was launched in October 2003 by Industry Canada in partnership with Infrastructure Canada, and the Canadian Space Agency. It was created to make available affordable satellite capacity for the deployment of broadband services (such as tele-health, tele-education, e-commerce, etc.) to communities in the far to mid-north, and in isolated and remote areas of Canada, where satellite technology is the only practical solution. The Government of Canada has contributed $155 million towards the costs of implementing this initiative. Of the $155 million, $85 million provided from the "national priority project envelope" of the Canada Strategic Infrastructure Fund. Canadian Space Agency provided $50 million in form of satellite capacity. Industry Canada contributed $20 million through additional satellite capacity for public benefit.

4. Colombia

In 2005, the Colombia government budgeted US$ 25.5 million for providing broadband connectivity for public institutions, including 3,000 public schools, 624 city halls, 120 public hospitals and 30 military facilities. Compartel (Colombian USO Fund) also provided US$ 20 million to upgrade infrastructure to provide broadband services to rural and low income areas.

5. Brazil

E-Government - Services for Citizens (GESAC) is a Brazilian Government initiative for taking broadband to the communities situated in isolated and underserved areas. The project implemented by Ministry of Communications is comprised of over 3.200 localities connected through satellite, providing services like Web access, Web pages hosting, e- mail and training. Priority is given to the communities with the lowest Human Development Index (HDI). Ministry of Communication also made agreements with various ministries like Social development Ministry, Defence Ministry for leveraging the infrastructure.

Using satellite-based broadband access to the Internet, distant schools, advanced military posts, rural and border settlements and hospitals located in the most remote regions have been connected.

These centres are also used by the Social Ministry to work as Telecentres offering following services:

- Validate cards which poor people will use to by food
- Work as development centre to the community in order to market local goods

Currently, the **GESAC** is present in 3-4 per thousand points of the domestic territory and is supposed to jump for 20 per thousand up to 2008.