सत्यमेव जयते

TELECOM REGULATORY AUTHORITY OF INDIA

Recommendations

on

National Broadband Plan

8th December, 2010

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PREFACE

India today stands at the threshold of great opportunities. A growing and robust economy, a young and increasingly literate population and wide technological base give it the opportunity of emerging as a major power. At the same time, it faces the challenges of reducing poverty and inequity. World over, it has been recognised that Information and Communication Technologies play a significant role in bridging the divide between the poor and the non-poor. In our country, while voice communication has, doubtless reduced isolation, the penetration of Internet and broadband has remained low, mainly due to a limited spread of wireline telephones and non availability, so far, of Broadband technologies. With the launch of 3G services, the stage is set for rapid spread of Broadband. At the same time, there is an urgent need for a nation-wide Broadband network to reach Education, healthcare, banking and other services to all the villages. Such a network would truly help in realising the objective of inclusive growth.

It is in this context that TRAI had initiated efforts, in July, 2009, for the spread of broadband in the country. In May this year, again, it has launched a Consultation Paper on the National Broadband Plan which has received wide and enthusiastic response from all stakeholders. Based on the Consultation process, TRAI has formulated the present Recommendations suggesting a National Broadband Plan, to be executed by the year 2013. It is, doubtless, a formidable task but a task that can be achieved.

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INTRODUCTION

1. The Eleventh Five Year Plan(2007-12) of India highlights the need for inclusive growth. In the Foreword to the Eleventh Five Year Plan document, Hon'ble Prime Minister emphasised the need to ensure that growth is widely spread so that its benefits, in terms of income and employment, are adequately shared by the poor and weaker sections of our society. For this to happen, the growth must be inclusive in the broadest sense. It must occur not just in our major cities but also in our villages and small towns.[1]

2. Although only the 11th biggest economy in the world, India is the second fastest-growing behind China. According to a study by Morgan Stanley, driven by a sterling demographic dividend, continuing structural reform and globalisation, India is poised to accelerate its growth rate to 9-9.5% over 2013-15[2]. The underlying assumption in continuation of the growth story is that growth-supportive policies are continued to be implemented. The bottlenecks needs to be identified and measures initiated to ensure that the country brings on board a very large percentage of its population currently living in destitution.

3. The UN Summit on the Millennium Development Goals, from 20-22 September 2010, concluded with the adoption of a global action plan to achieve the eight anti-poverty goals by the 2015. The eight goals agreed to by the members are to: Eradicate extreme poverty and hunger, Achieve universal primary education, Promote gender equality and empower women, Reduce child mortality, Improve maternal health,

[1] Planning Commission: Eleventh Five Year Plan (2007–2012), Foreword
[2] http://economictimes.indiatimes.com/news/economy/indicators/India-to-become-worlds-fastest-growing-economy-by-2013-15-Morgan-Stanley/articleshow/6322333.cms

Combat HIV/AIDS, malaria, and other diseases, Ensure environmental sustainability & Develop a global partnership for development.[3]

4. Information and Communication Technologies (ICTs) are part of MDG and have an impact on other MDGs. Target 18 of goal 8 mentions the following: In cooperation with the private sector, make available the benefits of new technologies, especially information and communications technologies. Table 1 shows some examples as to how ICT can assist in achieving other MDGs[4]. According to UN availability of broadband is important for making important applications available to the population. To quote from The Millennium Development Goals report, 2010 available on the UN MDG website ".. a challenge in bringing more people online in developing countries is the limited availability of broadband networks. Many of the most effective development applications of ICT, such as telemedicine, e-commerce, e-banking and e-government, are only available through a high-speed Internet connection. But a significant divide exists between those who enjoy fast access to an online world increasingly rich in multimedia content and those still struggling with slow, shared dial-up links."

Table 1: How ICTs can help achieve the MDGs

Goal/Target	Role of ICTs
1. Eradicate extreme poverty and hunger	Increase access to market information and reduce transaction costs for poor farmers and traders
2. Achieve universal primary education	Increase supply of trained teachers through ICT- enhanced distance training
3. Promote gender equality and empower women	Deliver educational and literacy programmes specifically targeted to poor girls and women using appropriate technologies
4. Reduce child	Increase access of rural care-givers to

[3] United Nations: The Millennium Development Goals report, 2010
[4] Source: ITU: http://www.itu.int/ITU-D/ict/publications/wtdr_03/material/ICTs%20&%20MDGs.pdf

mortality 5. Improve maternal health 6. Combat HIV/AIDS, malaria and other diseases.	specialist support and remote diagnosis. Enhance delivery of basic and in-service training for health workers. Increase monitoring and information-sharing on disease and famine
7. Ensure environmental sustainability	Remote sensing technologies and communications networks permit more effective monitoring, resource management, mitigation of environmental risks.

5. Experts are of the opinion that the impact of broadband on the GDP is much higher than any other ICT. According to World Bank a 10% increase in broadband penetration increases GDP of a developing country by 1.38%. It is therefore natural that countries are concerned about creating a robust broadband infrastructure that would sustain high growth of broadband services. The inclusive potential of ICT is evident at two levels: the benefits that it brings to poorer communities and the capacity of individuals within these communities to participate in new economic opportunities. ICT, particularly broadband, is, therefore, seen as a powerful tool for inclusive growth.

6. ITU's ICT Development Index (IDI) captures the level of advancement of ICTs in many countries worldwide and compares the progress made in bridging the digital divide. One of the main objectives of the IDI is to measure the development potential of ICTs, or the extent to which countries can use ICTs to enhance growth and development, based on available capabilities and skills required to make effective use of ICTs and enhance their impact. India stands at 117th position (out of 159 countries) in global ICT development index **(Annexure-I)**[5] . In its 'Measuring the Information Society 2010' report released in February this year, ITU stated that most poor countries rank at the low end because of

[5] ITU- Measuring the Information Society 2010

the close relationship between ICT uptake and national income. According to ITU, while high-speed Internet access is now available in almost all countries, fixed broadband penetration in the developing world remains as low as 3.5% compared to 23% in developed countries.

7. According to estimates by Indicus Analytics, by the year 2020, the 244 million households would have increased to about 288 million across rural and urban India. Those households earning less than 75000 per annum will fall from 23 million to less than 12 million in urban India and from 96.7 million currently to less than 77 million in rural areas. If we look at the projections for consumer durables penetration, more than 80% of households are expected to have TV, 2 wheelers, Refrigerator, electric fan and Air coolers by the year 2020[6]. It is also common knowledge that the size of middle class is increasing significantly with the result that purchasing power is increasing.

8. The Indicus Analytics report further states that, by the year 2020, Health care expenditures will grow rapidly, and so will those for education. But it will be recreation and communication that will drive household expenditure the most (Table 3). The Indian household will move more and more towards lifestyle enhancing expenditures[7].

Table 3: Expenditure of Households: Services[10]

	2000-01	2009-10	2019-20
Medical Care & Health Services	12%	11%	9%
Transport & Communication	36%	31%	25%
Personal Transport Equipment	2%	2%	1%
Operation Of Personal Transport Equipment	11%	7%	4%
Purchase of Transport Services	20%	15%	9%
Communication	4%	7%	10%
Recreation, Education & Cultural	9%	10%	11%

[6] India 2010 to 2020, Indicus Analytics, December 28, 2009
[7] India 2010 to 2020, Indicus Analytics, December 28, 2009

Services			
Education	5%	5%	4%
Others	4%	5%	7%
Miscellaneous Goods & Services	21%	24%	27%
Household Services And Durables	**100%**	**100%**	**100%**

Source: Expenditure Spectrum of India, 2009-10, Indicus Analytics

ICT role in development

9. Economy of the country and ICT has a recursive relationship. They help each other grow. However, this does not happen by itself. Appropriate measures need to taken to ensure that the window of opportunity is not lost. Broadband is by far the most important element of ICT today, having the largest impact of GDP. Broadband enables improved performance of ICTs which in turn have a fundamental impact on the way economies work and contributes to productivity growth by expanding markets, increasing business efficiency and reinforcing competitive pressure. Relative to other historical general purpose developments, such as railways and electricity, the impacts may be larger and materialize more rapidly. Broadband infrastructure enables country-wide facilities like health care, education, energy, job training, civic engagement, Government performance and public safety. As per the World bank, in low- and middle-income countries every 10 percentage point increase in broadband penetration accelerates economic growth by 1.38 percentage points—more than in high-income countries and more than for other telecommunications services. In a similar study, McKinsey & Company estimated that ―a 10 percent increase in broadband household penetration delivers a boost to a country‘s GDP that ranges from 0.1 percent to 1.4 percent.

10. Unfortunately, on the world stage India’s broadband story has not, so far, been impressive. In absolute terms China and USA had about 120 million and 85 million connections respectively by June 2010 in

comparison to India's 10 million. In a report[8] comparing Internet and PC penetration of BRICI countries (Brazil, Russia, India, China, and Indonesia), Boston Consultancy Group states that penetration in India is lowest on both counts.

11. Several countries worldwide, for example, the US, Japan, Australia, Canada, Portugal, South Korea, Germany, Singapore and Finland have identified broadband as a potential infrastructure, enabling the national economic & social growth and already developed national plans for creating nationwide broadband network reaching the unconnected areas. The Governments of these countries have also allocated suitable financial resources for creating countrywide high speed broadband network. Studies worldwide suggest positive returns from investment in broadband infrastructure. For example, an analysis for the European Commission estimates that broadband can create more than two million jobs in Europe by 2015, and an increase in GDP of at least EUR 636 billion. A study in Brazil reported that broadband added up to 1.4% to the employment growth rate. In China, every 10% increase in broadband penetration is seen as contributing an additional 2.5% to GDP growth.

Initiatives taken so far

12. The Authority has taken a number of initiatives in the past to promote the growth of broadband. These include the Authority's recommendation on Accelerating Growth of Internet and Broadband Penetration dated April 29, 2004 after which the Government issued Broadband Policy in December 2004 laying down the targets for broadband connections. It was estimated that the broadband connections would grow to 9 million

8 BCG Report: The Internet's new Billion: Digital Consumers in Brazil, Russia, India, China and Indonesia

by the end of year 2007 and 20 million connections by the end of year 2010 in India.

13. Till now, the main emphasis has been on DSL technologies. Since spectrum for 3G and BWA services has now been auctioned, mobile broadband sector will also gain momentum. The Authority is of the view that it is the appropriate time to treat the next decade as **"Digital Decade".**

14. Despite the known benefits of broadband, it is a matter of concern that India had just 10.29 million broadband connections in the country at the end of September 2010 as against the target of 20 million broadband subscribers by 2010, set by the Broadband Policy 2004. The net broadband addition per month is just 0.2 to 0.3 million in contrast to around 18 million mobile connections per month.

15. The availability of 3G and Broadband Wireless Access (BWA) technologies augur work for the growth of broadband. With a vice to accelerating the growth of broadband, TRAI submitted a proposal of taking the Broadband to all the villages to the Cabinet Secretary on 6th July 2009. Government constituted an Inter Ministerial Committee on 4th August 2009 under the Chairmanship of the Administrator, USOF to draw an action plan for extending broadband connectivity to all villages in the country. The committee submitted a concept paper to Department of Telecommunications in January 2010. This paper is under consideration of DoT. TRAI has also perused the report on "Broadband connectivity to Panchayats" by Shri Sam Pitroda, Advisor to PM, Public Information Infrastructure and Innovations. Vide a letter dated 1.4.2010 from Department of Telecommunications (DoT) (**Annexure-II**), sought the recommendations of the Authority on review of the definition of Broadband connectivity.

16. A consultation paper was issued on 10th June 2010 to seek the views of stakeholders for the formulation of a National Broadband Plan. The comments were posted on the TRAI web-site and open house discussions were held with all stakeholders on 6th September 2010 and 19th October 2010 at Hyderabad and New Delhi respectively. These recommendations are a result of above consultation process.

17. These recommendations seek to:

A. Make proposals for formulation of a National Broadband Plan
B. Propose an institutional framework
C. Suggest time schedule for creating a robust broadband infrastructure
D. Make proposals for funding of the creation of the broadband infrastructure
E. Review the definition of broadband;
F. Address regulatory and other measures required to achieve introduction and adoption of broadband.

Structure of these recommendations

18. Chapter 1 discusses International experiences regarding Broadband. Chapter 2 gives present status of broadband. Chapter 3 discusses factors influencing Broadband Demand elaborating present status and potential for broadband demand. Various factors affecting the demand like affordability, applications and content, awareness, literacy, utilization etc. are also dealt with in detail in this chapter. Chapter 4 deals with assessment of network requirement. Chapter 5 discusses the National Broadband Plan Chapter 6 deals with measures to improve broadband use. Chapter 7 gives the framework of National Broadband Plan.

CHAPTER 1: INTERNATIONAL EXPERIENCE

1.1. The importance of broadband has been recognized worldwide. According to ITU, for Governments, broadband is a way of promoting economic development and social benefits; for telecommunication companies, broadband offers a route to offset the current slowdown in the industry; for businesses, in particular small- and medium-sized enterprises, broadband brings the advantages of access to high-speed communications, and the ability to reach a worldwide audience that were previously only available to larger companies.

1.2. Countries world over have recognized the need for national broadband networks. National broadband network rollout becomes economically viable for two reasons. Firstly, research consistently shows that investment in any ICT has a direct positive effect on GDP growth. Secondly, broadband networks very quickly pay for themselves through the benefits that get delivered across society in many different ways. Since broadband network rollout can effectively be financed by innovation and cost-savings in sectors such as health, education, energy and transport, this makes them incredibly cost effective. Recent estimates show that, in some countries, cost savings of 0.5% to 1.5% over ten years in these four key sectors alone, could justify the cost of building national point-to-point, fibre optic networks[9].

1.3. Korea is the leading example of a country rising from a low level of ICT access to one of the highest in the world[10]. At the turn of the millennium, the Republic of Korea had a broadband penetration of just 1%. To promote adoption of Broadband, the Korean Government launched Cyber

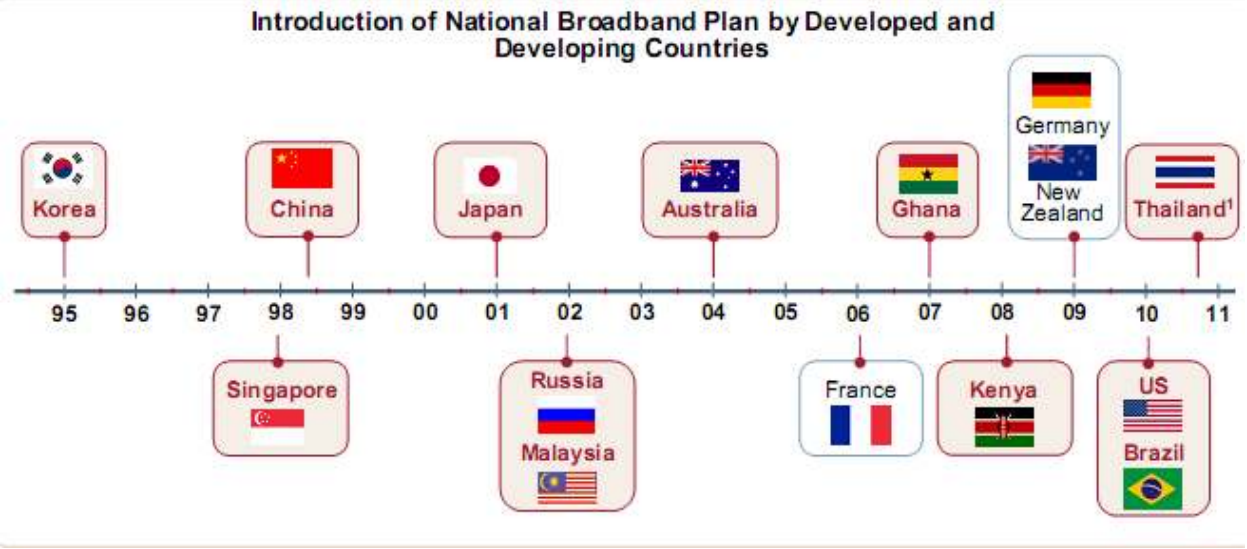
[9] ITU- **Speech by ITU Secretary-General,** http://www.itu.int/en/osg/speeches/pages/2010-03-08-2.aspx
[10] ITU: Broadband Korea: Internet case study March 2003

Korea 21, a programme offering affordable IT education to marginalized groups like housewives, the elderly, and the disabled. Complementing this, Korea embarked on a wide-ranging e-government programme, investing US$ 24 billion in a national fibre backbone that provides more than 28,000 Government departments and agencies with fast broadband access. Today, Korea is one of the world's most advanced broadband markets – standing well ahead of either the US or Canada, for example – demonstrating the power of political will in bringing broadband to the people.[11]

1.4. The Internet is largely recognized as a general purpose technology, and broadband is regarded as a basic infrastructure, in the same way as electricity, water or roads. Many even consider the Internet as a "fundamental human right," and some countries have started to put in place legislation stipulating that access to the Internet is a human right for their citizens[12]. Finland has declared Internet as a legal right. Recognizing the importance of broadband, several countries have developed their "National Broadband Plan", which has country-specific broadband goals along with detailed action plans. Figure 1 shows introduction of broadband in some of these developed and developing countries. Some of the International practices in respect of broadband initiatives are discussed in subsequent paragraphs.

[11] ITU- **Speech by ITU Secretary-General,** http://www.itu.int/en/osg/speeches/pages/2010-03-08-2.aspx
[12] World Telecommunication/ICT Development Report 2010

Figure1.1: Introduction of National Broadband Plan by developed and developing countries[13]



Note 1: National Broadband plan not yet launched. (Thailand)

AUSTRALIA[14]

1.5. At the end of June 2010, there were 9.6 million active Internet subscribers in Australia. The phasing out of dial-up Internet connections continued with nearly 92% of Internet connections now being non dial-up. Australian also continued to access increasingly faster download speed of 1.5 Mbps or greater. Australia now plans to build a high speed National Broadband network in order to revolutionize workplace and services including Education and health. It has passed a legislation to this effect in November 2010. The Government's National Broadband Network will be built and operated by a new company specifically established by the Australian Government to carry out this project. The Government will be the majority shareholder of this company, but significant private sector investment in the company is anticipated.

[13] Source: Analysis mason

[14] Source: Australian Government, Department of Broadband, Communication and the Digital Economy website, http://www.abs.gov.au/ausstats/abs@.nsf/mf/8153.0/, http://www.minister.dbcde.gov.au/media/media_releases/2010/101, http://www.dbcde.gov.au/broadband/national_broadband_network

1.6. The new National Broadband Network will Connect 90 percent of all Australian homes, schools and workplaces with broadband services with speeds up to 100 megabits per second, 100 times faster than those currently used by many households and businesses. It aims to Connect all other premises in Australia with next generation wireless and satellite technologies that will deliver broadband speeds of 12 megabits per second. The plan when implemented directly support up to 25,000 local jobs every year, on average, over the 8 year life of the project. Under the Government's new national broadband network every house, school and business in Australia will get access to affordable fast broadband.

1.7. The Government's National Broadband Network will be built and operated by a new company specifically established by the Australian Government to carry out this project. The Government will be the major shareholder of this company, but significant private sector investment in the company is anticipated. The Government will make an initial investment in this company but intends to sell down its interest in the company within 5 years after the network is built and fully operational, consistent with market conditions, and national and identity security considerations. This company jointly owned by the Government and the private sector will invest up to $43 billion over 8 years to build the national broadband network. The Government's investment in the company will be funded through the Building Australia Fund and the issuance of Aussie Infrastructure Bonds (AIBs), which will provide an opportunity for households and institutions to invest in the national broadband network. The network will provide provide fibre optic transmission links connecting cities, major regional centres and rural towns. It is expected to be rolled-out, simultaneously, in metropolitan, regional, and rural areas, covering all towns with a population of more than 1000 to achieve 90 per cent coverage of the FTTP network, and

remaining coverage to be delivered through wireless and satellite technologies.

EUROPEAN UNION[15]

1.8. The EU continues to be the largest broadband market in the world. In January 2010, there were 123.7 million fixed broadband lines, up 9 % since January 2009, and the average fixed broadband penetration rate in the EU reached 24.8 %, up 2 percentage points over one year. Mobile broadband take-up is growing in EU. The deployment of high-capacity broadband on the other hand is currently limited. While 83.4 % of fixed broadband lines in the EU offer speeds above 2 Mbps, only 23.2 % are above 10 Mbps. Growth in mobile broadband was significant in a number of EU countries in 2009. The estimated number of dedicated mobile broadband cards (25.1 million) corresponds to about 20 % of all fixed broadband connections, up from 10 % in 2008.

1.9. The Digital Agenda is Europe's strategy for a flourishing digital economy by 2020. The overall aim of the Digital Agenda is to deliver sustainable economic and social benefits from a digital single market based on fast and ultra fast Internet and interoperable applications. The Europe 2020 Strategy has underlined the importance of broadband deployment to promote social inclusion and competitiveness in the EU. It restated the objective to bring basic broadband to all Europeans by 2013 and seeks to ensure that, by 2020, (i) all Europeans have access to Internet speeds of above 30 Mbps; and (ii) 50% or more of European households subscribe to Internet connections above 100 Mbps.

[15] Europe's Digital Competitiveness Report, 2010, http://ec.europa.eu/information_society/digital-agenda/documents/edcr.pdf, European Commission's A Digital Agenda for Europe, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0245:FIN:EN:PDF

1.10. As per digital agenda for Europe, the Commission will work out an ambitious European Spectrum Policy Programme in 2010 for decision by the European Parliament and the Council that will create a co-ordinated and strategic spectrum policy at EU level to increase the efficiency of radio spectrum management and maximise the benefits for consumers and industry;

1.11. Member States would develop and make operational national broadband plans by 2012 that meet the coverage and speed and take-up targets defined in Europe 2020, they would also take measures, including legal provisions, to facilitate broadband investment, including issues such as Right of Way. The member states would use fully the Structural and Rural Development Funds that are already earmarked for investment in ICT infrastructures and servicesand implement the European Spectrum Policy Programme.

FINLAND[16]

1.12. Broadband Access a Legal Right: Finland is the first country in the world to make high-speed Internet access a legal right, obliging operators to provide connections of at least 1Mbps to every citizen. The Finnish Government reviewed its communications policy guidelines in December 2008. The guiding principle has been that telecommunications operators are responsible for supplying communications services on market terms. In future, however, if adequate communications services cannot be provided on commercial terms only, public aid may also be used to ensure that services are available to all.

[16] Source: Digital Britain report, June 2009

1.13. In the policy review, two aims were set for the development of broadband connections: a downstream rate of 1 Mbit/s by 2010 and 100 Mbit/s by 2015.By 2010, at the latest, every permanent residence and permanent office of business or public administration body would have access to a fixed or wireless subscriber connection with an average downstream rate of at least 1 Mbit/s. The rate of 1 Mbit/s has been defined as a universal service which a telecom operator subject to a universal service obligation must provide to permanent residences and business offices at a reasonable price by 1 July 2010 at the latest. By the end of 2015 practically all (more than 99 percent of population) permanent residences and permanent offices of business or public administration bodies will be no more than two kilometres reach to an optical fibre or cable network permitting 100 Mbit/s connections.

1.14. The Finnish Government also offers a tax deduction and installation of communications connections so that end-users that pay for subscriber connection costs themselves benefit from the deduction. All future transport infrastructures will be pre-installed with tubes into which optical fibre may later be installed, or "blown".

GERMANY[17]

1.15. Germany currently has good broadband penetration that compares well against international levels. Over 98 % of all German households have broadband with transmission rates of at least 384 kbps. Based on the currently accepted broadband definition of at least 1Mbps, penetration amounts to approximately 92%. Well over 70 % of households have access to transmission rates of at least 2Mbps, while some 20 % can avail of high-speed Internet access through VDSL connections with up to

[17] Federal Ministry of Economics and Technology: Innovation policy, information society, telecommunications- "The Federal Government's Broadband Strategy", February 2009

50 Mbps. Some 21million of the 23million broadband connections in service today are DSL lines operating through the standard telephone network.

1.16. In February 2009, the German Government issued "The Federal Government's Broadband Strategy". Working together with the federal states (Länder), local authorities and industry, the Federal Government intends to give a massive boost to the development of the broadband network in Germany. The aim is to have nationwide capable broadband access by no later than the end of 2010 and a total of 75 percent of households should have high speed broadband access with transmission rates of at least 50 Mbps by 2014.

1.17. Measures to achieve the short-term target of achieving blanket coverage capable of broadband access will focus mainly on sustaining and expanding financial support for local authorities and using instruments to improve financing options available to companies. The long-term goal of developing high-speed networks nationwide will be achieved by applying in addition more incentivised elements within the European regulatory framework. Apart from offering financial support, the package of measures will also provide stimulus to use synergies from infrastructure projects.

JAPAN

1.18. As of March 2010, Internet users in Japan is 94.08 million of which 32.04 million are Broadband subscribers of this 32.04 million, 17.79 million have FTTH facility while 9.74 million are covered by DSL and 4.35 million by cable. An average speed of 100Mbps to 1Gbps is available to all household on FTTH, while DSL offers a speed of 50 Mbps.

1.19. Japan Strategy 2015 seeks to utilize digital technologies, creating a condition of digital inclusion throughout the economy and society. The scope of the strategy covers following three priority areas:

(a) Electronic Government and Electronic Local Government
(b) Healthcare and Health Fields
(c) Education and Human Resource Fields

1.20. It also aims at development of infrastructure for existing industries, including small and medium enterprises and development of infrastructure for e-commerce that enables joint material procurement, joint sales, etc.

NEW ZEALAND[18]

1.21. In New Zealand, the number of broadband subscribers was 1.3 million in June 2010. Sixty % of broadband subscribers had a data cap of 5GB or more. Subscribers with upload speeds of 256kbps or more account for nearly 80 % of broadband subscribers.

1.22. The Ministry for Communication and Information Technology issued "The Digital Strategy 2.0" in response to the changes and challenges of a rapidly evolving digital world. In the next five years, the Government is committed to delivering fibre-to-the-premise connections to businesses and public institutions (such as secondary schools, tertiary and research institutes, hospitals and libraries) in major centres, and significantly increased bandwidth connections throughout the entire country. This will enable speeds of a gigabit or more. Openness is a central principle of Digital Strategy 2.0. Any network sponsored by Government has to conform to open access principles. Open access means multiple

[18] http://www.med.govt.nz/templates/StandardSummary____43904.aspx, http://www.stats.govt.nz/browse_for_stats/industry_sectors/information_technology_and_communications/ISPSurvey_HOTPJun10.aspx

connection providers can use the infrastructure to offer services to consumers.

1.23. The Government will invest at least $500 million into broadband infrastructure over the next five years, to get fast broadband to New Zealand homes and businesses. $340 million of this investment was announced as the first stage of the Broadband Investment Fund (BIF).

1.24. This Strategy recognises the convergence of broadcasting, telecommunications and the IT sectors. Over the next two years, the Government will ensure that conditions are in place for innovation to flourish across these converging sectors.

1.25. By following the policy, New Zealand aims to rank in the top half of the OECD for broadband uptake, speed and coverage by the year 2010. By the year 2012, 80 % of users will have access to broadband connections of 20 Mbps or higher and 90 per cent will have access to 10 Mbps or higher. Open-access urban fibre networks will be operating in at least 15 cities and towns. Terrestrial broadband coverage for 93 to 97 % of the population, with more affordable satellite solutions for remote locations. By the year 2018, 80 per cent of homes or premises will have access to fibre, or equivalent high-bandwidth capable technology. 90 % of users will have access to broadband connections of 20 Mbps or higher.

UNITED KINGDOM

1.26. As at the end of year 2009, the Number of fixed residential broadband connections in the UK was 16.8 million. 71% of the adults have broadband facility of which 15% have mobile broadband facility. The average broadband speed in the UK is 5.2Mbps.

1.27. As per Digital Britain Report of June 2009, the goal is to secure the UK's position as one of the world's leading digital knowledge economies. The report sets out a vision for some of the UK's critical communications issues, and aims at enabling Britain to be a global centre for the creative industries in the digital age, delivering an ever wider range of quality content, including public service content, within a clear and fair legal framework; The Digital Britain report set out 86 recommendations and actions across a wide range of areas. These include:

(a) Delivery of a Universal Service Commitment in broadband at a level of 2Mbps by 2012, and establishment of a Project to deliver at least 90% coverage of Next Generation broadband to homes and businesses by 2017.

(b) Delivery of a Digital Radio Upgrade from FM to DAB and from MW to FM, by the end 2015;

(c) Establishment of a work programme to improve digital skills in the UK, to ensure that the demands are met of sectors such as digital information and communications that are vital to the future of the UK economy and to enable UK citizens to participate fully in the wider benefits of the digital economy; and

(d) Encouraging investment in this new technology - which could increase web speeds to up to 100 Mbps - by giving companies maximum incentives to invest.

USA[19]

1.28. Federal Communications Commission (FCC) formulated the National Broadband Plan in 2010. The plan recommends the six goals to serve as

[19] http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-301294A1.pdf & US National Broadband Plan

a compass over the next decade including (i) At least 100 million U.S. homes should have affordable access to actual download speeds of at least 100 Mbps and actual upload speeds of at least 50 Mbps. (ii) Every American community should have affordable access to at least 1 Gbps broadband service to anchor institutions such as schools, hospitals and Government buildings.

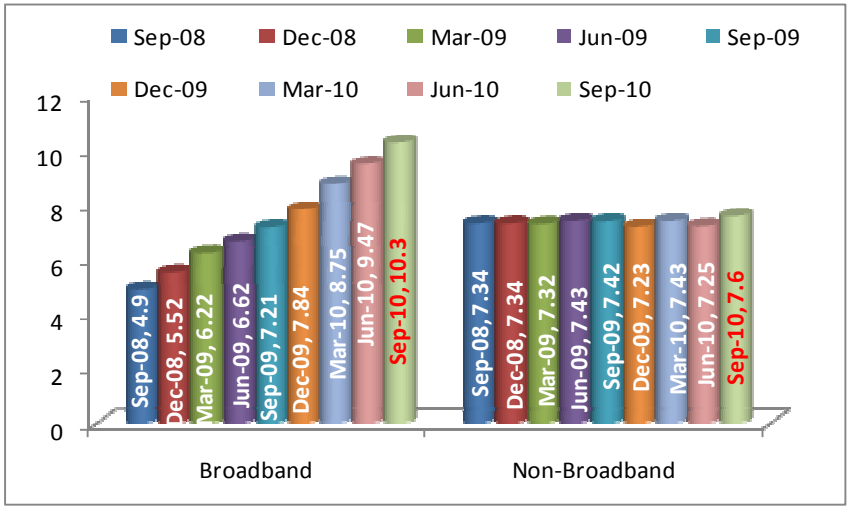
1.29. The Plan envisages making available 500 MHz of spectrum for the broadband services, as well as creating incentives for universal availability and adoption of broadband. It also aims at ensuring universal access to broadband network services through utilisation of the Connect America Fund (CAF) to support the provision of affordable broadband and voice. It also envisages the launching a National Digital Literacy Corps to organise and train youth and adults to teach digital literacy skills.

CHAPTER 2: PRESENT STATUS OF BROADBAND

A- BROADBAND STATUS IN INDIA

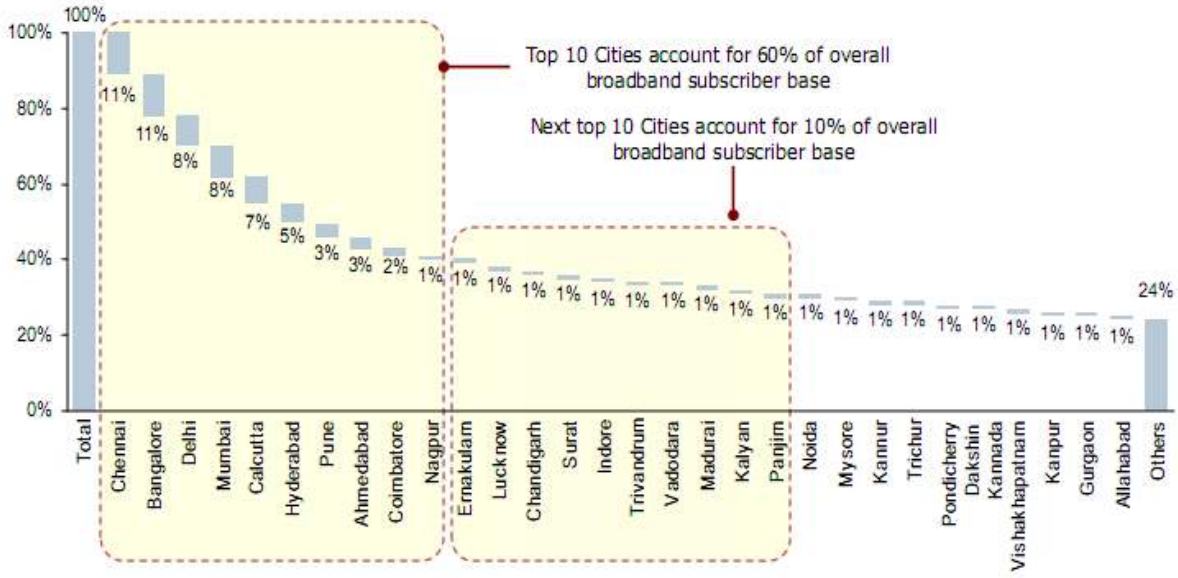
2.1. Pursuant to recommendations of TRAI, Government formulated Broadband Policy of 2004. In this policy, broadband was defined as an "always on" connection with downloads speeds of 256 kbps or more. There were 0.18 million broadband connections at the end of March 2005. These broadband connections have grown to 10.30 million by the end of September 2010. Considering the growth during the 5 year period from 1st April 2005 to 31st March 2010, the Cumulative Annual Growth Rate (CAGR) iso about 117%. A comparison of quarterly growth for the last two years is given in Figure 2.1. In the quarter ending September-2010, broadband registered a quarterly growth of 8.8% and Y-O-Y growth of about 43%. Non broadband Internet connections consist of dial up connections working upto 56.6 kbps and other connections with speeds less than 256 kbps.

Figure 2.1: Internet & Broadband Connections in Millions



2.2. The broadband growth has not only been slow but also biased in favour of urban areas. More than 60% broadband subscribers are in the top ten metros and tier-I cities and more than 75% connections are in top 30 cities. Just 5% of the broadband connections are in rural areas which is meagre compared to about 31% of total mobile telephone connections in rural areas. Figure 2.2 gives the broadband penetration for top 32 cities.

Figure 2.2: Broadband DSL Connections by Cities

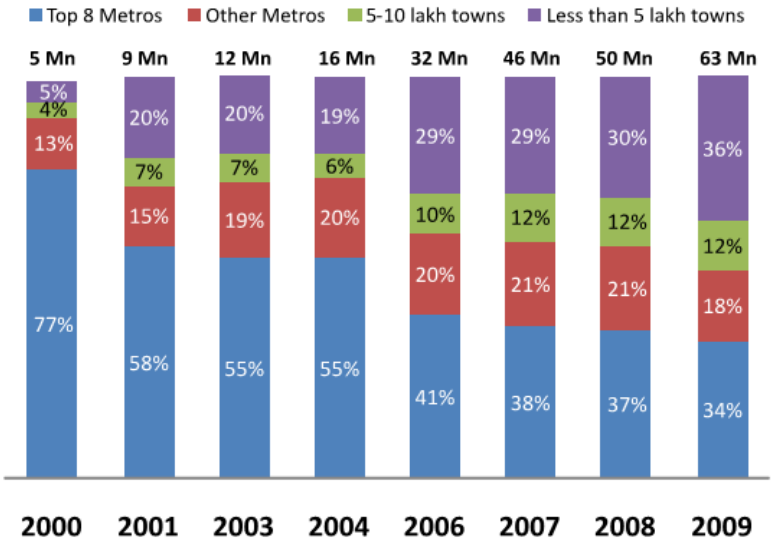


Source: CII Study[20]

2.3. In comparison, Internet services through non-broadband connections have penetrated well in smaller cities & towns (with population less than 0.5 million). In these cities, Internet usage has grown from 5% in year 2000 to 36% in year 2009[21]. Smaller towns have overtaken top 8 metros in terms of Internet usage. Figure 2.3 gives the spread of the Internet across different category of cities and towns.

[20] Deployment models and required investment for developing rural broadband infrastructure in India
[21] IAMAI & IMRB I CUBE Report 2009 -10

Figure 2.3: Internet Spread across the Cities



Source: IMRB & IAMAI I-cube report 2009-10

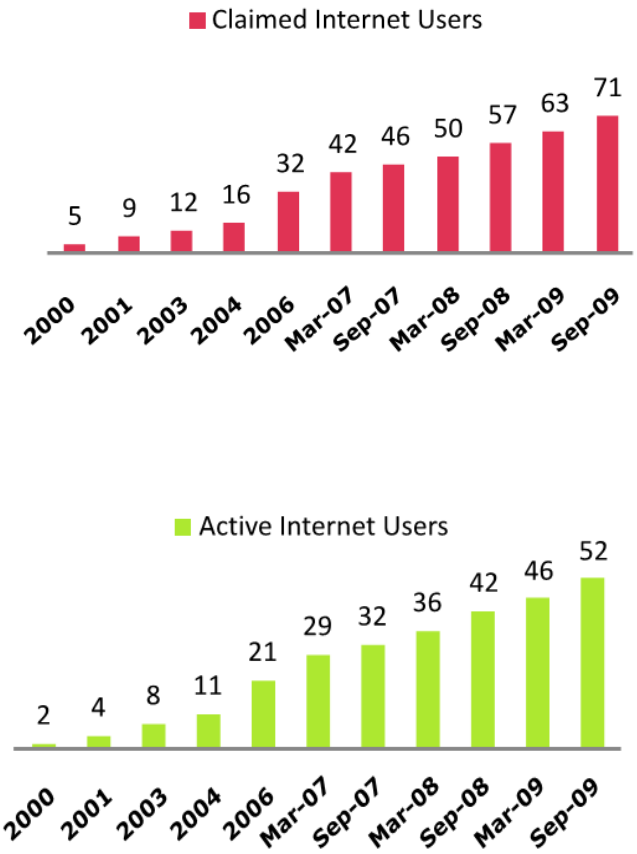
2.4. In India, claimed Internet users[22] have increased by 20% between September 2008 and September 2009. Similarly active Internet users[23] have increased from 42 million to 52 million from September 2008 to September 2009. Nearly 25% of Indian population stays in cities. Out of which, 32% of them are PC literate. Of the PC literate population, 72% claim to have used the Internet, of whom 73% are actively using Internet. The penetration of Internet usage is low at 24% (i.e. claimed Internet user / urban population) among urban individuals[24]. This indicates that a person capable of using the Internet is not using it due to a perceived lack of utility. Figures 2.4 gives details of claimed and active Internet users.

22 Claimed Internet user is an individual who has used at any point of time in the past. This gives indication that how many Indian has experienced the Internet in their lifetime.

23 Active Internet User is an individual who has used Internet at least once in the last month.

24 IAMAI & IMRB I-Cube report 2009-10.

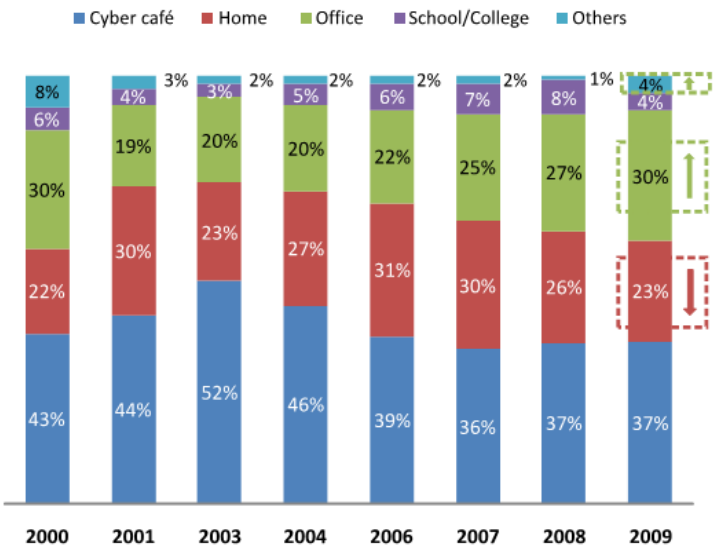
Figure 2.4: Internet Users claimed and active



Source: IAMAI & IMRB Survey- I-cube report 2009-2010

2.5. A large proportion of users access Internet from office and cyber café. Cyber cafes continue to dominate the share (37%) among various sources. However, accessing Internet through home has steadily declined over the years. This year, an interesting pattern has emerged with 4% of users accessing this medium through alternative sources such as mobile and kiosks. Figure 2.5 gives locations from where users access the Internet.

Figure 2.5: Internet Access points



Source: IMRB & IAMAI I-cube report 2009-10

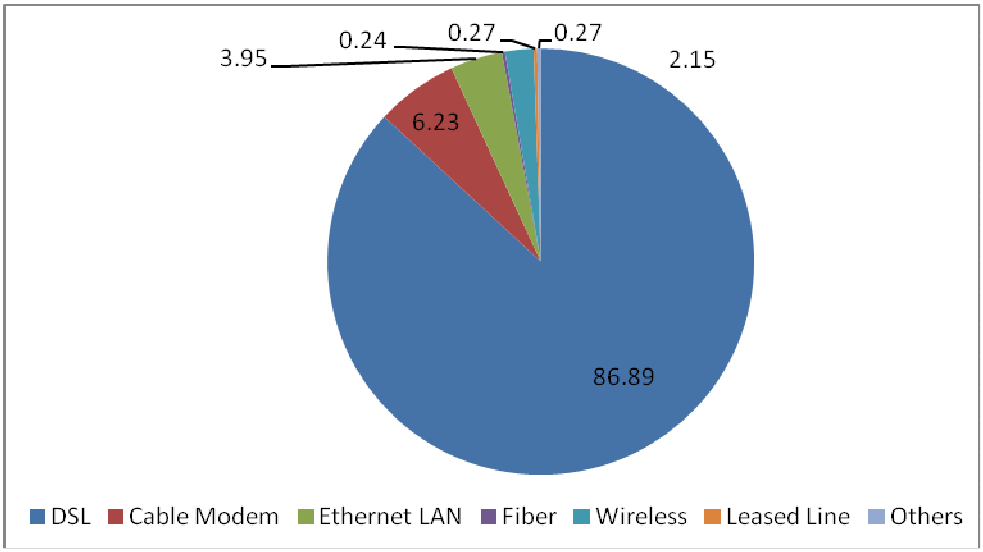
2.6. There were about 1.8 million data card subscribers at the end of September 2010, whose advertised speed is upto 3.1 Mbps. There are also 274.05 million wireless data subscribers who are able to use the Internet from their mobile device at the end of September 2010. At the end of September 2010, a growth of 94.11% on year-on- year basis has been noted in wireless data subscribers. However, most of these are on 2G mobile networks with limited data capabilities.

B – PREDOMINANT TECHNOLOGIES

2.7. While broadband has been deployed using Cable Modems, xDSL technologies, fiber and wireless, in India xDSL has been predominantly used. xDSL can be easily deployed on existing copper pairs going to subscriber's premises. Figure 2.9 gives the technology wise breakup of broadband connections. It is evident from the figure that 86.89% of total broadband connections are on DSL. The most common DSL technology deployed is ADSL2 and ADSL 2+. These technologies typically support

download speed upto 2 Mbps for copper loop length of less than 3 Km from the exchange. Higher speeds are possible on shorter loop lengths and pre-qualified copper pairs.

Figure 2.9: Technology wise broadband connections (In Percentage- September 2010)

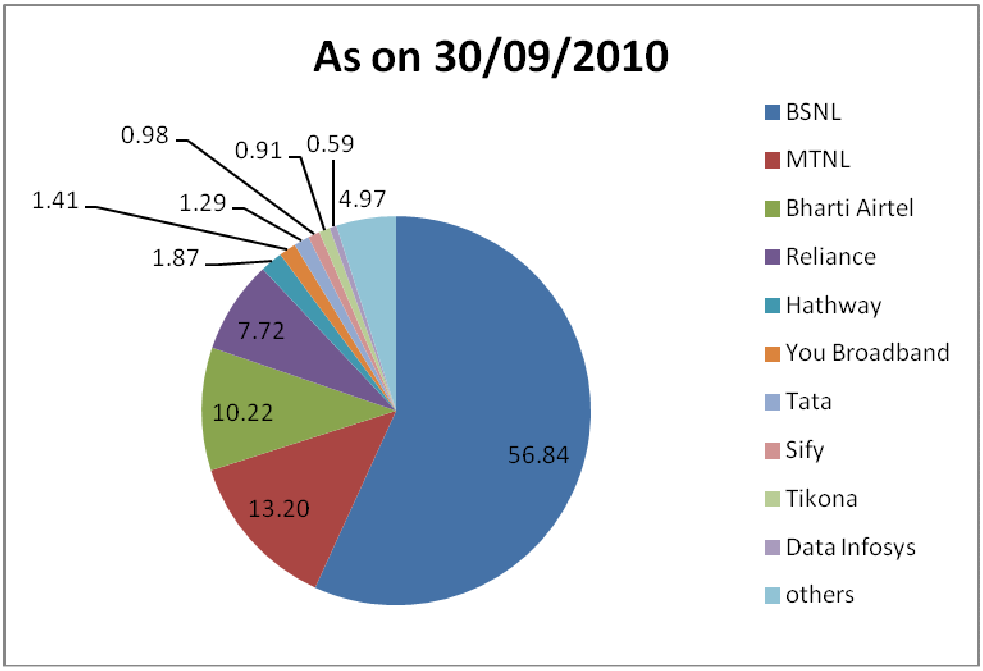


Source: TRAI

C – BROADBAND MARKET

2.8. Internet Service Providers (ISPs), Unified Access Service Licensees (UASLs), Cellular Mobile Service Providers (CMSPs) and Basic Service Operators (BSOs) are permitted to provide broadband access under the existing licensing framework. There are 105 service providers who are currently providing broadband services. However, top ten service providers have captured more than 95% of market and top 5 service providers have about 90% share. State owned companies BSNL and MTNL together have about 70% market share. This indicates that despite of having license for provisioning of broadband services, majority of service providers are unable to penetrate into the market and market is still dominated by few players only. Figure 2.10 gives the market share of different service providers.

Figure 2.10: Market Share of Broadband

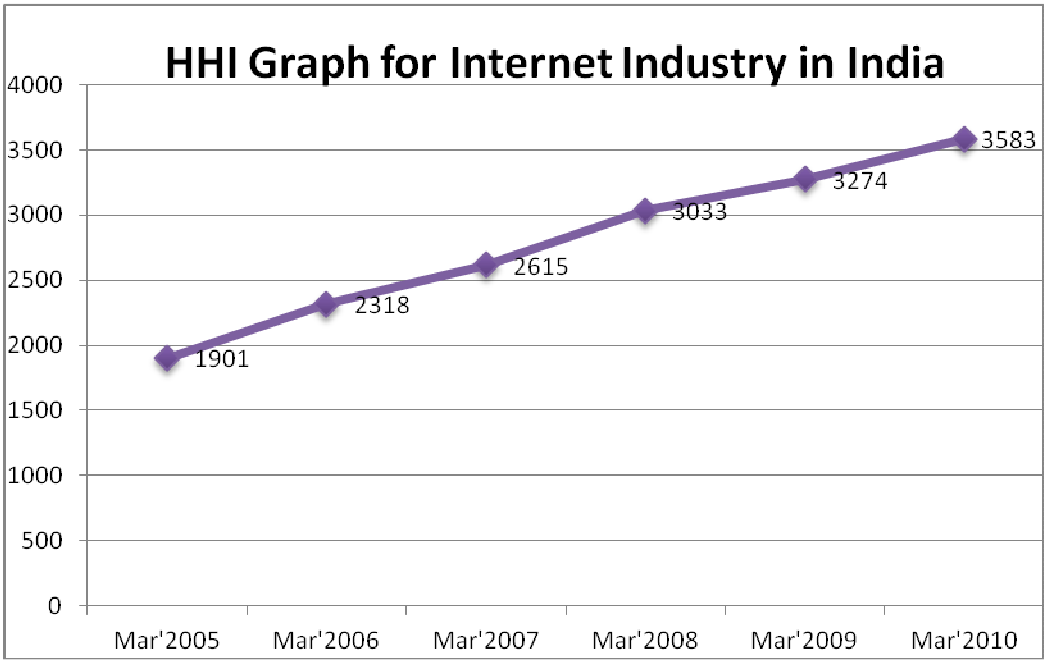


Source: TRAI

2.9. One way to assess concentration of market power is by using HHI[25] (Herfindahl-Hirschman Index). Based on market share of top 10 service providers, HHI changes in the last five years is given in figure 2.11. The figure shows that not only the market is concentrated but the concentration is getting worse with time.

25"HHI" means the Herfindahl-Hirschman Index, a commonly accepted measure of market concentration. It is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers. Value of HHI more than 1800 is considered as concentrated market.

Figure 2.11: HHI of Indian Internet Market



D– BROADBAND TARIFF TRENDS

2.10. Although broadband penetration is low in India, the entry level 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 service providers are charging broadband monthly rental between Rs 200/- to Rs 1600/- and providing various options for data transfer. Some service providers even provide unlimited download packages. Some of the service providers are already offering broadband services having zero rental schemes. However, in such schemes per Mb download charges are comparatively high ranging from Rs. 1.00/- to Rs. 2.00/- per Mb.

E – INDIA'S COMPARATIVE POSITION

2.11. ITU's ICT Development Index (IDI) captures the level of advancement of information and communication technologies (ICTs) in many countries worldwide and compares progress made. Its main objective is to provide

policy makers with a useful tool to benchmark and assess their information society developments and to monitor progress that has been made globally to close the digital divide.

2.12. The index combines 11 indicators into a single measure that can be used as a benchmarking tool globally, regionally and at national levels. It includes such indicators as households with a computer, the number of fixed broadband Internet subscribers and literacy rates. India stands at 117th position (out of 159 countries) in global ICT development index and at 20th position (out of 27 countries) in ICT development index of Asia Pacific region (refer table 2.1).

Table 2.1 : ICT Development Index (IDI), 2008, 2007 & 2002
Asia Pacific Region

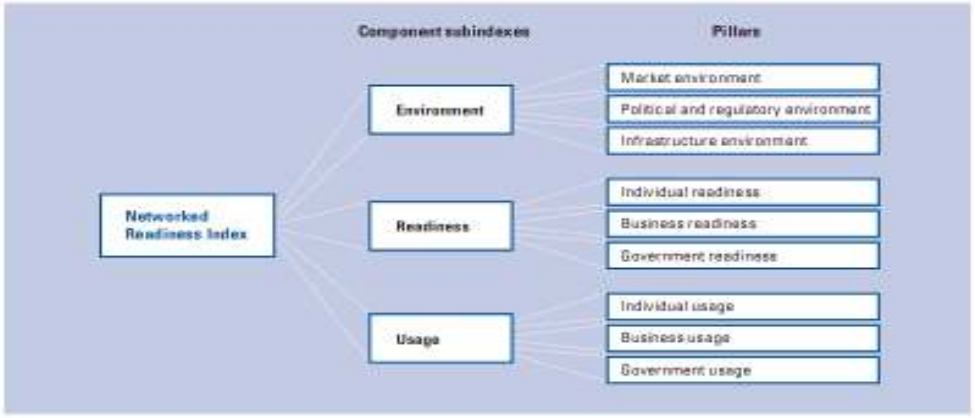
Economy	Regional rank 2008	World Rank 2008	IDI Value 2008	World Rank 2007	IDI Value 2007	World Rank 2002	IDI Value 2002	Rank change 2007-2008
Korea (Rep.)	1	3	7.68	2	7.23	2	5.84	-1
Japan	2	8	7.12	7	6.89	17	4.79	-1
Hong Kong, China	3	11	7.04	10	6.78	12	4.98	-1
Singapore	4	14	6.95	15	6.47	16	4.79	1
Australia	5	15	6.90	14	6.51	14	4.97	-1
New Zealand	6	16	6.81	16	6.38	18	4.72	0
Macao, China	7	24	6.29	28	5.73	23	4.33	4
Brunei Darussalam	8	42	5.07	42	4.77	39	3.25	0
Malaysia	9	56	3.96	55	3.66	50	2.71	-1
Maldives	10	68	3.54	72	3.11	87	1.97	4
Thailand	11	76	3.27	75	3.03	74	2.13	-1
China	12	79	3.23	77	3.03	90	1.96	-2
Iran(I.R.)	13	84	3.08	86	2.73	92	1.94	2
Viet Nam	14	86	3.05	93	2.61	106	1.59	7
Philippines	15	90	2.87	95	2.61	81	2.02	5
Fiji	16	91	2.81	88	2.69	85	2.00	-3
Mongolia	17	95	2.71	94	2.61	86	1.98	-1
Sri Lanka	18	105	2.51	104	2.32	99	1.74	-1

Indonesia	19	107	2.46	108	2.15	109	1.57	1
India	20	117	1.75	116	1.62	116	1.21	-1
Lao P.D.R.	21	118	1.74	117	1.60	123	1.09	-1
Myanmar	22	119	1.71	118	1.60	104	1.66	-1
Cambodia	23	120	1.70	120	1.53	122	1.10	0
Bhutan	24	123	1.62	124	1.48	117	1.15	1
Pakistan	25	128	1.54	127	1.45	144	0.92	-1
Bangladesh	26	137	1.41	137	1.34	128	1.05	0
Nepal	27	142	1.34	141	1.27	131	1.04	-1
Papua New Guinea	28	151	1.08	150	1.06	137	0.99	-1

Source: Measuring the Information Society 2010, ITU-D

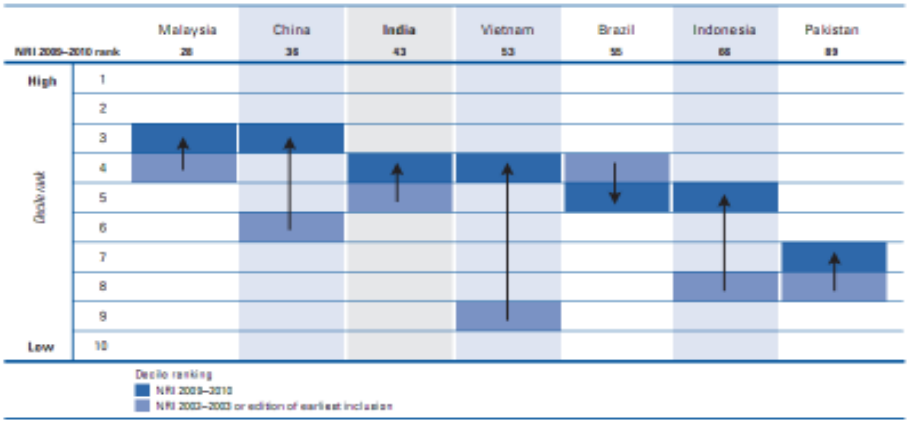
2.13. According to the World Economic Forum India is ranked 43rd out of 133 economies in the Network Readiness Index (NRI)[26] 2009–2010, with an impressive 11-place improvement since 2008. (refer figure 2.6) [27]. India stands at 22nd position among 133 countries in Government success in ICT promotion.

[26] The framework illustrated in Figure below translates into the NRI, whose three main building blocks or subindexes (environment, readiness, and usage) comprise a total of 68 variables, regrouped into the following nine pillars:



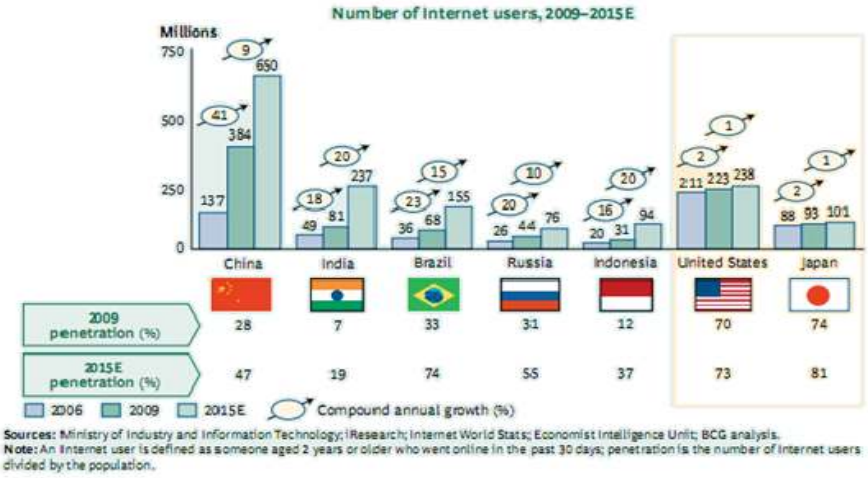
[27] , [2] Global Information Technology Report 2009-2010, world economic forum

Figure 2.6: Network Readiness Index 2002-2009



2.14. In a report[28] comparing Internet and PC penetration of BRICI countries (Brazil, Russia, India, China, and Indonesia), Boston Consultancy Group states that penetration in India is lowest. Penetration of Internet users in India was only 7%, which is expected to reach 19% by 2015 (refer figure 2.7). Similarly, PC penetration in India was only 4% at the end year 2009, which is expected to reach 17% by 2015. As per the BCG report, Internet users in Indian spend on an average only half an hour online each day, which is lowest rate among all the BRICI countries.

Figure 2.7: Internet Users in BRICI Countries



Sources: Ministry of Industry and Information Technology; iResearch; Internet World Stats; Economist Intelligence Unit; BCG analysis.
Note: An Internet user is defined as someone aged 2 years or older who went online in the past 30 days; penetration is the number of Internet users divided by the population.

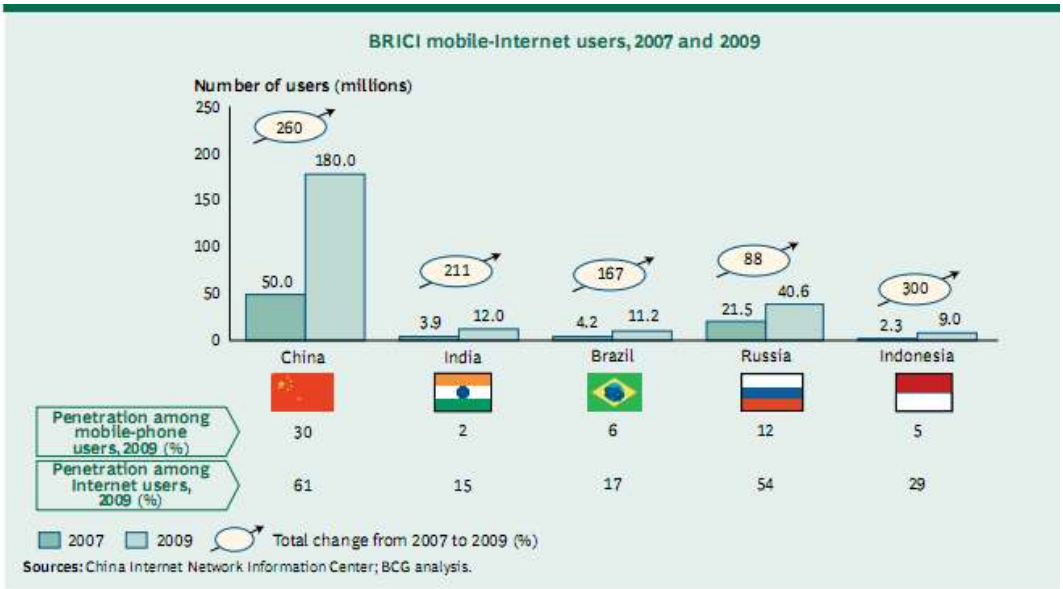
Source: BCG Report[29]

28 BCG Report: The Internet's new Billion: Digital Consumers in Brazil, Russia, India, China and Indonesia

29 BCG Report: The Internet's new Billion: Digital Consumers in Brazil, Russia, India, China and Indonesia

2.15. As per BCG report many digital consumers in BRICI countries have learned to use the Internet in large part through their mobile phone connections. In India, mobile Internet user base has tripled from 2007 to 2009 (Figure 2.8) [30].

Figure 2.8: BRICI Mobile Internet Users



Source: BCG

[30] The Internet's New Billions: Digital Consumers in Brazil, Russia, India, China and Indonesia

CHAPTER 3: FACTORS INFLUENCING BROADBAND DEMAND

3.1 Use of ICT, particularly broadband, is driven by a number of social, economical and technological factors. The need for inclusive growth has never been felt more than it is today. As it is important to include the large rural population in governance and decision making process it is equally important to provide life enhancing urban-like amenities to the rural population including health, education and entertainment. Experts are of the opinion that the impact broadband on the GDP is much higher than any other ICT. It is therefore natural that countries are concerned about creating a robust broadband infrastructure that would sustain high growth of broadband services. Deregulation and competition has driven down revenues from traditional services like plain old telephone service (POTS) and are forcing service provider to look for new streams of revenues and they find immense potential in broadband. Convergence of communications, media and IT is driving a host of new broadband services and creating new revenue streams across sectors and industries. The bottom line is, for a country like India, the Government can play a critical role in diffusion of modern ICT such as broadband.

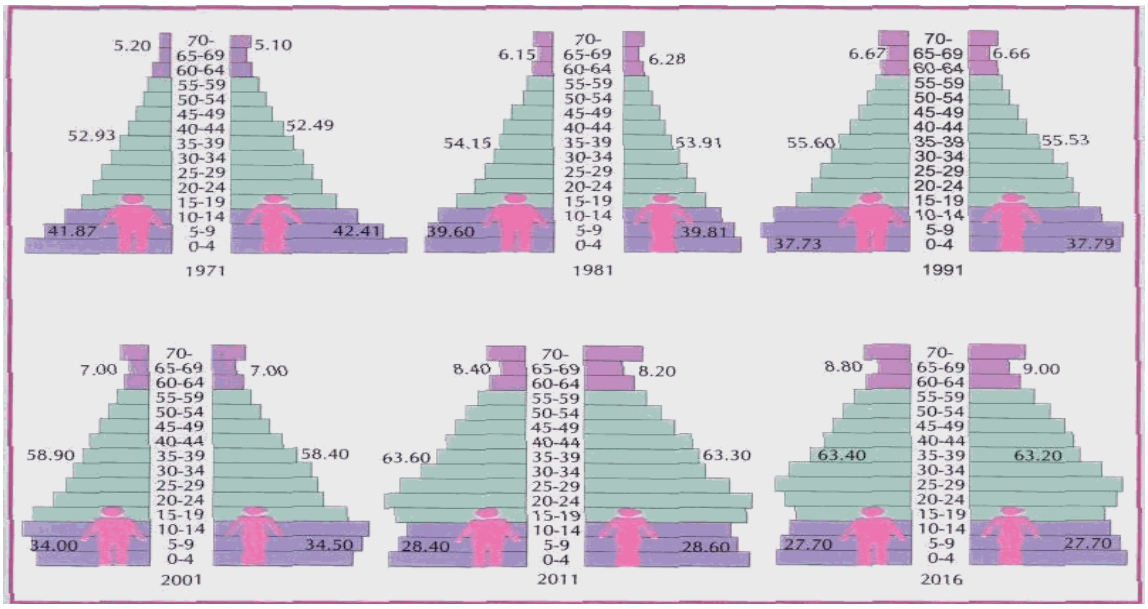
3.2 ICT has brought rural areas much closer to the markets and has improved business transactions. India's technological capabilities and rising exports in information technology (IT) have been one of the major drivers of growth. Goldman Sachs Economic Research paper on "India's Rising growth Potential" (Global Economics Paper No: 152) dated January 22, 2007 indicates that India's GDP (in US$ terms) will surpass that of the US before 2050, to make it the second largest economy.

3.3 The underlying assumption in continuation of the growth story is that growth-supportive policies are continued to be implemented. The cited report emphasizes that to continue growing, India will have to educate its children and its young people (especially its women). Lack of education can be a critical constraint to the growth of the knowledge-based IT sector, as well as in the move to mass employment in manufacturing. It is important to educate people to take the advantage of the demographic dividend.

3.4 The demographic dividend arises from the fact that more than 50% of its population of India is below the age of 25 and more than 65% hovers below the age of 35. This makes India one of the youngest countries in the world. It is being increasingly recognized that what matters is not the size of the population, but its age structure. A population "bulge" in the working age groups(15-64 years), however large the total population, is an inevitable advantage. Thus, India, which is beginning to be characterized by such a bulge, is seen as advantaged, despite its large population. (Fig 3.1)

Figure 3.1 : Changes in population pyramid[31] --India (1971-2016)

[31] Population commission



3.5 In the above context it is absolutely essential that the information and communication technologies (ICT) be harnessed to the utmost potential. The inclusive potential of ICT at two levels: the benefits that can be brought to poorer communities and the capacity of individuals within these communities to participate in new economic opportunities.

3.6 ICT, particularly broadband, is seen as a powerful tool for inclusive growth. With improving broadband penetration, wireless Internet access and growth of the country's economy, the "bottom of the pyramid" is being seen as a lucrative market conducive to further growth of ICT. In recognition that the country's development is unsustainable if it fails to include the large proportion of disenfranchised population into the growth process, the Government of India has integrated "inclusive growth" as the conceptual corner stone of its 11th Five Year Plan. The entire underprivileged section is the potential user of ICT. However, for the ICT sector, reaching out to the poor and needy is not just a business venture, but is aimed at improving the standard of living of the poor population of the country. If handled properly the underprivileged section of the society offers the ICT industry a huge opportunity to grow and flourish and this in turn would fuel the growth of the country.

3.7 Apart from demand pull to meet the target of Millennium Development Goals (MDGs), technology push with rapid technological innovations, enhanced processing capacity of devices, huge availability of memory space in hand held devices, increasing digitization of content and ease of managing and distributing the content online have changed the way people use the telecom services now.

3.8 The growth of the broadband has been slow in the past. In order to assess the demand of the broadband and to plan for future requirement, stakeholders' views were invited. Majority of stakeholders are of the view that innovative technologies are facilitating use of ICT in all facets of life. They feel that new applications, changing life style, and affordability of these services to people is likely to enhance broadband demand manifold. The following paragraphs to deliberate on various issues having direct impact on broadband growth:

- Technological Innovations
- Capable Hardware & affordability
- Enhance purchasing power driven from economic growth
- Broadband growth driven by new content and applications
- Broadband requirement fro Important application

A. Technological Innovations

3.9 Liberalization and competition in the telecommunications market have brought new and innovative technologies in the market. Convergence of communications, IT and entertainment and media along with widespread of IP technology are set to increase broadband use. Broadband will help service providers to realize new revenue streams and bolster up their bottom lines that have suffered decline due to reducing margins of traditional voice services.

3.10 Technological innovation permits new ways of creating, distributing, preserving, sharing and accessing digital content. As economies move to become more knowledge-intensive, information-rich activities will increase; new content will be created, collected, managed, processed, stored, delivered, and accessed. With a broadband connection each user can become a producer of content. This will spawn new businesses and give further boost to utilization of broadband.

3.11 Adoption of applications like cloud computing, server farming and decentralization of the processes will further require robust and scalable broadband infrastructure with higher emphasis on quality. Developments like smart grids in power management and GIS/GPS in transportation are revolutionizing public infrastructure but need high bandwidth, robust and reliable networks. Smart grids with smart meters and advanced ICT has potential of reducing transmission and distribution losses in India's power sector by 30% through better monitoring and management.

3.12 Miniaturization of devices, high processing with enhanced storage power, supporting multi-functions has created an environment facilitating users to create transmits and store huge contents. Such exchange of information also require high speed network emphasizing broadband requirement.

3.13 Various wireless and wireline technologies are evolving which facilitate high speed broadband access. Recently, ITU's Radio-communication Sector (ITU-R) has completed the assessment of six candidate submissions for the global 4G mobile wireless broadband technology, known as IMT-Advanced. Harmonization among these proposals has resulted in two technologies, "LTE-Advanced" and "Wireless MAN-Advanced" being accorded the official designation of IMT-Advanced,

qualifying them as true 4G technologies. With fiber in the access and wireless 4G one talks about delivering 100 Mbps data rates.

B. Capable hardware and affordability

3.14 The capabilities of smart phones bundled with pre loaded features and inbuilt applications permit access to new domains using Internet access. Data cards and Wireless Broadband CPEs facilitate availability of broadband anytime, anywhere further fueling wireless broadband demand.

3.15 The smart phones are handy, have huge memory, and can support wide range of data applications. They are likely to become more affordable with rising volumes and economies of scale. As per the study report "Internet Device Landscape" conducted by Intel Corporation, the number of Smart phones would increase to 18 million in the year 2014 from 2.5 million in the year 2010.

3.16 According to the IDC report, India Mobile Handsets Tracker, Q1 2010, June 2010 release, Indian Mobile Handsets industry grew to record 36.35 million shipments for the first time in a single quarter in Q1 2010 (January-March 2010). There was a growth of 39.5% year-on-year (Q1 2010 over Q1 2009) in terms of unit shipments. Table 3.1 and Figure 3.3 show percentages of growth in shipments of handsets with new, innovative features over the last three years - 2007 up to 2009[32]. Table 3.1 shows that presently, only about 2% of the handset are capable of accessing the high speed Internet. The number of smart phones is likely to increase exponentially after launch of 3G and BWA services. Studies

32IDC analyst view point : India Mobile Handsets market evolution along important demand trajectories gathers pace http://www.idcindia.com/analyst_viewpoint/index.asp

show that iPhone users are five times more likely to use the mobile Internet than the average mobile consumer.

Table 3.1 : India Mobile Handset Shipment

Handsets Shipped with Feature / Application (as a % age of total India shipments)	CY 2007	CY2008	CY2009
FM Radio	37%	59%	65%
Colour Display	69%	84%	84%
Calculator	99%	100%	99%
Primary Card Slot	17%	25%	36%
Music Player	20%	29%	37%
Bluetooth	19%	30%	34%
A2DP	8%	16%	17%
WiFi	0%	1%	2%
Embedded GPS	0%	1%	2%

Source: IDC's India Mobile Handsets Tracker, Q1 2010, June 2010 release

C. Enhanced purchasing power driven by economic growth

3.17 The Indian economy is growing fast and has become the 11th largest in terms of the market exchange rate at $1,235 billion (India GDP)[33]. In terms of purchasing power parity, the Indian economy is ranked fourth

[33] International Monetary Fund data for 2009

in the world. McKinsey study[34] forecasts that Indian incomes will almost triple over the next two decades. The report forecasts that India's real GDP growth rate over the coming two decades generally range between 6 and 9 percent per year. Average real household disposable income will grow from ₹ 113,744 in 2005 to ₹ 318,896 by 2025, at a compound annual growth rate of 5.3 percent.

3.18 Spending power in emerging market economies[35] grows rapidly owing to strong economic growth. Total consumer expenditure in emerging market economies (EMEs) experienced a period growth of 66.0% in real terms between 2000 and 2009 reaching US$7.5 trillion. In 2010, it is expected to increase by a real annual growth rate of 6.9% (in fixed US$ constant terms) to reach US$ 8.0 trillion. Although consumer spending in most of these economies is dominated by essential goods and services, there will be a gradual shift in spending patterns by 2020 when consumers will have more room for discretionary spending. India is projected to have the lowest per capita spending amongst EMEs at US$ 690 (fixed US$ constant terms) in 2010, followed by Vietnam (US$793), the Philippines (US$1,301) and China (US$1,399). Nonetheless, China, India and Indonesia will witness the highest period growth in per capita consumer expenditure amongst EMEs of over 80.0% in real terms between 2010 and 2020. As incomes of the rising middle class increase and spending potential of consumers in EMEs grows, there will be a gradual shift in consumer spending patterns from basic necessities like food and housing to household goods, communication, education leisure and recreation.

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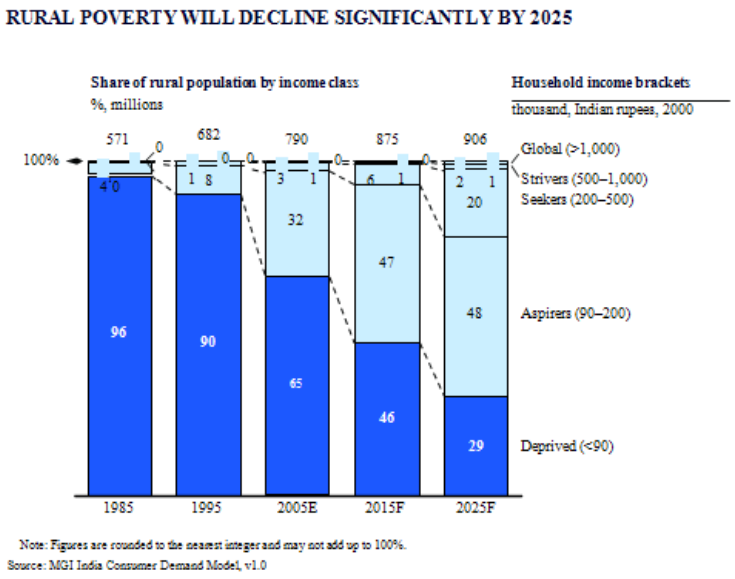
34 The 'Bird of Gold' : The Rise of India's Consumer Market, MGI report May 2007

35 Source: National Statistical Offices/OECD/Eurostat/Euromonitor International

Emerging market economies covers 25 key economies which include Argentina, Brazil, Chile, China, Colombia, Egypt, Hungary, India, Indonesia, Kazakhstan, Malaysia, Mexico, Morocco, Peru, Philippines, Poland, Romania, Russia, Saudi Arabia, South Africa, Thailand, Turkey, the UAE, Ukraine, and Vietnam.

3.19 McKinsey Global Institute (MGI) analysis shows that with the projected growth of GDP rural incomes in India will continue to rise, leading to a further significant decline in the level of rural poverty. It is projected that by 2025 the size of the rural deprived class will decline from 515 million people today, or 65 percent of the population, to 266 million, or about 29 percent of the rural population (Figure 3.2). With the rural population growing by 116 million over the next 20 years, the potential for telecom services especially broadband will grow exponentially.

Figure 3.2: Rural Poverty



3.20 MGI analysis also indicates that rural growth will be accelerated from a compound annual rate of 3.9 percent during the past two decades to 5.1 percent during the next two. By the end of 2025, rural consumption will have nearly tripled, creating a large potential market worth over 26 trillion Indian rupees ($577 billion). By way of comparison, in 20 years the rural Indian market will be larger than the total consumer markets in

countries such as South Korea or Canada today, and almost four times the size of today's urban Indian market. MGI forecast that per-household spending in rural India will reach current levels in urban India by 2017 (Figure 3.4).

Figure 3.3: Rural Consumption Growth

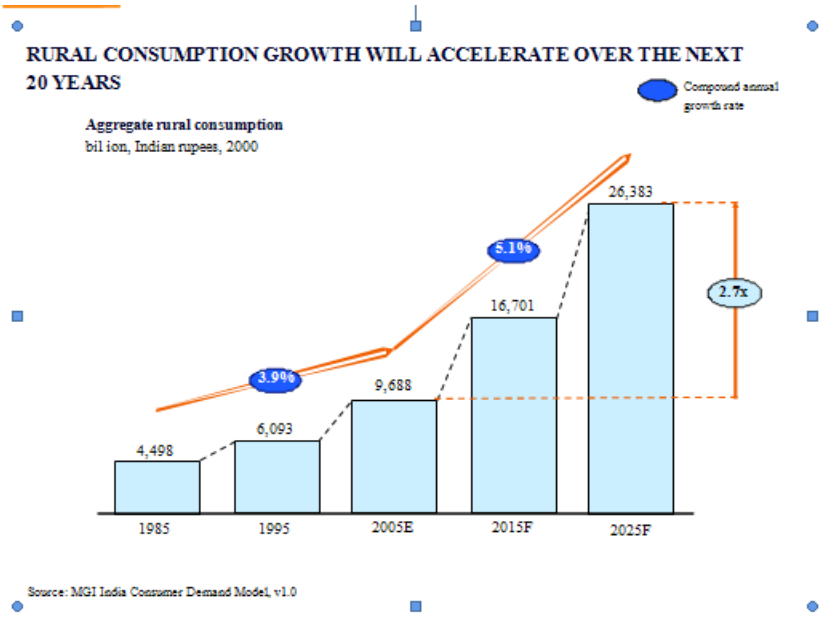
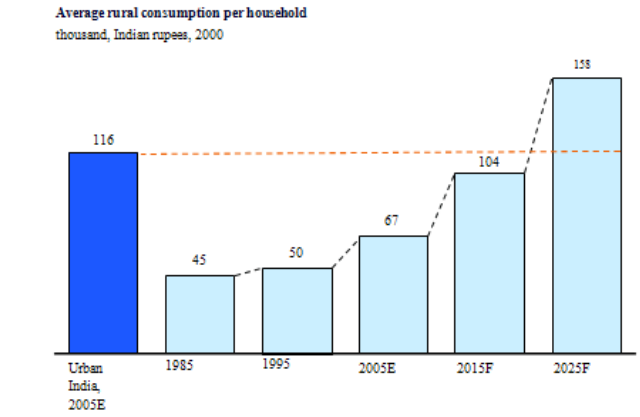


Figure 3.4: Per Household Consumption in Rural India

PER-HOUSEHOLD CONSUMPTION IN RURAL INDIA WILL REACH TODAY'S URBAN LEVELS BY 2017



Source: MGI India Consumer Demand Model, v1.0

3.21 The above analysis clearly forecasts continual growth of Indian economy, which will spread into rural areas as well in the coming future. Rural masses will be stronger economically enhancing their purchasing power and consumptions of goods & services other than their basic needs. This will definitely spur the demand of broadband in the rural areas provided suitable connectivity and applications are made available.

D. Broadband Growth Driven By New Content and Applications Development

3.22 The broadband ecosystem includes applications and content such as e-mail, search, news, maps, entertainment, e-government, e- commerce, e-banking, e- education, and e- health. Ultimately, the value of broadband is realized when it delivers useful applications and content to end-users.

3.23 3.26 Networks, devices and applications drive each other in a virtuous circle. The wide availability of fast and reliable networks and versatile devices to connect to those networks encourage innovators and entrepreneurs to develop exciting and useful applications and content. These new applications draw interest among end users, bring new users

online and increases usages among subscribers. This growth in the broadband ecosystem reinforces the cycle, encouraging service providers to boost the speed, functionality and reach of their networks.

3.24 Usage of Internet is spreading across various activities. There are different requirement for urban and rural population. Leisure activities music and video downloading, searching information especially education related is gaining popularity and showing considerable increase in usage pattern in rural India (Figure 3.5 & 3.6). As compared to urban areas music / video on Internet is more popular among the rural users. 67% of rural users access the Internet for this purpose as compared to 45% in urban areas.

Figure 3.5: Various purpose of accessing Internet (Urban)

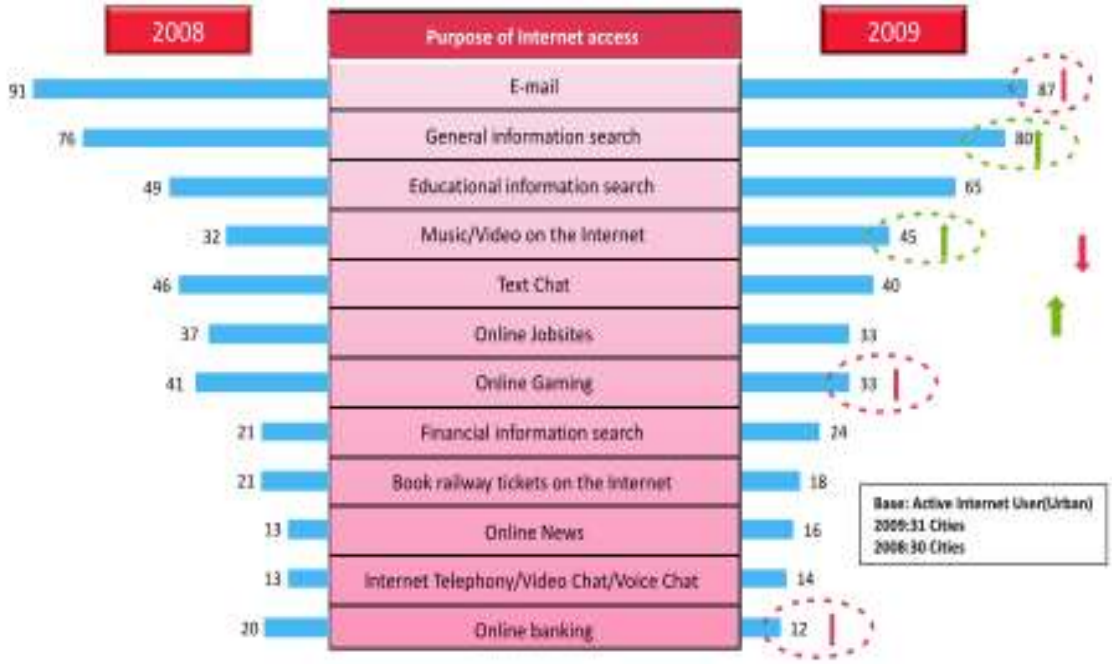
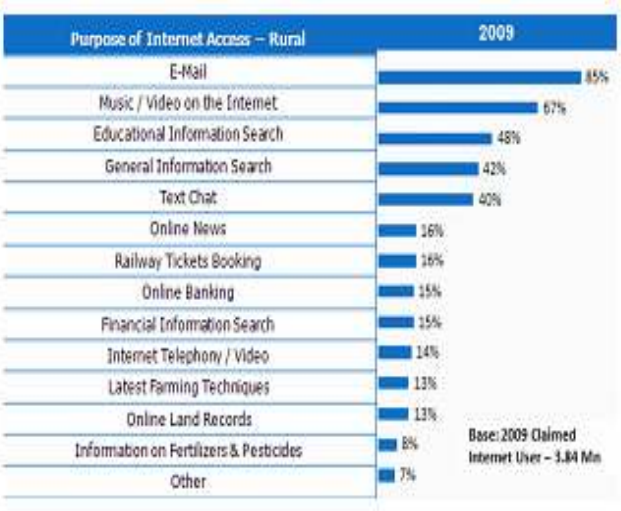


Figure 3.6: Purpose of accessing Internet (Rural)



Source: IAMAI & IMRB Internet for Rural India 2009

3.25 In response to the consultation paper, some of the stakeholders pointed out the need for increasing the scope of broadband from just e-mail to more value added applications, effective use of broadband in automation of operations and functions, innovative use of technology in imparting education, health services, enhancing e-commerce activities and adopting e-governance on large scale.

E. Broadband Requirement for Important Applications

1. e-Education

3.26 One of the eight goals of the United Nations' The Millennium Development Goals (MDGs) is to achieve universal primary education by 2015. India has committed to meeting the MDGs. India has reported that from the projected trend of NER in India the country is likely to achieve 100% NER well before the 2015 dead line[36]

3.27 The Eleventh Five Year Plan places highest priority on Education as a central instrument for achieving rapid and inclusive growth. India has notified 'Right of Children to Free and Compulsory Education Act 2009'

[36] Millenium Development Goal India Country Report 2009.

bill for providing free and compulsory education to all children aged 6-14 with effect from 1st April 2010. India has various target for education at under the different plans and scheme some of the major targets are:

1. Shiksha Abhiyan (SSA) (2001): useful and relevant elementary education for all children in the 6-14 age groups by 2010[37].
2. Rashtriya Madhyamik Shiksha Abhiyan (RMSA) (2009): providing universal access to secondary level education by 2017 and universal retention by 2020 and Have a secondary school within 5 km of every habitation and higher secondary school within 8 Km[38].
3. National Literacy Mission (NLM) for adult literacy: Achieve 80% literacy rate, Reduce gender gap in literacy to 10%, Reduce regional, social, and gender disparities.

3.28 In India there are 7,85,000 primary schools, 3,21,374 middle schools, 1,13,524 high schools and 58,390 pre degree junior colleges in India. In these schools about 92% primary schools, 82% middle schools 65% high school or higher secondary schools managed by Government / local bodies or aided by Government.

3.29 There is shortage in part of infrastructure for education as well as personnel. Under 11th five year plan over 12 lakh, teachers' posts have been sanctioned and 10.22 lakh recruitments reported. Under RMSA major targets include strengthening of 44,000 existing secondary schools, opening of 11,188 secondary schools, mostly through up-gradation of upper primary schools, appointment of 1.79 lakh additional teachers, and construction of 80,500 additional classrooms.

3.30 Various initiative are there from Government for increasing use of ICT in education. The Scheme of Sarve Shiksha Abhiyan (SSA) has a component of Computer Aided Learning (CAL), wherein a provision of Rs

[37] http://india.gov.in/sectors/education/sarva_shiksha.php
[38] Report to the people on Education 2009-10, Ministry of Human Resource Development

50 lakh per district has been made as Innovation Fund.39 The Centrally Sponsored Scheme "Information and Communication Technology [ICT] in School" was launched in December 2004, to provide opportunities to secondary stage students to develop ICT skills and also for ICT aided learning process. It has a provision that each secondary and higher secondary school will be serviced with broadband connectivity of at least 2 Mbps capacity.

3.31 Internationally countries also emphasizing the various program in education through ICTs. In USA Virtually every school in the country has Internet access. The FCC's has issued new E-Rate Order which will help bring affordable, super-fast fiber connections to America's New Zealand has a "Digital Strategy 2.0" plan. It has a plan to Develop and implement a National Education Network in which by 2012 all educational institutions, libraries, schools and researchers will be connected. France has a proposals related to the Development of "Digital Universities", in which it is proposed that develop digital services for the administration of universities, including virtual offices and online enrollment. United Kingdom has launched a Digital Britain program

3.32 In India, many states have provisions in their IT policies for encouraging the use of IT in schools/ colleges/ education institutes. Some of the states like Maharashtra, Kerala, west Bengal etc. has included the participation of private entities for providing the IT infrastructure and training. Kerala has launched programs like IT@school, akshaya project for encouraging the digital literacy in state.[40]

[39] mid term appraisal of 11th Five year plan 2007-12 , planning commission of India, http://www.planningcommission.gov.in/plans/mta/11th_mta/pdf/MTA_comp11th.pdf,.

[40] Information Technology Policy Towards an inclusive knowledge society 2007, Department of Information technology, Government of Kerala

3.33 Availability of applications and content in education is also increasing. Given the diversity of the country's educational, linguistic and social situation, there exists a need for a wide variety of digital content and resources for different subjects, curriculum, ages/grade levels and languages

3.34 Overall 14.25% schools are having the computers. Only 6.01 primary schools are having computers. 29.41% of upper primary schools are having the computers and 56.10 % Upper primary with higher secondary schools are having the computers41. This data is for 2007-08, it is expected that till now i.e. in 2010 some more upper primary and higher secondary school may have the computers.

3.35 It may be projected that all the upper primary and higher secondary school may have the computer by 2012. Therefore, broadband demand for all upper primary and higher secondary schools i.e. 376,227 schools may be projected by 2012. After considering the utility of broadband in education, various initiatives to increase the literacy and education it can be projected that there is strong possibility that all the schools may be covered on broadband by end of twelfth five year plan As per the figure 3.11, there are total 1,02,403 Government or Government aided schools are there in India. All these school will required at least 2 Mb broadband connection.

3.36 Based on above it is clear that there will be good demand of broadband from education sector and at least 2 Mb connectivity will be required for each education institute connection.

2. e-Health

[41] Elementry Education in India. Progress towards UEE, Analytical tables 2007-08 published by National University of Education Planning and Administration (NEUPA) & Department of School Education and Literacy.

3.37 Healthcare is potentially one of the most important areas where broadband can make an impact. It has been estimated that at least USD 5 trillion is spent worldwide on providing healthcare and savings of between 10% and 20% could be achieved through the use of telemedicine delivered by broadband. A World Health Organization report revealed an estimated shortage of almost 4.3 million medical staff worldwide, with the situation being most severe in the poorest countries. Medical advice, monitoring, diagnosis and training delivered through broadband can help a great deal to overcome these gaps. Training of professionals in all sectors can be delivered through broadband video and other applications.[42]

3.38 **Millennium Development Goal (MDG):** In order to make progress in achieving the MDGs which include reducing child mortality, improving maternal health, combating HIV/AIDS, malaria and other diseases, etc. by the target date of 2015, it is essential that countries and communities everywhere are enabled to take advantage of ICT revolution.[43] ICT applications in the health sector can bring efficiency gains, much as they can for education, employment and other priorities of the MDGs. ICT applications could, for example, improve the monitoring of demand for and supply of HIV/AIDS drugs, which would be highly relevant given the current lack of funding for these drugs. ICT technologies offer the potential to empower citizens with medical information and knowledge that can facilitate improved decision-making and care. ICT in health care can reduce costs and help to mitigate the impact of the crisis[44].

[42] http://www.broadbandcommission.org/report2.pdf
[43] http://www.broadbandcommission.org/report2.pdf
[44] United Nations e-Government survey 2010

3.39 ICT can contribute significantly towards achieving the vision, goals and objectives as well as broad strategies as articulated in the XIth Five Year Plan for the years 2007-12. Health Infrastructure is an important indicator to understand the healthcare delivery provisions and mechanisms in a country. As per the available information, 75% of health infrastructure, manpower (including the qualified consulting doctors practice) and other health resources are concentrated in urban, 23% in semi-urban (towns) and only 2% in rural areas; where as 70% of population live in the rural areas. Hospital beds per 1000 people are 0.10 in rural as compared to 2.2 in urban areas[45]. There is acute shortage of specialist manpower at the PHCs and CHCs.

3.40 ICT innovation may be leveraged to bring about a paradigm shift in the way health care delivery is managed. Broadband can be leveraged to achieve higher capacity and quality in health care segment. However, e-health applications will require various video based applications and high-bandwidth networks are essential for these services to function properly. With rapid advancements of technologies and development of innovative bandwidth intense applications, this requirement is likely to increase multifold. Connectivity will enable medical care providers to share data throughout their geographically dispersed clinical delivery sites, and to a lesser degree, reach the patient at home or at least at a central place in the village. To the extent that health care becomes dependent on access to computer networks, policymakers need to pay special attention to the needs of the medically underserved population to ensure that lack of network access does not further impede their access to care[46]. Thus, it is amply clear that there will be high bandwidth requirement in health care segment. Demand exists in health care

45 Current status of E-health in India source: http://openmed.nic.in/1265/01/skm12.pdf
46 http://knowledgecommission.gov.in/downloads/documents/wg_med.pdf

segment; however there are constraints at the supply side. Therefore effective solutions at supply side need to be worked out.

3.41 ICT have clearly made an impact on health care. It has improved dissemination of public health information; enabled remote consultation, diagnosis and treatment through telemedicine; facilitated collaboration and cooperation among health workers, including sharing of learning and training approaches; supported more effective health research and the dissemination and access to research findings; strengthened the ability to monitor the incidence of public health threats and respond in a more timely and effective manner; and improved the efficiency of administrative systems in health care facilities. This translates into savings in lives and resources, and direct improvements in people's health.[47].Ultimately, the value of broadband is realized when it delivers useful applications and content to end-users.

3.42 In order to reap the benefits of ICT in the health sector, it is desirable that all Health care establishments have broadband connectivity and are well connected. A common national Electronic Health Record (EHR) be maintained. The Government should ensure the development of a web-based network, connecting all health care establishments, in both public & private sector. This will enable electronic recording of data and would be accessible to authorized users, whenever & wherever they need it. This will also facilitate identifying solutions to specific medical challenges. A National eHealth portal should be developed that may facilitate interaction amongst various stakeholders to share information and facilitate provision of health care services. In addition, it is pertinent to ensure that all the manpower in the delivery chain have adequate ICT

[47] Improving Health, Connecting People: The role of ICTs in the Health Sector of Developing countries, A Framework paper, Infodev, working paper No. 7, 31 May 2006

training. Relevant web based applications needs to be developed to ensure automation of the entire process and data sharing mechanism.

3. e-Commerce

3.43 e-commerce is the use of electronic communication and digital information processing technology in business transactions to create, transform and redefine relations for value creation between or among organization or between organizations and individuals.

3.44 E-commerce in India is still in a nascent stage and businesses are not able to harness the full potential of ecommerce in India. There are several challenges that the businesses must overcome. The most important challenge in India for the development and implementation of ecommerce on a large scale is the unavailability of proper broadband connectivity, which is essential for a hassle free online e-commerce experience. Therefore even to those people who have access to the Internet, the browsing experience is very limited due to slow connection. The cost of a broadband connection in India is also higher than in other countries. The other technological challenge facing the Indian markets of ecommerce is the use of credit and other smart cards by the Indian consumers.

3.45 Another big achievement of ecommerce already is that it has helped to drastically improve the services of the Government sector. For example, it is now possible and easy to pay your telephone and electricity bills online, which would otherwise have taken hours together in lines to pay.

3.46 Indian economy is composed of a very large number of small and medium enterprises, who would be at a maximum benefit with e-commerce. A survey on "ICT adoption among MSMEs (micro, small and

medium sized enterprises) in India" by Internet and Mobile Association of India (IAMAI)[48] indicates that B2B e-commerce market size (in terms of transaction value or value of business is generated) as on December, 2007 was USD 78 billion. B2B e-commerce has been increasing at a rapid pace and was expected to touch USD 89 billion by December, 2009 at a CGR of 8.77%. If projection are made for same growth pattern it would be around USD 100 billion by the end of year 2010. Each SME may require 2 MB/s for providing E commerce facility to its consumers

4. e-banking

3.47 Access to basic financial services continues to be an unrealized dream for millions of our citizens; even more so for the citizens in rural and remote areas. The National Sample Survey data reveals that 51.4% of nearly 89.3 million farmer households do not have access to any credit either from institutional or non institutional sources. Only 13 per cent are availing loans from the banks in the income bracket of less than Rs. 50,000. A large percentage of rural population does not have a deposit account which means that they do not have access to even basic financial services. Banks find it difficult to operate large number of tiny accounts and micro transactions profitably. Currently, a bank branch in India serves about 16000 people – a number very high when compared to the developed countries.

3.48 The Australian Government in its report[49] "Government Role in Business to Business e-commerce" estimated that in the banking sector cost per transaction is reduced from $ 3 over the counter to $ 0.02 over the Internet. It has the potential of furthering financial inclusion by making

[48] www.iamai.in
[49] www.archive.dcita.gov.au

small ticket retail transactions cheaper, easier and faster for the banking sector as well as for the small customers.

3.49 The Reserve Bank of India has been actively involved in harnessing technology for the development of the Indian banking sector over the years. The cumulative expenditure on 'computerisation and development of communication networks' by public sector banks from September 1999 to March 2010 aggregated to Rs 22,052 crore. On an annual basis, the expenditure on 'computerisation and development of communication networks' registered a growth of 23.2 per cent in 2009-10[50].

3.50 Apart from this, Number of braches of PSB that have implemented CBS increased from 35464 as on March 31,2008 to 44304 as on 31st March 2009. The computerization of the banking sector, which is regarded as precursor to other technological initiatives, is almost in completion stage. The Proportion of the PSB branches that achieved full computerization increased from 93.7 percent as of end of March 2008 to 95 percent as of March 2009. That During 2008-09, the total number of automated teller machines (ATMs) installed by banks grew by 25.4 percent[51].

3.51 Edgar, Dunn & Company in their Global Advanced payment Forecasts suggested that there would be around USD 1842 Billion transaction in the year 2015.

3.52 Department of Post (DoP) has also shown need for large scale technology induction and automation to not only to cut cost but also to improve the quality of service. Towards this goal, India Post has already started setting up the Mail Business Centres (MBCs) as a key component for mail management. The MBCs are envisaged as frontline business wings of India Post offering one stop solution for varied mailing needs of the

[50] Appendix Table IV.10 to Report on trend and progress of banking in India 2009-10
[51] Economic survey 2009-10

customers, undertaking the task of collection, processing and delivery of bulk mail. For faster mail movement and improved quality of service, Automated Mail Processing Centres (AMPCs) are also being set up. India post also has plan for networking, once the networking of post offices is completed it can start various online services.

3.53 Money transfer can be an important component of the financial service and the scope of instant Money Order (iMO)/electronic Money Order (eMO) can be extended by tying up with international payment gateways. With increasing monetization of Indian economy, there is a huge potential in the money remittance market. In fact, several agencies have come in the market with innovative products to facilitate the remittances. Money remittance market of India Post which is at about Rs.8000 crores.

3.54 There are a total of 155,015 post offices in the country. (Position as on 31-03-2009). Of these 24,835 are departmental post offices. Up to 31-3-2009 a total of 12604 departmental post offices have been computerized. The DoP proposes to effect computerization and networking[52] of remaining departmental Post Offices (10841) and all Branch Post Offices (129553)by the year 2012. The major applications currently used in the computerized post offices of the Department are Meghdoot and Sanchay Post for Postal and Savings Bank operations respectively. These applications are LAN based solutions. Consequently, there is a need for communication between these applications and between the various post offices where the data are residing in a distributed architecture (LAN Based). Some later applications like e-Post, e-MO etc have been developed based on WAN architecture. But these are peripheral applications which again need to be synthesized with the Post office information system.

3.55 Since the number of computerized post offices is increasing and as all the Departmental Post Offices and Extra Departmental Post Offices will

[52] Annual Report 2009-2010, Department of Post, Government of India

be computerized during XIth Five Year Plan period, India post also has proposal to set up local training center in each division. These training centres will impart familiarization training to staff of Postal Accounts Offices on Postal/RMS Offices and to the Accounts staff of field units about the Accounting Procedures. For performing its operation Each Post office may require at least bandwidth of 2 Mb/s.

5. e-Governance

3.56 Government of India has drawn up a National e-Governance Plan (NeGP) in May, 2006 with an outlay of approximately Rs 6000 crores for delivering Government and private services at the doorstep of the citizens. The vision of this plan is to – "Make all Government services accessible to the common man in his locality, through common service delivery outlets and ensure efficiency, transparency & reliability of such services at affordable costs to realize the basic needs of the common man".

3.57 NeGP has been implemented through three main components: State Wide Area Networks (SWANs), State Data Centres (SDCs) and Common Services Centers (CSCs).

3.58 The CSCs are envisioned as the front-end delivery points for Government, private and social sector services to rural citizens of India, in an integrated manner. Department of Information technology (DIT) has planned to deploy 104881 Community Service Centers (CSC) in rural areas all over the country under NeGP in order to deliver e-governance services in the rural areas. 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

3.59 Once all the 2.5 lakhs CSCs are established and all the Government service delivered online, the utility of broadband will increase for rural masses. The CSCs are envisaged to provide high quality and cost-effective video and data services in the areas of e-governance, education, health, agriculture, entertainment as well as other private services. As the video content are supposed to consume sizable bandwidth, the bandwidth requirement for each CSC would be approximately 2 Mbps, which may increase in future.

6. E-entertainment and Social behavior

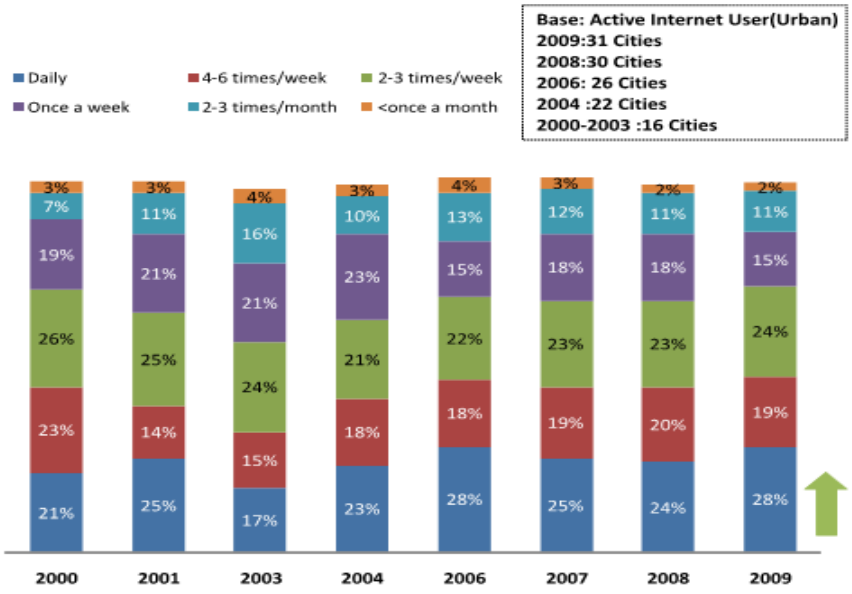
3.60 The socio-economic structure is changing with enhanced emphasis on networking. Apart from simple applications like e-mail, instant messaging, educational information, text chat etc, the focus is shifting to applications like video download, advertisements, gaming and video chat. Evolution of the web to provide more personalized services, likely adoption of Web 3.0 and increasing web networking will enhance Internet bandwidth requirement. The changing life style and enhanced popularity of networking sites encourage people to be connected online.

3.61 As per the study by Comscore metrics, more than 33 million Internet users (aged 15 and older) in India visited social networking sites in July 2010. Internationally, Facebook itself have more than 500 million active users in July 2010, out of which 50% active users log on to Facebook in any given day. Total 700 billion minutes were spent by users per month just on Facebook. Each user on an average creates about 90 pieces of content each month. According to the report, India now ranks as the fastest growing market and seventh largest market worldwide

for social networking, after the US, China, Germany, Russia, Brazil and the UK.

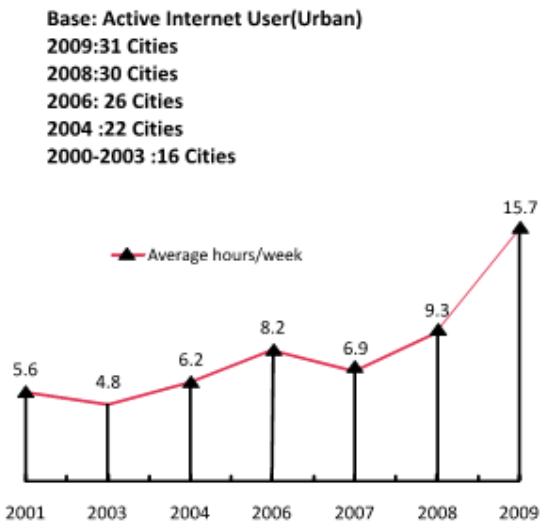
3.62 In India, Internet is becoming the routine for a user in urban areas. Almost half of the Internet users are going on-line 4-6 times a week. Internet usage has gone up from 9.3 hrs/ week to 15.7 hours per week i.e. a steep rise of 70% (Figure 3.8).

Figure 3.7: Internet Users Routine (Urban)



Source: IAMAI & IMRB Survey- I-cube 2009-10

Figure 3.8: Internet Usage (Urban)



Source: IAMAI & IMRB Survey- I-cube 2009-10

3.63 Video consumption is happening across multiple platforms – right from TV to Online, Mobile and across newer devices like tablets. It is interesting to note that rural users are more inclined to these activities as compared to urban. Nielsen conducted a survey (sample size: 27,000 online consumers in 55 countries) on video consumption habits and found that claimed TV viewership is higher than average in the emerging BRIC economies, Brazil, Russia, India and China. 70% of online consumers watched video over the Internet. Penetration is predictably highest among younger consumers. Mobile Video is already used by 11% of global online consumers: penetration is highest in Asia-Pacific and among consumers in their late 20s.

CHAPTER 4: ASSESSMENT OF NETWORK REQUIREMENT

A. Broadband Target

4.1. Broadband policy announced by the Government in December 2004 set a target of 9 million broadband connections by the end of the year 2007 and 20 million connections by the end of the year 2010. The achievement has just been 10.30 million broadband connections by the end of September 2010. The analysis of the broadband growth for previous quarters (December '08 to September '10) indicates quarterly growth of about 0.7 million (Table 4.1).

Table 4.1: Growth of broadband subscribers

Quarter ending	Broadband subscribers (in Millions)	Increase in broadband subscriber in the qtr (in Millions)
Sep'08	4.90	
Dec'08	5.52	0.62
March,09	6.24	0.72
June'09	6.63	0.39
Sep'09	7.23	0.59
Dec'09	7.83	0.61
March'10	8.75	0.92
June'10	9.45	0.70
Sep'10	10.29	0.83
	Average	0.7

4.2 The present broadband growth has been primarily using DSL technology on copper loop. About 86% of 10.3 million broadband connections are

provided using DSL technology. Sluggish growth of broadband has been, among other factors, due to limited availability of adequate infrastructure to support broadband.

4.2. While the availability of copper loops in the country is estimated to be about 40 million only 8.9 million broadband connections have been provided using DSL technology till now. Ethernet/LAN has contributed about 6.12% of broadband subscribers. With conservative estimates of about 50% copper loops being fit to support DSL connections, the number of wireline broadband subscribers is projected to increase to 16.6 million subscribers and 22.2 million subscribers by the year 2012 and 2014 respectively, if DSL remains the predominant technology.

4.3. India has approximately 80 million cable homes, which are expected to grow to 103 million by 2014. TRAI has, in its recommendation on "Implementation of Digital Addressable cable TV Systems in India" in August, 2010, recommended that all cable TV homes will be digital & addressable by the year 2013. The plan envisages that all major cities having population of one million and above would be digitally addressable by the end of the year 2012. As per the industry information, 70% of cable TV homes (i.e 56 million cable TV homes) are in cities having population of more than one million. All cable with digital addressability if upgraded to optical fibre will be capable of supporting broadband given that fiber backhaul for providing broadband service is ensured. Even with the modest assumption of just 50% and 70% of cable with digital addressable systems providing broadband, the number of broadband connections provided by cable network by the end of 2012 and 2014 will be 28 Million and 72 million respectively.

4.4. The spectrum for 3G and BWA technologies for provision of high speed data services has been allocated recently. It is expected that wireless

broadband will be available to subscribers from early 2011. There were 687.71 million wireless subscribers at the end of September 2010. Out of 687.71 million wireless subscribers, about 274 million wireless data subscribers (i.e 39.8%) are able to use Internet services from their mobile device. The mobile Internet user base has tripled from 2007 to 2009. We also have 1.5 million high speed data card subscribers. The high growth of data subscribers, capable of using Internet through mobile devices, makes available a ready population which could adopt broadband.

4.5. In the TRAI's recommendations on "Spectrum Management and Licensing Framework" dated 11th May 2010 it is estimated that number of smart phones will be about 120 million by the year 2014. Even at a conservative estimate, there would be 80 million smart phones. It indicates high growth rate in wireless broadband segment. While most of the smart phone users will be expected to become wireless broadband subscribers, only those subscribers having minimum download speed of 2 Mbps or more will qualify for broadband as per the proposed definition by the year 2014. Lot of network evolution both in wireline and wireless segment is expected by the year 2014. Wireless networks would be expected to adopt IMT advance supporting much higher download speed. At the same time, a robust network on optical fibre is expected to be available. As such, subscribers will get more choices from different competitive technologies and forecasting of expected number of subscriber is difficult.. Thus, preference of subscriber may be shifted toward wireline broadband. The mobility support on wireless broadband networks would drive its adoption.

4.6. The growth projections of mobile subscribers is likely to be maintained and expected to reach 888 million mobile subscribers by 2012 and one billion mobile subscribers by 2014. Considering that the percentage of the data subscribers is atleast maintained, if not increased further, the

number of data subscribers through mobile device will be 353 million and 398 million by the year 2012 and 2014 respectively. With a conservative estimate, it is expected that atleast 7.5 % of data subscribers capable of using Internet (i.e 26.5 million subscribers) will adopt broadband by 2012 and about 15% (i.e 59.7 million subscribers) by 2014.

4.7. The expected growth of broadband using wireline technologies will be 44.6 million and 94.2 million for 2012 and 2014 respectively. However contribution of wireless broadband technologies by the year end 2012 and 2014 is expected to be 26.5 million subscribers and 59.6 million subscribers respectively (Table 4.2).

Table 4.2: Projected Ratio of Wireless and Wireline Broadband

Year	Wireline Broadband subscribers			Wireless broadband subscribers	Total broadband subscribers
	DSL BB (in Millions)	Cable BB (in Millions)	Total	Wireless BB Subscriber (in Millions)	
2010	11.0	-	11.0	-	11.0
2012	16.6	28.0	44.6	26.5	71.1
2014	22.2	72.0	94.2	59.7	153.9

4.8. As wireless broadband is yet to be launched in a big way and expected to take some time, the expected broadband from wireline itself is expected to be 50 million by 2012 and 100 million by 2014.

4.9. In view of above discussions, **The Authority recommends that the broadband target in National Broadband Policy may be fixed as Under:**

- **75.0 Million broadband connections to be provided by the end of year 2012**
- **160 Million Broadband connections to be provided by 2014.**

B. Bandwidth Requirement

4.10. Achieve the broadband target as indicated in paragraph 4.8, will require coverage of 30% and 60% households to have access with broadband connections by the year 2012 and 2014 respectively (Table 4.3).

Table 4.3: Meeting broadband targets

Year	No of Households	% of Households to be covered for broadband	Number of Broadband Connections
2012	**268 Million**	**30%**	**~75 Million**
2014	**275 Million**	**60%**	**~160 Million**

4.11. 70% of Indian population lives in the villages. In order to provide ubiquitous coverage of broadband and ensuring availability of required bandwidth for provision of broadband across the country, study of demographic pattern, location wise broadband demand, and backhaul bandwidth requirement is necessary.

4.12. India is a vast country. The usage pattern and behavior of users across the country differs based on the classifications like rural/ urban, type of usage, mode of access etc. The demographic pattern of India is summarized in table 4.4, and 4.5.

Table 4.4 : Demographic Pattern of India

Demographic Pattern	
Population of India	1028737436
Rural Population (72.2%)	742,490,639
Urban Population (27.8%)	286,119,689
Number of inhabited villages	593,731
Number of Gram Panchayat	265000
Av. No. of Village per Gram Panchayat	2.24
No of Blocks in India	6374
Av. No. of Panchyat per Block	41.57
No. of District HQ	610
Total Area in sq k.m.	3287240

Source: Census of India 2001

Table 4.5: Rural & Urban Population distribution

Rural Population Demography				
Villages	**No. of villages**	**Population**	**Average Population per village**	**Average Household per village***
Less than 100	45,276	2,274,375	50	11
100-199	46,276	6,912,023	149	32
200-499	127,511	43,960,187	345	73
500-999	145,402	105,274,341	724	154
1,000-1,999	129,977	183,294,133	1,410	300
2,000-9,999	80,413	239,184,866	2,974	633
5,000-9,999	14,799	98,112,136	6,630	1,411
10,000 & above	3,961	63,478,578	16,026	3,410
Total	593,615	742,490,639	1,251	266
Urban Population Demography (Town)				
Towns	**No.of Towns**	**Population**	**Average Population per Town**	**Average Household per Town***
Less than 5000	192	667,772	3,478	828
5,000-9,999	879	6,658,356	7,575	1,804
10,000-19,999	1,346	19,458,295	14,456	3,442
20,000-49,999	1,163	35,154,857	30,228	7,197
50,000-99,999	404	27,832,412	68,892	16,403

Total	3,984	89,771,692	22,533	5,365
Cities	**No.of Cities**	**Population**	**Average population of a City**	**Av. No. of House Holds**
1,00,000-4,99,999	320	60,554,358	189,232	45,055
5,00,000-9,99,999	32	24,650,202	770,319	183,409
Total	352	85,204,560	242,058	57,633
Metros	**No.of Cities & Metros**	**Population**	**Average population of a Big City / Metro**	**Av. No. of House Holds**
10,00,000-& above	42#	111,143,437	2,646,272	630,065

Source: Census of India 2001

*Household (Rural- 4.7, Urban- 4.2) as per NSS Report No. 532: Education in India 2007-08
#Census 2001 shows 35 cities above 1 million the number 42 is arrived on the basis of projection population for the year in 2010.

4.13. For these recommendations villages means all villages mentioned in table 4.5. Similarly towns, cities and metros are also refer to the table 4.5. Population of villages, town, cities and metros areas population of year 2001 mentioned in table 4.5 is taken as base population for projections.

4.14. In order to estimate the broadband bandwidth requirement and plan access & core network, the number of the household in Metro/big cities, cities, town and villages have to be calculated. This will be used to estimate location wise bandwidth requirement. Table 4.6 based on census of India data 2001 gives average household details.

Table 4.6: Rural & Urban Population distribution

Category	Number of Villages/ towns/ cities	Total Population	Average population per Village/town/city	Average Number of Household* per village/town/city
Villages	593,615	742,490,639	1,251	266
Towns (0 to 99,999)	3,984	89,771,692	22,533	5,365
Cities (1,00,000 to 999,999)	352	85204560	242,058	57,633

Metros (more than 1 million)	42	111143437	2,646,272	630,065

Source: Census of India 2001

*Household (Rural- 4.7, Urban- 4.2) as per NSS Report No. 532: Education in India 2007-08

4.15. About 60% of broadband connections are in top 10 cities. The penetration of Internet and Broadband is high in metros. Considering high demand and the advantages of the broadband, it is expected that wireline broadband penetration in metro cities by 2014 may cross 100 percent households. Wireline Broadband penetration in cities, small towns and rural areas will also increase. Based on the demographic pattern given in Tables 4.4 & 4.5 and broadband projections as per Table 4.3, the projected percentage of wireline broadband household location wise is given in table 4.7 and figure 4.1A and 4.1B.

Table 4.7: Wireline Broadband Penetration Projection Demographic Pattern

Demographic Areas	2010			2012			2014		
	HHs (million)[53]	Broadband Penetration (%)	Broadband HHs (millions)	HHs (million)	Broadband Penetration (%)	Broadband HHs (millions)	HHs (million)	Broadband Penetration (%)	Broadband HHs (millions)
Metros (More than 1 million)	28	20%	5.6	29	70%	20	~29	100%	29
Cities (1Lakh to 1 million)	22	5%	1.10	22	40%	9	23	80%	19.2
Towns (Upto 1Lakh)	23	4%	0.92	23	25%	6	24	50%	12
Villages	188	2%	3.77	194	8%	15	198	20%	39.6

[53] Household is calculated by dividing the population by 4.2 for urban area and 4.7 for rural area. Population for each demographic area is calculated from projected population of India for that year and taking the ratio of total population in proportionate to ratio for that area in 2001. As per 2001 census ratio for various demographic areas was:

Demographic Area	Population	% of total population
10Lakh more (42 Cities)	111143437	10.80%
1Lakh-10Lakh	85204560	8.28%
upto 1Lakh	89771692	8.73%
Rural	742490639	72.18%
Total	1028610328	

Total House Holds (India)	**261**	**4%**	**11.39**	**268**	**~20%**	**50**	**275**	**36%**	**~100**

Figure 4.1A: Wireline Broadband Target and Penetration projection (in percentage) for the year 2014

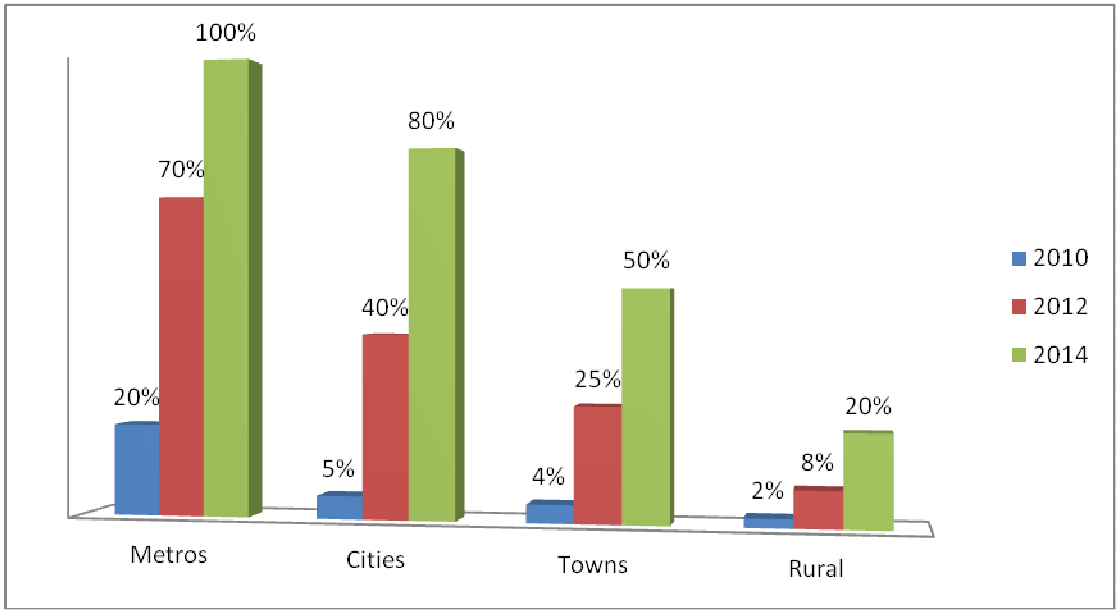
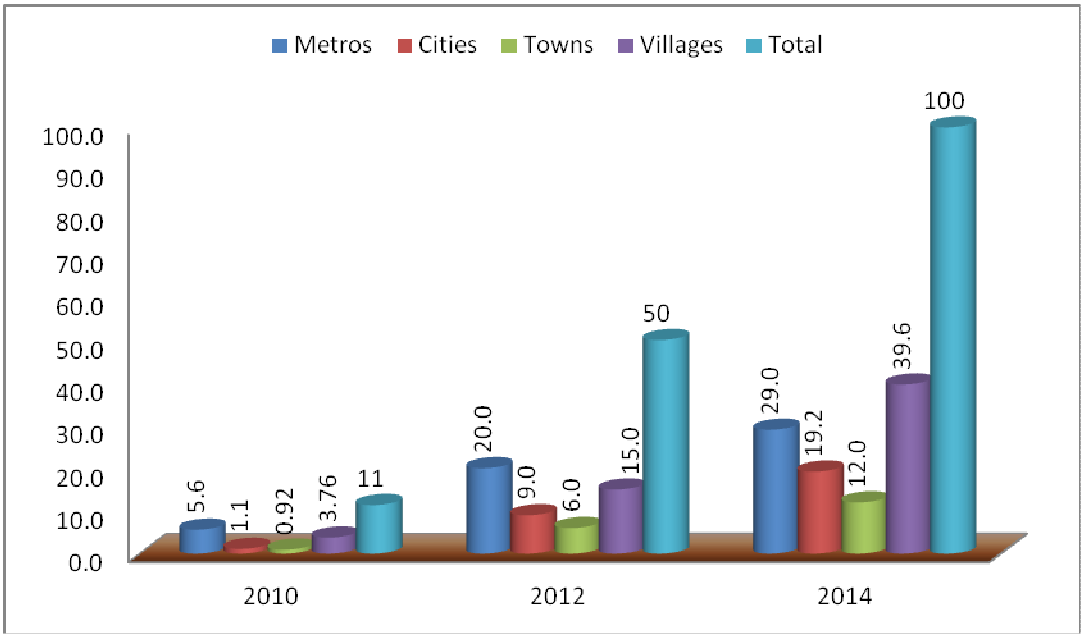


Figure 4.1B : Wireline Broadband projection in millions of subscriber



4.16. Wireless broadband growth is expected to increase after the launch of wireless broadband services. Wireless broadband target and penetration projection is given in table 4.8, figure 4.2A and 4.2B.

Table 4.8 : Wireless Broadband Penetration Projection Demographic Pattern

Demographic Areas	2012			2014		
	HHs (million)	Wireless Broadband Penetration (%)	Wireless Broadband HHs (millions)	HHs (million)	Wireless Broadband Penetration (%)	Wireless Broadband HHs (millions)
Metros (More than 1 million)	29	38%	10.5	30	62%	18
Cities (1Lakh to 1 million)	22	23%	5	23	45%	11
towns(Upto 1Lakh)	23	13%	3	24	50%	7.2
Villages	193	5%	8	199	12%	23.5
Total House Holds (India)	**268**	**10%**	**26.5**	**275**	**22%**	**59.7**

Figure 4.2A: Wireless Broadband Target and Penetration projection (in%) for the year 2014

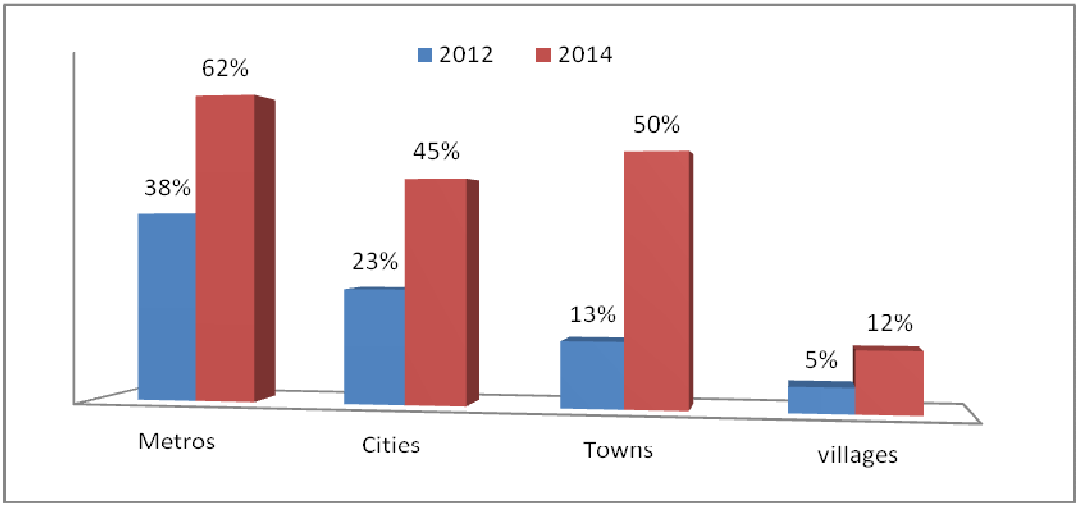
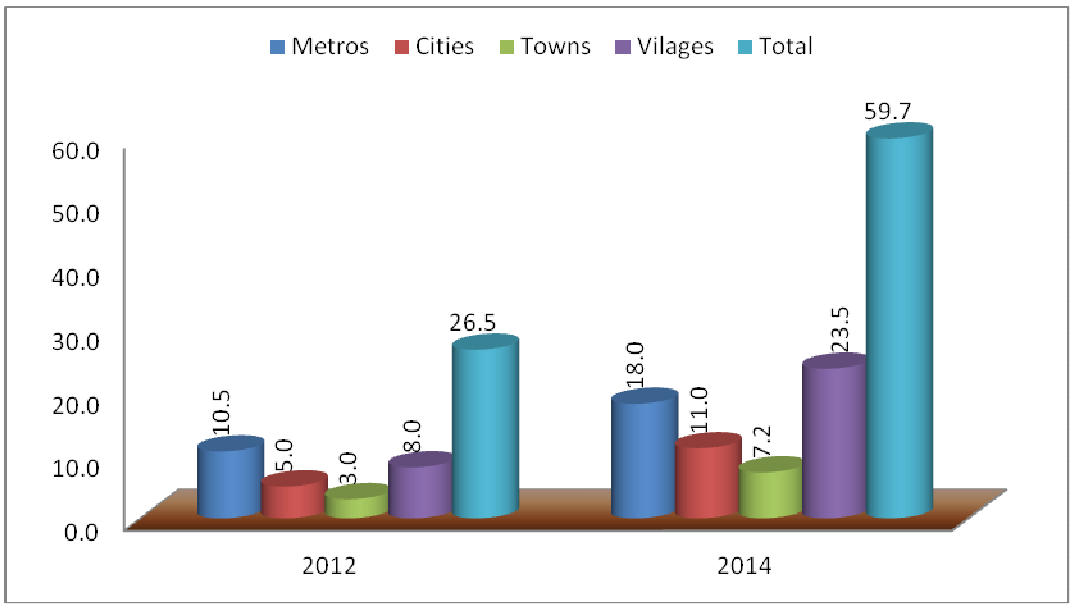


Figure 4.2B : Wireless Broadband projection in millions of subscriber



4.17. As mentioned before, it is estimated that there will be 11 million, 50 million and 100 million wireleine broadband subscribers in 2010, 2012 and 2014 respectively. In addition to wireline broadband subscribers, there will be 26.5 and 59.7 million wireless broadband subscribers by 2012 and 2014 respectively. Ratio of wireline broadband and wireless Internet can be calculated as detailed in Table 4.9.

Table 4.9: Share of Wireless and Wireline Subscriber (in Millions)

Demographic Areas	2012			2014		
	Total	Wireline Broadband	Wireless Internet	Total	Wireline Broadband	Wireless Internet
Metros (More than 1 million)	30.5	20	10.5	47	29	18
Cities (1Lakh to 1 million)	14	9	5	30	19.2	11
Towns (Upto 1Lakh)	9	6	3	19	12	7.2
Villages	23	15	8	63	39.6	23.5
Total House Holds	**76.5**	**50**	**26.5**	**159.7**	**100**	**59.7**

4.18. With increasing demand of applications and changing usage pattern, it is expected that bandwidth requirement will increase exponentially in every segment. Bandwidth requirement for widely used applications has been estimated and is given in table 4.10.

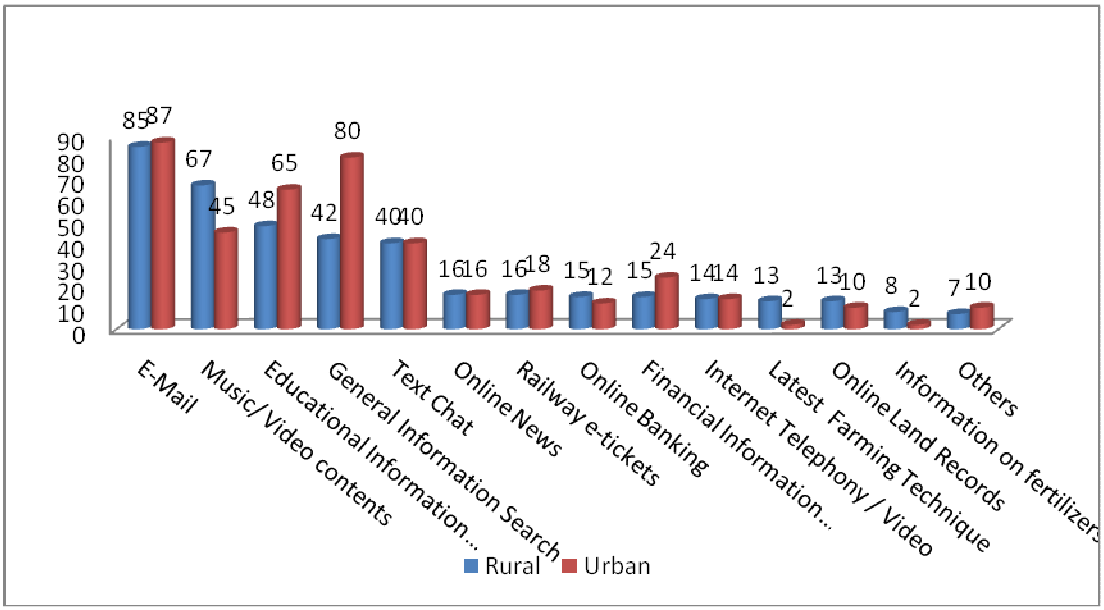
Table 4.10: Bandwidth required for various applications

Application	Min. Bandwidth Required
Internet Surfing	Upto 256 Kbps
E-mail	64 Kbps
Voice Chatting	64 Kbps
Video Clips	256-512 Kbps
Tele-education	256-512 Kbps
Tele-medicine	256 Kbps to 4 Mbps
Video streaming per Channel	2 Mbps (Approx.)
Video gaming	256-512 Kbps (high precision games may required higher bandwidth)
High Definition Video per Channel	4-8 Mbps
Online gaming/ Video on demand/ Video streaming/ IPTV	3-4 Mbps

4.19. Over the years Internet has been evolving as a platform not only for communication but also for various other applications. The Internet usage pattern is different in different segment of population. In urban areas, apart from e-mail, educational information search is second most popular application. In rural areas, while e-mail is most

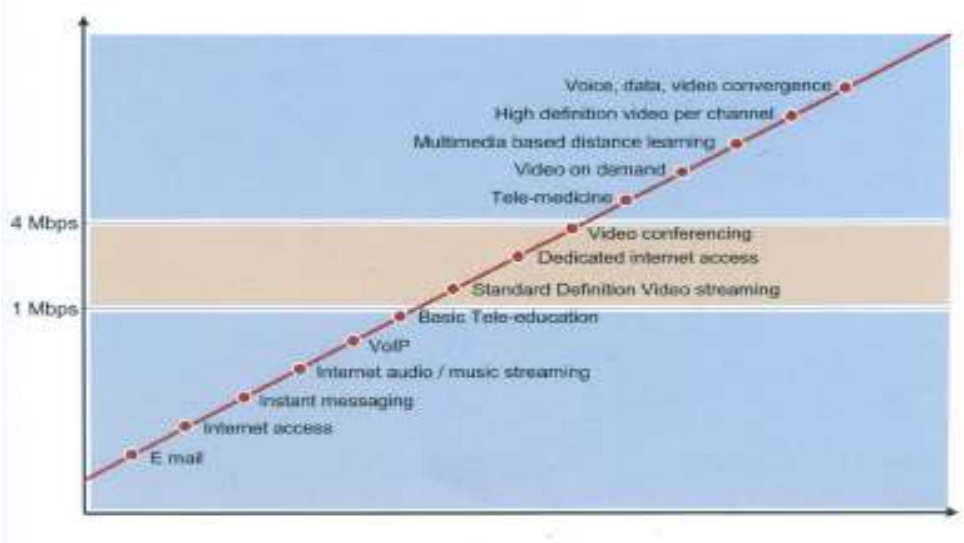
commonly used application, music and video content is preferred over other applications (Refer figure 4.3).

Figure 4.3: Purpose of Internet Access



4.20. The bandwidth requirement is likely to increase in future due to adoption of high bandwidth applications such as video on demand, tele-medicine, multi-media based distance learning and video conferencing. Some of these applications may require bandwidth speeds even more than 4 Mbps per user as shown in figure 4.4.

Figure 4.4: Bandwidth requirement per user



Source: CII Report[54]

4.21. The bandwidth requirement in rural areas is high due to usage of multimedia particularly where literacy is low. Most of the applications presently available on Internet are in English. As English literacy in rural areas is low, communication through video will be a popular application. e-education and e-health will pickup and are expected to have high video content. Initially broadband may be used through community centers. The proliferation of broadband connectionswill increase with the knowledge and awareness. Considering the bandwidth requirements as discussed for various applications, on an average a minimum of 2 Mbps per household will be necessary to support the broadband requirements till 2014. The holding time of the session is expected to be high for entertainment and e-education applications; therefore, adoption of low contention ratio for planning of the network will be necessary. Accordingly, contention ratio of 10:1 has been considered for working out bandwidth requirement (Refer Table 4.11).

Table 4.11: Bandwidth Requirement for Villages

Villages	2012			2014		
	Total	Wireless	Wireline	Total	Wireless	Wireline
Total Broadband Subscriber in Villages (in millions)	23.0	8.0	15.0	63.1	23.5	39.6
Av. No of HHs* per village	327.00	327.00	327.00	334	334	334
BB penetration	12%	4%	8%	32%	12%	20%

[54] CII study: Deployment Models and Required Investments for Developing Rural Broadband Infrastructure in India

(%)						
BB Households	39.64	13.48	26.16	106.44	39.64	66.80
BW requirement per HH (in Mbps)	2	2	2	2	2	2
BW requirement in access network (in Mbps) per village	79.29	26.97	52.32	212.9	79.28	133.60
contention ratio	10:01	10:01	10:01	10:01	10:01	10:01
BW requirement per village in Backhaul in Mbps	7.93	2.70	5.23	21.29	7.93	13.36
BW req. Per Gram panchayat in Mbps (2.24 village per GP)	17.76	6.04	11.72	47.69	17.76	29.93
BW req. Per Block in Mbps (approx 41 gram panchayat per block)	728.19	247.68	480.51	1955	728.13	1226.98

*****Projected household is taken for population of 2012 & 2014

4.22. For urban areas, bandwidth demand will be high frequency broadband usage and users are expected to remain connected for long time. The changing social behavior of urban population will require higher bandwidth to upload user generated content and to access social networking sites. IPTV and YouTube viewership is increasing. The household connection is likely to be used by many members of a family for a variety of applications. Popularity of HDTV is also increasing giving rise to higher bandwidth requirement. Therefore, in order to effectively support broadband requirement for bandwidth hungry applications, on an average a minimum of 2 Mbps bandwidth per household will be required by 2012 and 4 Mbps per household by 2014. Based on the above assumptions, bandwidth requirement for towns, cities and metros for broadband usage has been worked out and is given is given in Table 4.12.

Table 4.12: Bandwidth forecast in Urban areas by 2012 & 2014

Towns	2012			2014		
	Total	Wireless	Wireline	Total	Wireless	Wireline
Total Broadband Subscriber in Towns (in million)	9	3	6	19.2	7.2	12
Av. No of HHs* in town	5773	5773	5773	6024	6024	6024
BB penetration in percentage	39%	13%	26%	80%	30%	50%
BB Households in town	2259	753	1506	4819	1807	3012
BW requirement per HH (in Mbps)	2	2	2	4	4	4
BW requirement in access network (in Mbps) in town	4518	1506	3012	19277	7229	12048
contention ratio	10:01	10:01	10:01	10:01	10:01	10:01
BW requirement per town in Backhaul in Mbps	451.80	150.60	301.20	1927.68	722.88	1204.80
Cities	**2012**			**2014**		
Total Broadband Subscriber in Cities (in million)	14	5	9	30	11	19.2
Av. No of HHs* in cities	62500	62500	62500	65341	65341	65341
BB penetration in percentage	64%	23%	41%	130%	48%	83%
BB Households in cities	39773	14205	25568	85227	31250	54546
BW requirement per HH (in Mbps)	2	2	2	4	4	4
BW requirement in access network (in Mbps) in cities	79545	28409	51136	340910	125000	218182
contention ratio	10:01	10:01	10:01	10:01	10:01	10:01
BW requirement per city in Backhaul in Mbps	7955	2841	5114	34091	12500	21818
Metros	**2012**			**2014**		

Total Broadband Subscriber in Metros (in million)	30.5	10.5	20	47	18	29
Av. No of HHs*in Metro	690476	690476	690476	714286	714286	714286
BB penetration in Metro	105%	36%	69%	157%	60%	97%
BB Households in Metro	726190	250000	476190	1119048	428572	690476
BW requirement per HH	2	2	2	4	4	4
BW requirement in access network (in Mbps) in Metro	1452381	500000	952381	4476192	1714286	2761906
contention ratio	10:01	10:01	10:01	10:01	10:01	10:01
BW requirement per metro in Backhaul in Mbps	145238	50000	95238	447619	171429	276191

***Projected household is taken for population of 2012 & 2014

4.23. To summarize, The total bandwidth requirement for broadband (wireline + wireless) is given in table 4.13:

Table 4.13: Summary of Wireline Bandwidth Requirement

BW Requirement	**Rural/ Urban**	**Area**	**2012 in Mbps**	**2014 in Mbps**
Bandwidth per household	**Rural**	Village	2	2
	Urban	Town	2	4
		Cities	2	4
		Big Cities and metro	2	4
Backhaul requirement	**Rural**	Village	7.93	21.29
		Gram Panchayat	17.76	47.69
		Block	728.19	1955
	Urban	Town	451.80	1927.68
		Cities	7955	34091
		Big Cities and metro	145238	447619

CHAPTER 5: NATIONAL OPTICAL FIBRE PLAN

A – PLANNING OF NATIONAL NETWORK

A1. Planning Premise

5.1. While enunciating a broadband plan both speed and availability are important considerations. It is important to increase speeds by deploying faster next-generation broadband networks so that applications and services that will play important roles in improving quality of life and boosting economic growth are not precluded. At the same time, it is also important for the decision makers to see that broadband availability is increased and broadband is made available to reach most households and businesses.

5.2. Making a comprehensive plan for a national network is an involved process. Broadly, the plan would broadly delineate the utilisation of the existing network, new infrastructure required to be built, desirable technologies, expected outcomes, timeframe and financing. Service providers, infrastructure companies or other responsible agencies would use the broad level framework to make detailed plans for deploying the network. Available and evolving technologies have a bearing on planning decisions and should be appropriately evaluated. New technologies, when introduced, should bring more capacity, increased reliability and reduced cost. Building a communication infrastructure is usually quite expensive and economic planning plays a vital role. It is very important that the economical conditions of customers are taken into consideration. Economic consideration for urban and rural areas would be different and need to be appropriately factored in while making tactical and strategic plans. Also important to take into consideration is the service set

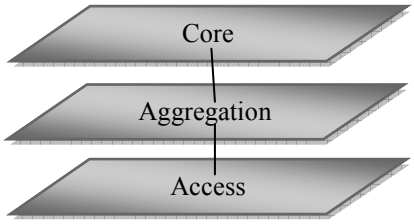
suitable for different type of user population. Access to cloud computing which would be necessity for big businesses and SMEs alike, the need for tele-medicine, tele-education, entertainment and gaming would determine the bandwidth calculations and technology selection.

5.3. A network that delivers broadband and the required services would have several elements that would work as a system and perform the desired functions. Example of such elements would be provider routers, provider edge routers, Ethernet switches layer 2/layer 3 switches, customer edge routers, ducts, cables, transmission equipment and the required customer relationship management hardware and software. These elements would have different capacities, life times and costs. In order to simplify planning as well as achieve simplicity and ease of implementation, network planning may be done at several levels based on type of equipments, media, their life cycle, costs, demand forecast, planning timeframes etc. While electronics may be planned for up to 5 year time frame, the passive component like fiber cable, ducts etc. are more likely to have planning horizons of 20 years. Thus, at the strategic level where plans may be for 10 years or more, the physical structure having long life is given due attention. At the tactical level, usually 3-5 years the implementation agencies would have a more detailed plan. The decisions about the type of switching equipment to be used are also made at this level. At the tactical level the goals specified should support the goals specified at the strategic level. At the operation level, for a period of 1 to 3 years, the planning would include access priorities, transition from existing network infrastructure to new infrastructure, documentation system, business establishment and related goals.

A2. Network Structure

5.4. An important aspect of planning the network is to decide the physical structure. The structure will decide robustness, reliability and scalability of the network. For long haul network covering the length and breadth of the country, the service providers provide the backbone or core network. This network may be designed as a network of routers located in important cities and interconnected in a combination of ring, mesh and star configurations. The backbone may be structured as a single monolith network or as interconnected hierarchy of national, regional and state networks with presence in DHQ and other important cities. In today's context this network would be an IP network that has interface for both Ethernet and Time Division Multiplexing(TDM) streams and can handle multiple protocols. The IP backbone could be used for a large number of applications relating to voice, data and video. The Access Network or the 'last mile' going upto the customer premises are based on the applications to be delivered to the end-user. For high bandwidth, high quality network, fiber based technologies are chosen. For the service providers having legacy copper network, ADSL and its variants are the natural choice. Wireless Technologies beyond 3G offer promise of high speed broadband networks and operators who have relevant spectrum may prefer to deploy these in some areas. Aggregation network functions as the collection agent of data from several sources in the access network and efficiently transport it to the backbone/core network. The layers of network down to the access are indicated in the figure below:

Fig 5.1 Network Layers



5.5. The access network is deployed by the licenced service providers using various wireline and wireless technologies. This network goes upto subscriber premises and must be designed and dimensioned on the basis of the services and applications that each customer requires. The aggregation network for broadband service has been deployed by large service providers to meet their own requirements. Standalone service providers who offer their own broadband service would have to connect their equipment to a large service provider's aggregation network or directly to the backbone network. In the latter case, the small service provider would have to build its own aggregation network at a substantial cost. Most pan-India service providers have built their own backbone network; others would have to interconnect their network to one or more of these backbones to offer inter-state VPN or broadband service to the customers. Non-availability of aggregation access network, specially in the rural areas, and the backhaul from Blocks to the DHQs at competitive rates to the service providers is one of the major impediments in the growth of broadband. The recommendations given in this document addresses these issues.

A3 What demands are to be met?

5.6. Assessment of demand made in chapter 4 has been summarized here. These parameters would be used in proposals for the access aggregation and backhaul networks:

5.7. Demographically speaking the total population estimated in the census of 2001 of 1.03 billion is distributed in the ratio of 72.2% and 27.8% in rural and urban areas. There are 5,93,615 inhabited villages, 3,74,552 villages with population more than 500 and 2,65,000 gram panchayats. There are 6374 blocks and 610 DHQs. The total area of the country is 32,87,240 square km giving about 13 km average block radius. There are about 266 households per village.

5.8. The total number of broadband connections are expected to be 75 million by 2012 and 160 million by 2014. To achieve this number of households that are expected to have broadband are 11 million out of 261 million (4%) in 2010, ~75 million out of 268 million (30%) in 2012 and ~160 million out of 275 million (60%) in 2014.

5.9. Wireline is expected to contribute 54 million connections by 2012 and 95 million by 2014. Out of these wireline connections, Cable broadband will be 28 million by 2012 and 72 million by 2014. Wireless broadband will be 60 million by 2014.

5.10. For the services and applications that are likely to be useful in rural areas a conservative average of 2 Mbps per household can taken for planning purposes. Some connections like that in CSC and some affluent households may be of higher data rates but many others may require a lesser data rate. The average number of broadband households in 2012 and 2014 would be 23 and 63 millions in rural area. The total backhaul bandwidth required per block will be 728 Mbps in 2012 and 1955 Mbps in 2014 (wireline 480.51 and 1226.98 and wireless 247.68 and 728.13). Assuming a contention ratio of 1:10, bandwidth required per village will be 8 Mbps in 2012 and 21 Mbps per village in 2014.

5.11. Backhaul requirement from block to DHQ would be 728 Mbps in 2012 and about 1955 (Approx. 2 Gbps) in 2014

B – Infrastructure for Broadband

5.12. As discussed earlier, the present status of broadband penetration in the country on the basis of various technologies and type of media is as below:

Table 5.1 Technology wise broadband penetration

Technology	%	Subscribers (in Millions)
DSL	86.89	8.95
Cable Modem	6.23	0.64
Ethernet LAN	3.95	0.41
Optical Fiber	0.24	0.02
Wireless	2.15	0.22
Leased Line	0.27	0.03
Others	0.26	0.03
Total	100.00	10.30

Figures reported by service providers for Sept 2010

5.13. In the short term i.e. 1-2 years, it would be important to reuse the existing network to the extent possible through enhancements that could be carried out during this period. However, from a long term perspective, it is necessary to evaluate various technological options available and choose those that offer better price performance ratio and are technologically more efficient.

5.14. In the consultation paper stakeholders were asked to suggest network topology to support high speed broadband using evolving wireless

technologies. The majority of stakeholders suggested Government should continue to adopt technology neutral policy so that all technologies are provided level playing field. Some of the stakeholders suggested that topology should be based on the principle of efficient utilization of various types of available infrastructure. This can be achieved by combining wireless technologies with the fiber based network. Fiber and Microwave can be used for the backhaul whereas wireless technologies can play a vital role in the access side of the network.

5.15. Some stakeholders supported the idea of the development of a robust pan-India National Broadband network in the long-term, however they would like it to be technology neutral. These stakeholders further stated that it is important for the Authority to leverage and harness all available technologies to achieve the national broadband objectives in the most expeditious and effective manner. Hence, the focus should not only be on a particular media, but all available technologies should be leveraged for building up such a national broadband backbone.

B1. Backbone/Core Network

5.16. Integrated service providers having large footprint have all created their IP backbone networks. A backbone primarily consists of carrier grade core and edge routers connected with high speed optical fiber links. The contemporary IP backbones are multi-protocol multi-service networks that can cater to voice, data and video traffic. The same backbone could be used for high speed Internet access, VPNs, hosting services and Video based services like IPTV. It is expected that with increasing traffic requirements the service providers would make appropriate enhancements and would also expand their networks to cover district head quarters, if not already done. The service providers who do not own

backbone network can obtain leased lines or VPNs and connect their access network to other service providers backbone.

B2. Aggregation/backhaul network

5.17. Aggregation network exists in the metro and cities. As the number of broadband connections increase the service providers would be forced to build more aggregation point to economically take the traffic to the backbone network. Backhaul is a constraint and the proposed agency would have a role is this. In the rural areas no aggregation exists and backhaul primarily belongs to BSNL. It is possible that in some cases the optic fiber cable connecting village to the block and block to the backbone would have no spare fiber to meet the requirements. It would therefore be essential to plan a shared aggregation and backhaul network

B3. Access Network

5.18. The country has about 40 million copper loops, primarily with the PSUs BSNL and MTNL. It was natural therefore that the initial deployments of broadband took place on copper using xDSL technologies. Today, the country has about 86% broadband connections, by far the largest, working on copper using DSL technologies. DSL, however, has a pronounced speed-distance tradeoff. The popular version, ADSL 2+, can theoretically support upto 24 Mbps but on very short loops, it can support only 2 Mbps up to at a distance about 3.5 kms. This limits the coverage area around the central office premises where the DSLAMs are installed. Functioning of DSL is highly sensitive to the quality of the copper loops. A large number of old pairs may need conditioning to qualify for use with DSL technology. Testing and conditioning each pair is a time consuming and expensive process. Currently, not much investment is being made in the copper network resulting in limited expansion and declining availability with time. With about 16 million

loops in rural areas and 24 million in urban areas ubiquitous broadband coverage is not possible through copper. Copper based technologies like DSL therefore have a limited role to play to an extent of about 20% deployment by 2014 but for scaling up the level of deployment and bandwidth other technologies would have to be looked into.

5.19. Some of the stakeholders have, in their response to the consultation paper, indicated their preference for wireless technologies for reasons of economic suitability and its ubiquitous availability. Wireless access technologies will include 3G wireless, Broadband Wireless Access, LTE, WiMAX, and other technologies that might come in future. The 3G GSM networks deployed by some of the operators are capable of providing throughput of 2 Mb per cell for stationary customers. For large scale deployment of broadband at higher speeds, this would be inadequate and it would be difficult to give credible cell-wide broadband coverage using 3G alone. Also when the customer moves from cell to cell it would be difficult to ensure that the connection is sustained at the negotiated broadband rate. At 2 Mbps the cell-radius would only be about 10 meters giving a cell area of about 300 sq m. 3.5G wireless technologies are typically capable of providing broadband speed of about 14.4 Mbps per cell site with 5 MHz carrier but these have not yet been commercially deployed in India. Some operators have deployed CDMA networks with EVDO which can give about 3 Mbps connection to a subscriber but not on a sustained basis. Thus today we do not have wireless deployments that can give credible wireless broadband that fits today's broadband definition and gives large-scale broadband connections.

5.20. There has been widespread adoption of GSM/CDMA as a 2G technology primarily for voice and UMTS/HSPA/CDMA 2000/EVDO as 3G primarily for data applications. LTE and mobile WiMax are the next step in the technological roadmap. Both LTE and WiMAX offer higher data rates,

lower latency and greater spectral efficiency than previous technologies. With these technologies, it is possible to achieve bandwidth upto 140 Mbps per cell site with 20 MHz carrier. However, the scarcity of spectrum and provision of adequate backhaul to support the increasing demand are the two key constraints. In their response, some of the stakeholders have stated that these IP-based Next Generation Networks (both fixed and wireless) will be built on fiber-based core and aggregation networks that can flexibly provide bandwidth to wireless base stations as well as wireline access networks.

5.21. In the subsequent paragraphs, an attempt has been made to access the requirement of spectrum in following four scenarios for achieving the wireless broadband targets given in the Tables 4.11 and 4.12:

- Metros cities like Delhi;
- Large cities like Nagpur;
- Cities having population between 1 Lakh and 10 lakh; and
- Villages

5.22. For the metro and large cities like Delhi and Nagpur it is assumed that a wireless broadband household penetration of 36% and 60% will be achieved in the year 2012 and 2014 respectively (Table 4.12). For the year 2012 download/ upload (DL/UL) traffic channel bandwidth ratio of 3:1 has been taken. In view of increase in demand of more video based applications, it is expected that by the year 2014 this ratio will change to 2:1. For the purpose of estimating the spectrum requirement, the spectrum efficiency figures and usable data throughput projected for Wimax and LTE technologies has been taken.

5.23. Presently 20 MHz of spectrum has been allocated to each of the three operators for BWA. Assuming that by 2012 an operator will deploy

around 500 BTSs in Delhi and around 150 BTSs in Nagpur and by year 2014, 1000 and 250 BTSs in Delhi and Nagpur respectively, it is seen from Table Nos. 5.2 and 5.3 that the spectrum requirement in Delhi and Nagpur will be around 641MHz and 328 MHz respectively.

5.24. For estimating the spectrum requirement for wireless broadband in cities having population between one to ten Lakh, the penetration rate has been taken as 23% and 48% for the years 2012 and 2014 respectively. Being smaller cities compared to Metros, it is assumed that an operator with 20 MHz of spectrum will install about 50 BTS by the year 2012, which will be increased to 100 BTS by 2014. The spectrum requirement as given in table 5.4 works out to be around 22 MHz and 113 MHz for the years 2012 and 2014 respectively.

Table 5.2 Estimated Spectrum Requirements for Delhi

	2012	**2014**
Max downloaded data throughput required (Gbps)	368	1,922
Download/Upload traffic channel bandwidth ratio	3:1	2:1
Total data Throughput required (Gbps)	491	2,883
BWA Spectrum Assigned to Service Provider (MHz)	20	20
Estimated throughput per cell with 20 MHz Spectrum (Mbps)	70	90
Estimated BTSs deployment by a Service providers	500	1000
Throughputs available with 20MHz spectrum (Gbps)	35	90
Total Spectrum required for providing required throughputs (MHz)	**280**	**641**

Table 5.3 Estimated Spectrum Requirements for Nagpur		
	2012	**2014**
Max downloaded data throughput required (Gbps)	48.6	246.0
Download/Upload traffic channel bandwidth ratio	3:1	2:1
Total data Throughput required (Gbps)	65	369
BWA Spectrum Assigned to Service Provider (MHz)	20	20
Estimated throughput per cell with 20 MHz Spectrum (Mbps)	70	90
Estimated BTSs deployment by a Service providers	150	250
Throughputs available with 20MHz spectrum (Gbps)	10.5	22.5
Spectrum required for providing required throughputs (MHz)	**123**	**328**

Table 5.4 Estimated Spectrum Requirements for Cities with 1-10 lakh population		
	2012	**2014**
Max downloaded data throughput required (Gbps)	2.8	34.0
Download/Upload traffic channel bandwidth ratio	3:1	2:1
Total data Throughput required (Gbps)	3.8	51
BWA Spectrum Assigned to Service Provider (MHz)	20	20
Estimated throughput per cell with 20 MHz Spectrum (Mbps)	70	90
Estimated BTSs deployment by a Service providers	50	100
Throughputs available with 20MHz spectrum (Gbps)	3.5	9
Spectrum required for providing required throughputs (MHz)	**22**	**113**

5.25. For rural areas, the strategy for providing broadband will have to be different from cities as unlike cities the availability of optical fiber in villages is low and for last mile access wireless may be required to be planned in short to medium term i.e upto 2014. For estimating the

spectrum requirements in rural areas a Block has been taken as a unit. The penetration percentage has been taken as 8% and 20% and bandwidth required per HH as 2 Mbps and 4 Mbps for the years 2012 and 2014 respectively. It is also assumed that each village will have a Community Service Centre (CSC) with a bandwidth requirement of 10 and 20 Mbps for 2012/ 2014.

5.26. With these assumptions it is seen (Table 5.5) that a single operator with 20 MHz of spectrum will have to deploy 12 and 17 BTSs per Block to fulfill the projected demand for the years 2012 and 2014 respectively.

Table 5.5 Estimated Spectrum Requirements for Wireless Broadband in Rural areas

	2012	**2014**
Number of blocks	6000	6000
Average number of villages ber block	100	100
Number of Households per village	327	334
Percentage of HH having BB	4%	12%
Estimated HHs having BB in a village	13.1	40.1
BB data rates per HH (Mbps)	2	2
BB data rate per CSC	10	20
BW required per village	36.2	100.16
BW required per block (Mbps)	3616	10016
Contention Ratio	10:1	10:1
Max downloaded data throughput required (Mbps)	362	1002
Download/Upload traffic channel bandwidth ratio	3:1	2:1
Total data Throughput required (Mbps)	482.1	1502.4
Estimated throughput per cell with 20 Mhz Spectrum (Mbps)*	40	90
Calculated Total BTSs required to meet the throughput demand in a block	12	17
* For 2012, single sector has been taken and for 2014, three sectors is taken.		

5.27. The other option for providing the broadband is through coaxial cables used for Cable TV. India today has a large broadcasting sector comprising 550 television channels and about 85 million Cable TV households in India. Cable TV networks can be a cheaper and convenient source of providing broadband to households as cable TV networks already have access to large number of households. A cable television (CATV) network is based on broadband coaxial cables. It has a tree like

structure in through which the signal is transmitted from the head-end and propagated through the coaxial cable to the users. The bandwidth on the cable is divided into channels. A channel on the cable can be used for analog TV or digital transmissions like digital radio, digital TV or Internet access. One channel can have a bit rate of 30 Mbps or more for the downstream and normally lower for the upstream, but the bandwidth is shared among all users connected to the headend. By and large cable TV networks are analog and one way. These networks require upgradation for providing broadband.

5.28. International experience suggests that provision of broadband services is an attractive business avenue for the cable TV sector. There were 451.94 million broadband connections worldwide as per the World Broadband Statistics for the quarter ending December 2009. Out of these 20.32% were cable modem connections. The majority of the cable modem connections were in North America (52.37%). Some European countries like UK, Netherlands, Germany, Spain & Belgium also have a good number of cable modem connections.

5.29. Bundling broadband with digital TV channels is a promising proposition. Operators can provide broadband at competitive prices and still generate relatively high margins. Most of the cable TV networks, in India, are analog and are one way. These networks require upgradation for providing broadband. In some cases the highly fragmented existing cable TV networks may not be upgradeable and may require total replacement. The available data suggests that, in India, only 10% of existing cable TV network i.e. approximately 8 million cable TV connections are capable of providing broadband access at present.

5.30. Assuming that the average length of cable laid by the cable operator to each home is 100 meters, for 85 million cable TV homes the total cable

laid is around 8.5 million kilometres. Further, the cable operator is provided connectivity by MSO on optical fiber which has an average length of 1.5 kilometres. According to the industry, MSOs have laid around 30,000 km of optical fiber to provide connectivity to cable operators besides large backbone fiber network for inter city and intra city connectivity. At many places they are using the fiber networks of telecom service providers.

5.31. Considering all the above aspects the Authority has worked out a framework of implementation of digitization with addressability of the cable TV network in India by December 2013. The recommendations on implementation of Digital Addressable Cable System in India were sent to the Ministry of Information and Broadcasting on 5th August 2010.

5.32. TRAI, in these recommendations, has discussed the investment required in the setting up of such a system in India and suggested measures and fiscal incentives for its implementation which would provide digital cable TV services along with broadband services to the subscribers.

5.33. To provide Internet services, cable operators are required to upgrade their cable networks so that signals could flow in both directions. They also need to build a sophisticated end-to-end IP networking infrastructure in each community they want to serve which is robust enough to support data subscribers. These include items like Internet backbone connectivity, routers, servers, network management tools, as well as security and billing systems.

5.34. The current major broadband technologies deployed by the cable industry are DOCSIS and Ethernet over cable technology.

- DOCSIS (Data Over Cable Service Interface Specification) provides bidirectional transfer of signal between a Cable Modem Termination System (CMTS) placed at the head-end and Cable Modem (CM) at customer location over the existing coaxial or HFC network. The Ethernet solution has an Ethernet network, based on optical fiber backbone and extended LAN technology using CAT5/6 cable as the last mile or Ethernet over Cable (EoC) based on deeper fiber concept with last mile delivery on existing co-axial cable.
- Ethernet based network is easy to deploy to deliver high speed symmetric bandwidth through highly scalable network catering to present and future demand of bandwidth. Also, a combination of DOCSIS in the backhaul and Ethernet-over-coaxial (EoC) in distribution network is used in certain cases.

5.35. The digitisation of the cable TV network would involve upgradation of the distribution network and cable head-ends. In addition, there is requirement of encryption (CAS), subscriber management system (SMS), Set Top Box at the subscriber premises and skill development. The total requirements of fund estimated by different sections of the industry vary from Rs. 30,000 to Rs. 60,000 crores. Even though there is a wide variation in the industry estimates of overall investment required for achieving digitization with addressability, there is no disputing the fact that the requirement of funds is very large. Therefore the Authority, in its recommendations, has proposed a number of possible incentives that can be offered to various stakeholders so that digitization with addressability is implemented in the shortest possible time and the transition made is sustained. These include income tax holiday, for the period from the date of setting up of the digital addressable network, or 1.04.2011 whichever is later, till 31.03.2019, reduction of the basic custom duty on the major items in digital addressable broadcast distribution i.e. digital head-end equipments and STBs, to zero level for

the next 3 years and rationalization of the taxes and levies on the distribution sector. Also the MSOs/LCOs should be eligible to seek Right of Way (RoW) on non exclusive basis for laying optical fiber being a vital infrastructure.

5.36. Migration to addressable digital systems calls for large capital investment and so the duties and levies applicable to the broadcast distribution sector require rationalization. The Authority has recommended that the Government, as a special measure, allow reduction of the basic custom duty on the major items in digital addressable broadcast distribution i.e. digital head-end equipments and STBs, to zero level for the next 3 years. The cable television industry need to pay service tax and entertainment tax in the states which varies widely from state to state. Moreover, high/ multiple taxes make the services costlier. In addition to these measure it was also recommended that MSOs/LCOs should be eligible to seek Right of Way (RoW) on non exclusive basis for laying optical fiber being a vital infrastructure.

5.37. TRAI has also recommended for the enhancement of the limit for foreign investment to 74% from the existing 49%, for all MSOs (operating at national and state level) who take up digitization of their networks with addressability.

5.38. Broadband on cable TV has some limitations as well. The present deployment using DOCSIS version 1 has a limit of 30 Mbps per RF channel and a subscriber can get a maximum of 3 Mbps. The newer version, DOCSIS 3.0 is claimed to have a maximum limit of 50 Mbps per RF channel with each subscriber being able to get upto 20 Mbps. In the Ethernet option it can deliver upto 96 Mbps per cable section with the present version supporting upto 32 users. The newer version can support

upto 128 users. In addition, the cost of upgradation of the cable TV network from analog to digital is high.

5.39. The wireline telecom connectivity as on June 2010 is 9.46 million in the rural areas whereas in the urban areas it is 26.72 million. When we compare these figures with the cable TV homes connectivity, the cable network caters to much larger rural population and promises to be a potential network through which the broadband penetration can be achieved. Presently, for providing broadband services to their subscribers, cable operators take Internet bandwidth from an ISP which makes their business model less viable. In order to get bandwidth at affordable rates, if they want to get bandwidth directly then they have to take ISP licence in either category A (for national level-having entry fee of Rs. 30 lakh) or category B (for state level-with entry fee of Rs. 20 lakh). The Authority, in its recommendations on Spectrum Management and Licensing Framework, dated 11th May, 2010, has proposed reintroduction of Category C license for the ISPs with a District-wide jurisdiction. This would enable small operators including the cable operators to offer Internet service alongwith other services. Since the intention is to enable small operators to acquire ISP licence, the Authority has proposed that those operators who have a turnover of less than Rs.1crore, need not be charged any licence fee. If, MSOs, and more importantly LCOs in the rural areas, are provided access to nearest concentration/aggregation point of the national broadband network at par with ISP, the business model of the cable networks would become attractive enabling thereby to achieve the twin objectives of the spread of addressable digital cable TV services and the broadband services to every nook and corner of the country.

5.40. Examination of various technologies on wireline, wireless and cable has revealed several limitations in meeting the requirements. We, therefore

need to look for a viable alternative that can meet the needs of high bandwidth, reliability, scalability and sustainability besides being economic. It is in this context that an optic fibre network stands out as an alternative that meets these criteria.

5.41. Optical fiber, which is one of the most promising technologies for the future, has been mostly laid by the service provider for long haul traffic. There is only a small amount of fiber in the access network resulting in only about 0.53% broadband connections working on optical fiber. However, with increasing bandwidth demand in the access network, fiber is being increasingly used by the service providers. As more and more bandwidth is being demanded in the access networks, the fiber has become more common in this network level. A combination of FTTx technologies preferably using multi-star topology could be economically used to meet future bandwidth demand in rural and urban areas. This topology can be implemented using Passive Optical Networks (PON) which reduce the amount of fibers from the Central Offices (CO) as compared to a point-to-point system. One, or fiber pair, from the CO in the network is split into several subscriber lines by use of passive optical splitters. These splitters are inexpensive and do not use electronics and no maintenance and power supply is required. They can be kept at any convenient location in the network. In the provider's end, there is a Optical Line Terminal (OLT) in the CO and at or near the customer premises there is an Optical Network Terminal(ONT).

5.42. Optical Fiber in the access network is capable of providing high bandwidth throughput for services (even upto 100 Mbps) such as high-definition IP Television (IPTV), video on demand (VoD) etc. Some of the stakeholders submitted that the futuristic networks can only be created by deploying the deeper fiber networks within the close proximity of the users. The robustness of any fiber networks can be achieved with its

layout, and many providers are delivering FTTH & FTTB+LAN on overhead fiber network in an unplanned structure and are finding difficult to maintain the QOS.

5.43. In metros and big cities, the demand of bandwidth is leading towards a situation where FTTH / FTTB will be inevitable. In the USA, for example, Google has planned FTTH trials with municipalities. They will develop open access networks offering 1 Gbps. In June 2010, Ireland national carrier Eircom has announced two large scale, open access broadband fiber to the home (FTTH) trials for up to 10,000 residential and business customers in communities.

5.44. At present in India, it is not compulsory to make provision for internal wiring or telecom service termination equipment while erecting any multi stories building. There is a need to consider the option of mandating the creation of internal network by the builders of multi-dwelling units in such a way that any service provider is able to use it for providing services to the residents of the building.

5.45. However, the real bottleneck lies in the "backhaul segment", which transports the aggregated cellular traffic from the cell towers to the switching centers. Today, a large part of the wireless backhaul network is primarily built using microwave that cannot be scaled up to carry the amount of high-speed multimedia traffic expected to be seen in this part of the network as the broadband vision is realized over the next few years. Therefore, there is a need to build a high-speed optical network based on standardized transport technologies such as next-generation SDH, DWDM and Carrier Ethernet that reaches up to the last-mile cell towers.

5.46. To fulfill the objective of providing broadband connectivity at every Panchayat/habitation, there is need to provide state of the art ICT

infrastructure, architecture tools and technology to organize, access and mobilize information at Panchayat/habitation. For maximum utilization of broadband capabilities and providing the benefit from convergence of voice, data and video for improving training, education, service delivery and governance to rural mass, there is a need to establish Optical Fiber Cable based high capacity broadband connectivity at every Panchayat/habitation.

5.47. Internationally, considering the long term sustainability, security and reliability aspect among various available technologies, most countries have adopted Optical Fiber based connectivity for rural needs. It is observed that all National level broadband plans provide for the reach of broadband upto rural and remote areas through OF network.

5.48. The Government has proposed to implement a massive programme of broadband for all, under which all the 250,000 Gram Panchayats in the country will be provided high speed broadband connectivity by 2012. In its consultation paper, the Authority has sought the views of the stakeholders regarding the need to create a national optical fiber network extending upto villages. Majority of stakeholders supported the idea of creating optical fiber network upto village level. Some stakeholders are of the view that wireless technologies are capable of handling the village requirement and there is no need for OFC upto village level.

5.49. Presently, Optical fiber connectivity is largely available upto the district headquarters. In the rural areas OFC is available upto block headquarters. In India about 750,000 route kilometer optical fiber is available which includes 500,000 Km optical fiber network of state owned operator BSNL. In rural domain Optical fiber is primarily provided by BSNL and it is estimated that about 30% of villages having population

more than 1000 have been provided optical fiber connectivity by BSNL. Status of fiber laid by different service providers is given in the Figure below:

Figure 5.2 Status of fiber coverage by service providers.

Service Provider	Total Fibre Laid	Cities / Towns Covered	Metros / Tier I Cities*	Other Cities / Towns	Gram Panchayats	Mid Sized Villages	Small Villages
BSNL	614,755 RKm**	All cities & 28 K gram panchayats	●	●	◔	○	○
Reliance	190,000 RKm**	44	●	◔	○	○	○
Airtel	126,357 RKm**	130	●	◔	○	○	○
Tata Communications	40,000 RKm**	60	●	◔	○	○	○
RailTel	37,720 RKm	600	●	◑	◔	○	○
PowerGrid	21,652 RKm	110	●	◔	○	○	○
GAILTEL	13,000 RKm	200	◑	◔	○	○	○

Level of Backbone Infrastructure Coverage : Very High ● High ◕ Medium ◑ Low ◔ No Coverage ○

Source: Analysis Mason[55]

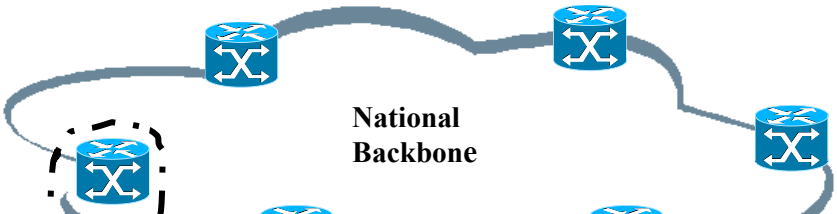
5.50. It can be seen that there is hardly any coverage at the level of Panchayat and other villages. If broadband is to be extended to the villages then arrangements need to be made to aggregate village traffic and backhaul it to the backbone. In the first phase fiber may be laid for aggregating traffic in the Panchayats and for the backhaul. This would cover about 2.65 lakh villages. There are additionally about 1.15 lakh habitations with population above 500 which could be taken up in the second phase.

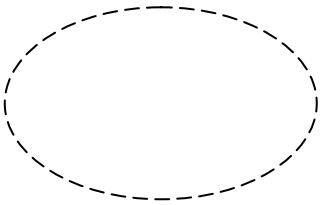
5.51. There are many ways an optical fiber based network can be planned for rural areas. Intra-block fiber network can be provided through Passive

[55] CII Report: Deployment Models and Required Investments for Developing Rural Broadband Infrastructure in India

Optical Networks with one or more Optical Line Terminals(OLT) placed at strategic locations. Single fiber could be taken for a group of villages up to as far away from the OLT as possible and then a passive splitter would be used to split fiber into a number of directions so as to serve as many villages as possible. At the village end the fiber terminates onto an Optical Network Terminal (ONT) that provides interface for various services. The block traffic can be backhauled to the backbone at the nearest node at the DHQ or the any other city. Below the ONT the service provider would provide his own access network using copper or fiber or coaxial cable or wireless. The diagram below explains this architecture.

Fig 5.3 Access aggregation and backhaul with fiber





5.52. As per the demand projected in Chapter 4, the bandwidth requirement per household would be 2 Mbps. The total number of broadband households would be 40 and 107 and the requirement of bandwidth per village is estimated as 80 and 212 Mbps in the years 2012 and 2014. The bandwidth required per block would be 729 Mbps and 1955Mbps in the years 2012 and 2014. OLTs are commonly available with capacities upto 8 Gbps. The passive splitter split the fiber in the ratio 1:32. For the number of households projected it would be possible to serve the block with 2 or 3 OLTs. At the fiber end closer to the subscriber there would

optical network terminal (ONT) which would typically provide Ethernet, POTS, HPNA and Video ports.

5.53. In the urban areas the service providers would deploy various configurations of FTTX taking the fiber into households where bandwidth requirement is high or upto the building for serving multi-dwelling units or to the curb where a number of discreet houses are to be served. Traffic from a number of OLTs can be aggregated through Ethernet switches and taken to the backbone network. In the urban areas the bandwidth requirement per household is taken as 2 Mbps in the year 2012 and 4 Mbps in the year 2014. The bandwidth requirement for small towns in the access is about 5 Gbps and 20 Gbps in the access and 452 Mbps and 2 Gpbs in the backhaul at 1:10 contention ration in the years 2012 and 2014 respectively. For the cities the bandwidth requirement in the access is 80 Gbps and 341 Gbps and in the backhaul 8Mbps and 34 Mbps. For the metros the requirement is 1452 Gbps and 4477 Gbps in the access and 145 Gbps and 448 Gbps in the backhaul with 1: 10 contention ratio.

C – Benefits of fiber optic network

- It gives a high bandwidth infrastructure that future proofs the network. It would be possible to provide bandwidth upto 100 Mbps through the network.

- It gives high quality and reliable and secure broadband network
- It provides a long term service solution that can provide a host of existing and as yet unimagined services for the consumer and for business.
- The network pays back for itself and also provides long term revenue streams.
- It will lead to digital economy

- It will enhance Participation of people in governance
- It will generate source of revenue for the Government
- It will help in disaster management, weather forecasting, fisheries etc
- It will provide boost to cable industry
- It facilitate to provide advanced online education, commercial, medical activities.
- It enables various monitoring including environmental monitoring, Smart Monitoring (e.g. traffic cams, playground cams) etc.
- It help to generate faster scientific sample analysis.
- It generate the opportunity for various related applications including software development.
- It provide the ability to work from home or other remote location

5.54. As per tentative estimates the total Capex for laying optical fiber networks across the country comes to about Rs 65,669 crores. Against this revenue it is estimated that NOFA will earn an annual revenue of around Rs 26289 crore consisting a revenue of Rs 3962 crore from towns, 6193 crore from cities and 9703 crore from Metro and big cities. Additionally it will earn a revenue of around 6431 crores from its business in rural areas. Taking 20% of the Capex as annual operational expenses they would be about 13000 crore. It is seen that the profit potential of such an enterprise will be of the order of around 13289 crore per year ie such an enterprise will be able to achieve break even in 5 years time.

D– Cost and Financing

5.55. The cost of laying OFC for rural areas has been summarized in the Table 5.6. It is proposed that atleast a 24-fiber cable would be laid in any of the sections. Cost of laying each km of cable has been calculated as Rs 2,25,000 which includes the cost of digging, HDPE pipes and the cable. The central office end equipment has been taken as a pair of OLTs at a cost of Rs 80,000 each and the ONTs at the cost of Rs 15,000 each.

Table 5.6 Cost of optical fiber cable and end equipment

Calculation of laying fiber and equipment		
	Cost of fiber, trenching and laying	
1	Cost of Optical Fiber (Rs/Km)	30,000
2	Average Digging and pulling Cost of OFC (Rs/ Km)	1,62,000
3	Cost of HDPE Pipes In Rs. Per Km	33,000
4	Total cost of OFC including labour and material (Rs/Km)	2,25,000
	Cost of end equipment	
5	Cost of OLT per unit	80,000
6	Cost of ONT per unit	15,000

5.56. The total cost of the access aggregation and the backhaul for 6374 blocks including 3,74,552 villages having more than 500 population is given in Table 4.7 The average number of villages per block comes to 59. The following assumptions are made to simplify the planning and arrive at indicative figures. The deployment is considered to be greenfield. Considering the total area of the country and the number of blocks the average radius of the block comes to about 13 km. The distance of passive splitter is taken as 8 km from the OLT and that of ONT as 5 km from the splitter. Cost of each OLT is taken as Rs 80,000 and of each ONT as Rs 15000. It is presumed that running cables on four routes from the OLT would suffice for the number of villages served by one OLT. These figures have been used to arrive at a cost of Rs 48127 crores for the fiber optic access aggregation for all the blocks and Rs 7171 crores

for the backhaul. The total cost of the fiber network to be created by the proposed agency would be Rs 55298 crores.

Table 5.7 Cost of Aggregation and Backhaul

	Cost of Access Aggregation Network and Backhaul for all Blocks		
1	Average no of villages per block	59	
2	Average block radius(km)	13	
3	Optic fiber to splitter(km)	8	
4	Optic fiber from splitter to village(km)	5	
5	Average backhaul Block to DHQ(km)	50	
	Access aggregation cost		
6	Cost of 2 OLTs (Rs)	160000	
7	Cost of ONTs in a block(Rs)	1770000	
8	Cost of trenching & laying cable (per km)	225000	
9	Cable to be laid per block(km)	327	
10	Cost of laying cable per block(Rs)	73575000	
11	Cost of cable and equipment	75505000	
12	Cost for all blocks(Rs)	481268870000.00	
		48127	crores
	Backhaul Cost		
13	Average cable length(km)	50	
14	Total length for all blocks(km)	318700	
15	Cost of backhaul	71707500000	
		7171	crores

5.54 If it is presumed that priority would be given to 63 cities identified by the Jawarharlal Nehru Urban Renewal Mission (JNURM) i.e. 7 Category A (above 4 million population), 28 Category B (1-4 million population) and 28 Category C(less than 1 million population) cities. To make an estimation of cost, based on feedback for some service providers, it is estimated that the Category A cities would require on an average about 1000 route km of fiber, Category B cities about 500 route km of fiber and the rest of the cities on an average about 300 route km fiber. The total requirement would, therefore, be about 29,400 route km of fiber at a cost of about Rs 662 crores. For the remaining 4315 towns if we presume that 100 km of fiber will be laid then the total cost would be about Rs. 9709 crores.

5.55 The cost of laying optical fiber cable consists primarily of digging the trenches, cost of the HDPE pipe, cost of optical fiber cable and cost of the optical fiber equipments. The above estimate does not include cost of Right of Way (ROW), generally paid to local Government / agencies granting ROW permission. Currently when telecom service providers seek ROW permission, they pay ROW charges averaging approximately Rs.3.0 lakh per kilometer. It has been proposed in these recommendations that the Government as SOFA will have equity participation of the states there would be no ROW charges.

5.56 The total estimated cost of creating optical fiber infrastructure rural and urban areas is as follows:

Table 5.8: Estimated Cost of Optical Fibre Infrastructure Rural & Urban

Area	**Cost (**in Rs)
Rural	55298 crores
JNURM cities	662 crores
Other cities	9709 crores
Total	**65669 crores**

5.54 A total of 2402998 km fiber is to be laid in the access network and about 50 km for each block. This gives a total requirement of about of fiber for all 6374 block. For JNURM cities about 29,400 route km of fiber will be laid and for remaining 4315 towns about 431500 km fibre will be laid. Therefore approximately 2545198 Kms of fibre will be laid across the country. Depending on the soil condition one labour would be able to do 1-2 meter per day. Taking 2 meter per day for rural areas the number of Man days would be 1272599000. This indicates the project will generate 100 man days work for 1272590 people.

C – Institutional Framework

5.55 The backbone IP network, as it exists in India, has been developed by a number of service providers reaching out to a number of cities and towns. More investment is likely to be made as the volume of traffic increases and business requirements dictate increase in outreach. The access network reaching out to households and businesses would be developed by the service providers using a combination of technologies in the urban areas. In rural areas while the last mile would still be best left to the service providers, it would be the intra block aggregation network and the backhaul connecting the block to the backbone that may prove to be the bottleneck for growth of broadband if not given due attention. No single service provider would have resources to make a suitable network of fiber which requires an investment of about Rs 48127crores for aggregation and Rs 7000 cr for the backhaul to be able to cover all villages above 500 population. The service providers would vie for a limited number of customers in each village. The total average household penetration in 2014 is expected to be 20% in a village or 107 households. Assuming that the most dominant service provider has 50% market share, it would then have about 54 customers. Building a village to block and backhaul from the block just for that many customers would be totally unviable. This is where the Government intervention would be necessary and a suitable institutional framework would need to be established to oversee creation and maintenance of the much needed shared fiber aggregation and backhaul which all the service providers can connect to in order to serve their rural customers economically.

5.56 The problem of availability of high bandwidth fiber optic network is not limited to rural areas. Growth of broadband in urban areas too is limited by non-availability of fiber in the aggregation and the access networks.

The work is initially proposed to be carried out in the 63 cities identified by Jawarharlal Nehru Urban Renewal Mission (JNNURM) ie 7 cities with more than 4 million population(Category A), 28 cities with 1-4 million population(Category B) and 28 selected cities with less than 1 million population(Category C). It is estimated that the Category A cities would require on an average about 1000 route km of fiber, Category B cities about 500 route km of fiber and the rest of the cities on an average about 300 route km fiber. The total requirement would be about 29,400 route km of fiber at a cost of about Rs 662 crores. The remaining 4315 cities/towns would require about 431500 km of optic fiber cable to be laid at a cost of about Rs 9700 crores. The proposed institutional framework can encompass the work of creation of shared fiber infrastructure in the urban areas.

5.57 It is important to create a suitable institutional framework at national and state levels with clearly outlined authority and responsibilities. Creating a national optical fiber infrastructure would involve rational network planning taking into account state of development of the network, well planned procurement, efficient management of large amount of material, management of large labour requirement, organizing massive investment, quick execution and meeting time schedules. There are options that may give rise to problems like availability of funds, difficulty in non-discriminatory sharing of infrastructure, pace of rollout, network duplication, difficulties in transfer of existing asset to the company, right of way and general operational problems. It is therefore necessary to evolve a functional model that would be successful in India context.

5.58 A number of options were considered for institutional framework for agency that could build the required network. One option could be to setup an autonomous national level agency to manage and co-ordinate

the project on mission mode as well as to subsequently administer the optical fiber network. This agency would be responsible to construct, own and lease the optical fiber network and would in turn lease out fiber infrastructure to all telecom service providers and others on non-discriminatory and transparent terms and conditions. Though it would require initial financial support it should in time be able to meet its own operational expenses. This option has the advantage of autonomy, fast decision making, centralized planning and procurement, availability of loans and funds through the Government, ease of coordination with the other ministries and departments, no ROW problems, creation of infrastructure is not hampered by viability issues. The second option is to form a special purpose vehicle (SPV) with public private partnership to create a nationwide optical fiber network. USOF could invite the options for investment from various private agencies to be a partner in the project. Once the project is completed the PPP firm shall maintain the OFC under a well defined framework. OFC may be leased out to service providers on demand at predetermined rates prescribed by the regulator. Revenue earned by this leasing operation may be shared between USOF and private partners. The advantage of the method is that the Government being a partner ROW and other clearances may be faster and because of the private participation the decision making process may be faster. The disadvantage is the private partner may not perceive the business as lucrative, the bid amounts may be low and it may be difficult to carry out the work in the amount of funds made available. The third option could be to create the optical fiber network by a consortium of service providers having clearly laid down framework for its functioning. The consortium may find it difficult to coordinate with state and central Governments for clearances and ROW. There are variations of these basic models and all of these needs to be seen in the light of what has been stated in paragraph 5.58.

5.59 Taking into account the above discussion, the following recommendations are made:

National Level

- It is proposed that a 100%, central Government owned, holding company called National Optical Fiber Agency (NOFA) be formed. The company shall be registered under the Companies Act of 1956
    - NOFA should be headed by a person of eminence and Board of the company would have complete autonomy in functioning as available for Delhi Metro Rail Corporation.
    - NOFA would discharge the following functions:
    - Carry out top level planning of the shared fiber network in the country
    - Oversee the work of creation of shared fiber infrastructure
    - Centrally organize procurement of equipment, fiber and other material in order to get volume benefits.
    - Plan, install, operate and maintain shared fiber network in the 63 JNURM identified cities and provide means to allow any service provider to use the network for giving broadband connections using any technology in the last mile.
    - Arrange and manage funds from the Government programmes like USOF
    - Debt is to be raised by NOFA and further given to state level agencies

State Level

- A State Optical Fiber Agency (SOFA) should be formed in every State with 51% equity held by NOFA and 49% by the respective

State Government. NOFA would be the holding company of all the SOFAs.

- All the SOFAs, under the overall guidance of NOFA have to carry out the works related to creation of shared infrastructure for access aggregation and backhaul in the rural areas and shared fiber infrastructure in the urban areas where necessary. In doing so SOFAs would carry out the following activities:
    - Plan, install, operate and maintain access aggregation network in the rural areas to connect various access network deployed by the service providers to the block headquarters.
    - Plan, install, operate and maintain the backhaul between block head quarter and the district/state headquarters and provide means to connect it to any service providers' backbone network.
    - Plan, install, operate and maintain backhaul for wireless access networks to be connected to the backbone wherever they are a bottleneck.
    - Plan, install, operate and maintain shared fiber network in urban areas other than the 63 JNNURM identified cities and provide means to allow any service provider to use the network for giving broadband connections using any technology in the last mile.
    - The agency would have option to build, using various financing models, the required infrastructure and also buy or lease elements like ducts, manholes, cables or fibers and associated electronics from service providers and other agencies.
    - Fix large contractors for carrying out the trenching, laying and equipment installation works. Work in each state may be given to atleast two contractors

- The SOFAs would pay back the debt of NOFA from the revenues.
- The States would take care of all the ROW issues. This would be one of the conditions for the programme to be taken up in a State. SOFAs would be allowed to carry out reinstatement and there would be no reinstatement charges.
- The SOFAs would be given National Long Distance (NLD) licence with the condition that they will not access the subscribers directly for providing any service permitted to NLD licencees. The agencies would pay the designated licence fee.

General

- NOFA would be responsible for training and awareness programmes.
- TRAI would, from time to time, fix the rates at which NOFA (in urban areas) and SOFAs would lease infrastructure to the service providers.

D – Time Frame

5.60 A fiber optic network once created provides a infrastructure with virtually unlimited bandwidth that effectively makes the network future-proof. A single shared network for reaching upto the villages would make best use of resources for the country and help the service providers to economise and offer competitive tariff to the customers. Such a convergent network allows carriage of signals of all types of services – voice, data and video. Having said that, the Authority is conscious of the fact that creating such a network is a time consuming exercise, a fact that is borne out by the experience of other countries. Due to the nature of work and likely availability of finance

in installments, the work would need to be broken down into phased activities and completed as follows:

5.61 The proposed time schedule is as follows:

Table 5.9 Proposed schedule of activities

Sl No	Activity	Completion Date
1	Decision the Government	31st January, 2011
2	Creation of NOFA	28th February, 2011
3	Addressing letter to States	15th March, 2011
4	Creation of all SOFAs	31st March, 2011
5	Network Planning by SOFA/NOFA	30th June, 2011
6	Finalization of executing agencies	30th September, 2011
7	Completion of trenching and laying fiber for backhaul and access traffic aggregation	30th June 2012
8	Planning and material procurement by NOFA	31st December 2011
9	Installation, testing and commissioning of equipment for backhaul from all blocks and aggregation of all Panchayat villages by SOFA	30th June 2011 to 30th 31st August 2012
9	Planning, procurement, installation, testing and commissioning of equipment for rest of the villages with population more than 500	31st October, 2012
10	Planning and material procurement for urban areas by NOFA	31st December 2011
11	Laying of cables, equipment installation and commissioning in phased manner in urban areas	31st December 2012

E – Financing

5.62 Regarding financing it has been suggested in section C that the State level agency that will execute the project will owned by central and state Governments. The Government will make available the funds for creation of the block level aggregation network and the backhaul. The company would be eligible to get grants from Government funds like USOF and MGNERGS. USOF has an available balance of about Rs 13789 cr. The last year collection was 5778.00cr and assuming same collection for next two years then funds of the order of 24000 cr would be available. The company can also raise finance from the market.

5.63 Trenching is a major activity in creation of fiber network and involves huge cost. Supporting trenching activities through Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) will provide a viable solution. Here it is important to mention that Government has started the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) with an objective to provide at least 100 days of guaranteed wage employment in a financial year to every household whose adult members volunteer to do unskilled manual work. MGNREGS covers the entire country with the exception of districts that have a hundred percent urban population. Government has allocated fund of Rs 39100 crore for this scheme in the current financial year and similar allocations are expected in the future years. Possibility of funding the cost of the digging for laying of optical fiber cable upto the villages through allocated resources for NREGS was explored by the Authority. Once the proposals are agreed to, the case would be taken up with the Ministry of Rural Development to include digging of trenches in the list of permissible works for the MGNREGS.

5.64 It is also recommended that digging of trenches, for laying optical fiber, may be declared as a permissible item for MGNREG scheme.

5.65 SOFA will undertake the reinstatement work itself or will pay the reinstatement charges to the concerned agency.

5.66 A total of 327 km fiber is to be laid in the access network and about 50 km for each block. This gives a total requirement of about 2402998 km of fiber for all 6374 block. Depending on the soil condition one labour would be able to do 1-2 meter per day. Taking 2 meter per day for rural areas the number of Man days would be 1201499000. This indicates the amount of work that will be generated for the poor through this project.

5.67 If financing through USOF and MGNREGS cannot be done to the extent indicated then Government of India may provide loans through banks under priority lending with sovereign guarantee.

5.68 The fiber infrastructure will give real benefit to the rural India and would go a long way in bridging the rural divide and promoting inclusive growth.

CHAPTER 6: OTHER SUPPORTING MEASURES

6.1 While infrastructure creation is a basic requirement for the growth of broadband, it is not a sufficient condition. For broadband to be adopted, several measures need to be taken by Government and other stakeholders.

A- POLICY MEASURES

A-1 Definition of Broadband

6.2 According to Broadband Policy 2004, broadband is defined 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*".

6.3 Initially broadband was mainly used for various elementary applications like e-Mail, voice chatting and text information. For these applications, speed of 256 kbps was considered sufficient. Presently, broadband has become the leading delivery system for a wide range of content and applications.

This change in the usage pattern has enhanced the bandwidth requirement per household. Therefore, the existing speed of 256 kbps may not support many of these applications and there is a need to review the existing definition of broadband.

6.4 Stakeholders have varying views over the definition of broadband. Some of the stakeholders advocated the retention of current definition with 256 Kbps download speed. They were of the opinion that higher threshold will deter growth of evolving but promising technologies and will reward technologies which may offer the speed but offer none of the economies. They also opined that since technologies keep on developing for the bandwidth enhancement, it is better left to the market dynamics and only QoS need to be defined.

6.5 Some stakeholders wanted that the definition of broadband should be considered from end-user point of view. In view of use of video and bandwidth intensive applications and the futuristic demand, the minimum speed of broadband connection should be enhanced to at least 2 Mbps. This benchmark for speed should be annually reviewed.

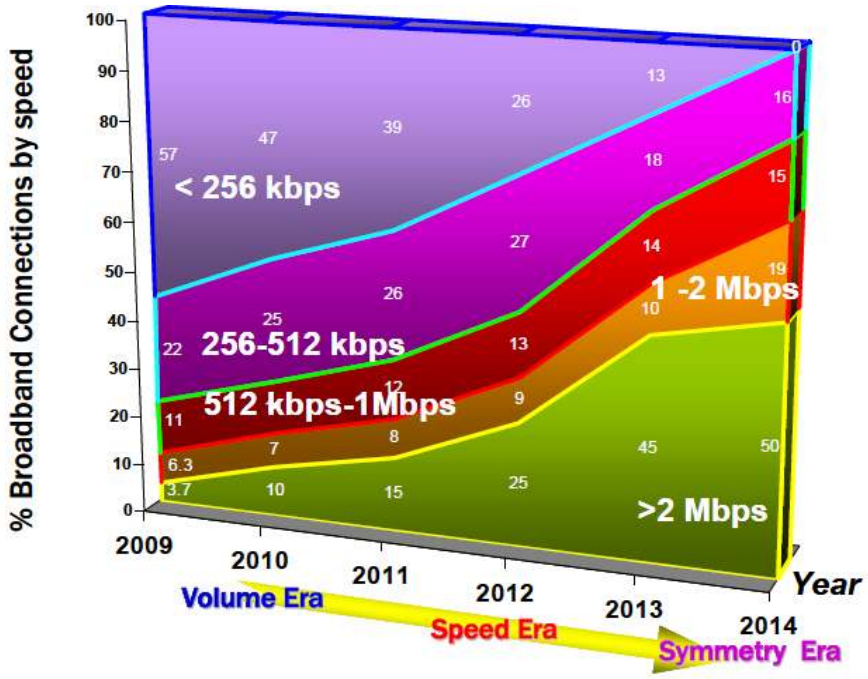
6.6 Another school of thought was that there is no need to define a minimum speed criterion for broadband as minimum speed does not deter the delivered speed and service providers will offer speeds based on demand requirements and competition. It is pointed out that several players are already offering high speed plans (as per bandwidth requirements) with high download limits to customers. In their opinion, the most important consideration while defining broadband is that the definition is simple to understand and reflects the intended

user experience in terms of supporting applications and services. They suggested setting a definition that is realistic, meets the present requirements and evolving over time.

6.7 Some of the stakeholders are of the opinion that the existing speed of 256 Kbps in the definition of broadband should be replaced with at least 512 Kbps as it will not only improve the user experience but will also help in achieving the higher growth of broadband.

6.8 Based on assessment of potential applications that can run on the broadband network in 2014, CII (Confederation of Indian Industries) in its report[56] has projected the growth of the current broadband network up to 2014(refer figure 6.1).

Figure 6.1: Broadband Speed : Vision 2015



[56] India 2009-2014: Broadband roadmap for inclusive Growth

Source: CII- India 2009-2014: Broadband roadmap for inclusive Growth

6.9 As per CII projection, the proportion of connections with speed below 256 kbps will gradually reduce over the next 5 years and the proportion of connections with speed above 256 kbps will increase over the next 5 years. They have also projected that based on aspired application demand, connections of speed up to 256 kbps will cease to exist by 2014 and at least 50% of all connections will have speeds above 2 Mbps.

6.10 Another linked issue is what should be the definition of wireless broadband. The present definition of broadband emphasise on "an always on data connection" and having "minimum download speed of 256 Kbps" to an individual subscriber from the PoP of service provider. The existing definition is inclined towards fixed broadband access, wherein there is a dedicated resource (DSL, Cable, Fibre etc.) between service provider's PoP and customer premises, which can provide an always-on connectivity to the users. However, in case of wireless networks, a broadband connection is not always-on, as the resources like channels using spectrum are allocated to a subscriber only on his request and remain till the termination of data connection by the user. Once the data connection is terminated, the resource becomes free for allocation to another user.

6.11 In addition, the speed of Internet access to ultimate end user is based on the available throughput of the BTS, number of subscribers present in a particular cell site and their location w.r.t the base station. Available speed is higher near the BTS but lower towards cell edge. Moreover, resource-intensive use

by one wireless broadband customer impacts the speeds at which others can communicate. This is unlike the dedicated user access technology used in wireline broadband systems, where sharing of capacity occurs only at the PoP and not at the access level.

6.12 ITU (International Telecom Union) in its document "Core ICT Indicators 2010" released in January 2010 has defined broadband as follows:

"***Fixed broadband*** *refers to technologies at speeds of at least 256kbit/s, in one or both directions, such as DSL (Digital Subscriber Line), cable modem, high speed leased lines, fibre-to-the-home, powerline, satellite, fixed wireless, Wireless Local Area Network and WiMAX."*

*"**Mobile broadband** refers to technologies at speeds of atleast 256kbit/s, in one or both directions, such as Wideband CDMA (W-CDMA), known as Universal Mobile Telecommunications System (UMTS) in Europe; High-speed Downlink Packet Access (HSDPA), complemented by High-Speed Uplink Packet Access (HSUPA); CDMA2000 1xEV-DO and CDMA 2000 1xEVDV. Access can be via any device (handheld computer laptop or mobile cellular telephone etc.)."*

6.13 The stakeholders in favour of having separate definitions for fixed and mobile broadband mentioned that the cell sites for mobile networks have constantly changing mix and volume of voice and data uses, which put varying strains on the available spectrum resources. This limits the spectrum resource that

can be allocated to any one user and to all users within the area served by a certain cell. What services or applications can be supported successfully and with high quality by any network will therefore depend on the customer density in any BTS area.

6.14 Those not in favour of separate definition of wireline and wireless broadband were of the view that in this era of fixed mobile convergence especially for the Broadband traffic, there should be a uniform policy irrespective of the access technology.

6.15 Some of stakeholders mentioned that the definition of broadband should evolve as technologies evolve. There should be a periodic trigger for review of definition. In their opinion the definition of should involve a number of QoS parameters, including overall upload and download speeds, latency etc. Categorization based on fixed and mobile will not allow definition to be technology neutral.

6.16 Basically there are two issues for consideration in the definition of broadband. First is whether there should be separate definition of wireline and wireless broadband and second is what should be the minimum speed for a broadband connection. With the evolution of various 4G technologies like LTE, we can achieve maximum bandwidth upto 140 Mbps, which are comparable with wireline technologies. In such a scenario there seems to be no need to define wireline and wireless broadband separately.

6.17 Customer satisfaction is the prime issue and there has to be some minimum quality of service that service providers must

deliver to their customers. Service providers must dimension their infrastructure such as to ensure delivery of a minimum bandwidth to their customers. If no definition for broadband connection is stipulated, then a customer may not know what speed he is supposed to get from a broadband connection resulting in his dissatisfaction. Our aim should be to ensure provision of quality broadband services in the country. The Authority has, therefore decided to adopt a common definition for both wireline and wireless broadband.

6.18 As regards the speed, since 2004, the focus has shifted from content for the general Internet to content for broadband services. Focus over localised content has now given way to data and multimedia-rich content requiring high-speed connections. The Authority is of the view that though there is a need to upgrade the minimum download speed of broadband connections in a phased manner, the need of the hour is to focus on developing a broadband platform which easily supports capacity upgrades to match the bandwidth demand of future applications as they appear.

6.19 US has upgraded the minimum speed for a broadband connection from 200 kbps to 768 Kbps. In Germany broadband is defined as a connection with minimum 1Mbps. European Union has envisaged provision of broadband speed of 30 Mbps by the year 2020. In Japan no specific definition of Broadband has been provided. However, generally available broadband speeds are in the range of 50-100 Mbps. Similarly UK has Universal Service Commitment in broadband at a level of 2 Mbps by 2012.

6.20 Setting a very high speed for broadband right away may affect the affordability of broadband especially for rural people, who

will be the major consumers of broadband in the coming years. Further, the network required for supporting high speed broadband need to be put in place in most parts of the country before enhancing the speed.

6.21 **The Authority recommends that:**

Broadband connection may be defined as

"A data connection using any technology that is able to support interactive services including Internet access and support a minimum download speed of 512 Kilo bits per second (Kbps)".

6.22 **It is to be noted that the upload speed will atleast be half the download speed. This definition of broadband (Both Wireline and Wireless) given in para 6.21 above, which will be effective from 1st January 2011. The stipulated download speed of 2 Mbps will be effective from 1st January 2015.**

A-2 Right of way

6.23 Obtaining Right of Way (RoW) permission has become a major hurdle in rolling out new telecom infrastructure which requires laying of cables and thereby provisioning of advanced broadband services in a time bound manner. RoW is one very important factor which dissuades service providers to venture into creation of new infrastructure for telecom services/broadband services.

6.24 It has been the experience of service providers that the local authorities take long time in granting permission for RoW and in a number of cases, the operators have to approach multiple

agencies for obtaining RoW clearance. This not only delays the rollout plans of the service providers but also increases the cost. For granting permission, the municipalities / local authorities levy fees and bank guarantee from service providers. These charges are not uniform across the country.

6.25 Some of the stakeholders mentioned that though the Indian Telegraph Act of 1985 has guaranteed right of way to telecom operators, multiple agencies such as the local Governments, municipalities and State Governments have developed their own norms for providing permission of ROW and are levying exorbitant and erratic charges which range between few thousands to Rs. 26 Lakh per km for laying cable. They were of the view that there is a need to have appropriate policies in place for ensuring access to right of way at reasonable prices, and preferably at no charge to facilitate broadband services to the public. They suggested that RoW to all operators should be available on restoration basis or any other thing connected with or related to any work undertaken for laying of cables, otherwise it may not be economically viable to roll-out new telecom services.

6.26 Some of the stakeholders suggested the formulation of a National Telecom Infrastructure Policy (NTIP) for RoW purposes. They mentioned that State Governments and local bodies including municipalities demand rental and other recurring RoW charges and there have been even occasions where service providers have been compelled to give free bandwidth in lieu of RoW permission / restoration charges etc.

6.27 Some stakeholders are of the view that RoW permissions for broadband (i.e. laying OFC, Ducts) must be treated separately and on priority relative to normal ROW permissions as already recommended by TRAI previously. In their view there is a need to re-emphasise and reiterate the RoW guidelines issued in the year 2005 and 2008 and coordinate with various State Governments for its uniform implementation.

6.28 In order to streamline the provisions of Right of Way (ROW) for telecom services, a committee of secretaries was set up by Group on Telecom and IT Convergence (GOT-IT) in the year 2000. The committee studied the ROW policies of various state Governments and submitted its report containing model guidelines for streamlining the ROW provisioning. This report was circulated to all State Governments on 24th August, 2000.

6.29 These model guidelines clearly states that that all State Governments should extend the facility of rights of way for laying underground Telecom cables to all licensees without levying any compensatory charges / levy /lease rentals /license fee or imposing free bandwidth requirements or asking for revenue share/ cashless equity etc. There is also a clear statement that the only admissible charges are reinstatement charges or charges directly linked to the restoration work.

6.30 TRAI has sent several recommendations to streamline the ROW procedures under various recommendations, DoT in response to TRAI's recommendations on "Growth of Broadband" sent in January 2008, has stated that "ROW procedure including

streamlining / rationalizing ROW cost is State subject and therefore Central Government cannot mandate the State Governments. The recommendations of state level committee formed to suggest streamlining the RoW procedures in year 2000 can be recirculated to state Governments and Union territories". DoT circulated this report vide their letter dated 9th April 2008 to all the States and the Union Territories.

6.31 It is a fact that despite various steps taken by Government, problems such as levy of very high charges, lack of uniformity in decision making processes, non-availability of single window system for ROW clearance, long time in granting permissions and non-availability of detailed GIS maps etc. have remained unresolved and are impending growth of telecom network in the country. There is a need to ensure uniform procedures especially the charges for RoW permissions across the country for timely and faster rollout of telecom infrastructure.

6.32 Section 10 of the Indian telegraph Act 1885 states that

"Power for telegraph authority to place and maintain telegraph lines and posts – The telegraph authority may, from time to time, place and maintain a telegraph line under, over, along, or across, and posts in or upon any immovable property:

Provided that –

a. the telegraph authority shall not exercise the powers conferred by this section except for the purposes of a telegraph established or maintained by the [Central Government], or to be so established or maintained;
b. the [Central Government] shall not acquire any right other than that of user only in the property under, over, along,

across in or upon which the telegraph authority places any telegraph line or post; and

c. except as hereinafter provided, the telegraph authority shall not exercise those powers in respect of any property vested in or under the control or management of any local authority, without the permission of that authority; and

d. in the exercise of the powers conferred by this section, the telegraph authority shall do as little damage as possible, and, when it has exercised those powers in respect of any property other than that referred to in clause (c), shall pay full compensation to all persons interested for any damage sustained by them by reason of the exercise of those powers."

6.33 Section 12 of the Indian telegraph Act 1885 states that

> **"Power for local authority to give permission under section 10, clause (c), subject to conditions –** Any permission given by a local authority under section 10, clause (c), may be given subject to such reasonable conditions as that authority thinks fit to impose, as to the payment of any expenses to which the authority will necessarily be put in consequence of the exercise of the powers conferred by that section, or as to the time or mode of execution of any work, or as to any other think connected with or relative to any work undertaken by the telegraph authority under those powers."

6.34 The perusal of the provisions of the Indian telegraph Act 1885 indicates that RoW permission is required from local Authority and it must be subjected to reasonable restrictions.

6.35 **The Authority recommends that Government may fix and notify the charges for Right of Way in consultation with the State Governments on priority basis and ensure time bound availability of RoW to telecom service providers after due intimation to the agency concern.**

A-3 Availability of Spectrum

6.36 In the "National Broadband Plan", the Authority has emphasised the need to lay optical fibre for fulfilling the demand for broadband in future, however, it is conscious of the fact that in view of the increasing applications available on smartphones and the facility of mobility provided by wireless broadband, a large number of consumers in cities will use both wireline and wireless broadband. Fixed wireless when in office or home for using applications requiring higher speeds and for longer duration like IPTV, full motion video, e-medicine, e-commerce, e-learning etc.; wireless broadband when on move for chatting, accessing social networking sites, using location based services, video calling etc.

6.37 In view of the foregoing, the Authority in its recommendations of May 2010 has noted that the next five years are going to see the spread of 3G as well as the introduction of 4G services enabling subscribers to benefit from data and application services. An increasing availability of smartphones with significant processing capacity and a wide array of applications is resulting in higher requirements of spectrum. It is estimated that the total requirement of spectrum in the next five years would be of the order of 500 to 800 MHz including 275MHz for voice services alone.

6.38 In order to fulfil the future demand of spectrum, the Authority has noted in its recommendations of May 2010 that "the availability of spectrum for commercial wireless services in our country falls short of requirements and compares unfavourably with other countries. Although India has the second largest network in terms of number of mobile phones, it is lagging behind most countries in terms of introduction of 3G, BWA and other data based services. This is primarily because of the uncertainty and delayed or non- availability of spectrum for these services. It is noteworthy that LTE is being introduced in other countries this year and is likely to be deployed widely in the next 2 years. If we wish to introduce high speed wireless services, essential for the economic and social development of our country, then it is necessary to take quick and firm decisions to vacate the spectrum useful for the commercial services and relocate some of the existing non-commercial services in other bands. The objective of this exercise would be to identify the possibilities of vacating higher amount of spectrum for commercial services including drawing up a definitive timeframe while simultaneously taking due cognizance of the requirements of Government agencies including Defence and Department of Space. A time bound action plan is needed to be prepared on priority basis covering objective review of the usage of the available spectrum, actual need of the spectrum, possibility of relocating in other less important band and refarming of the vacant spectrum".

6.39 **The Authority reiterates the following recommendation sent as part of its recommendations on Spectrum Management and Licensing Framework, dated 11th May 2010**

6.40 **The Authority recommends that it should be entrusted with the task of carrying out a review of the present usage of spectrum available with Government agencies. The objective of this exercise will be:**

- **to identify the spectrum actually in use by them;**
- **to assess the efficiency of spectrum use;**
- **to identify possible alternative solutions;**
- **to examine the creation of a separate defence band;**
- **to draw up a suitable schedule for release of spectrum for Telecommunications.**

B- MEASURES FOR CONSUMERS

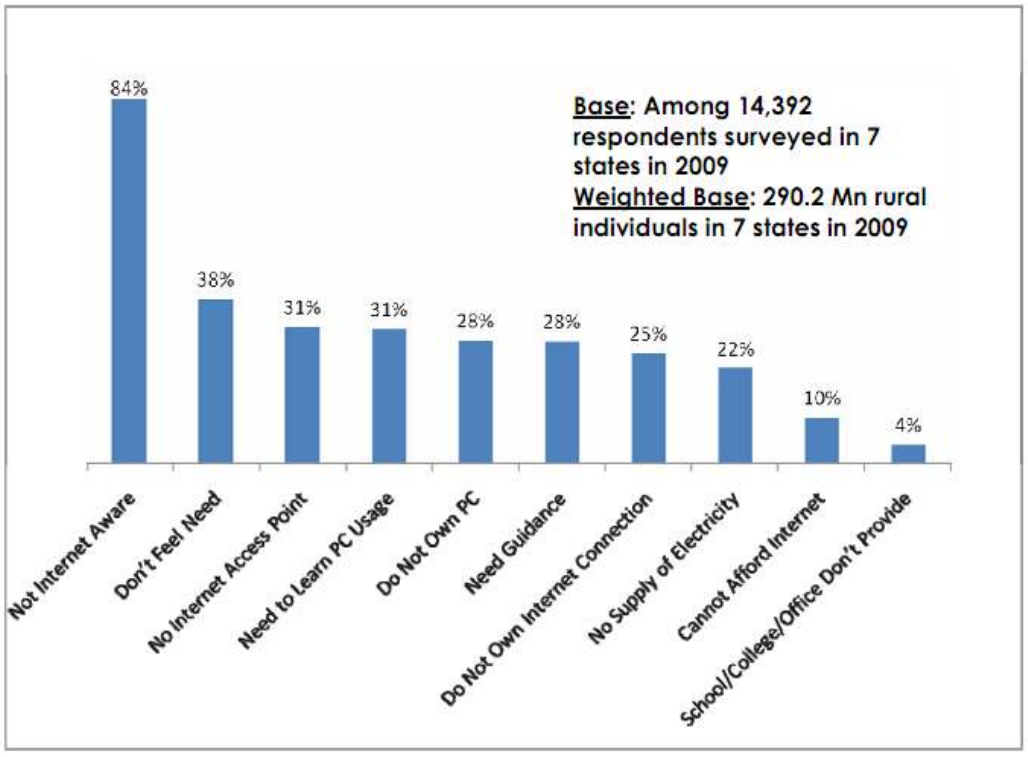
B-1 Awareness

6.41 Another major reason for low uptake of broadband in India is lack of consumer awareness regarding the benefits and applications available through broadband. Amongst the non-users, the level of awareness about broadband is fairly low, however, even amongst the users of computers, mobile phones and Internet, there is a lack of awareness about the potential of broadband w.r.t the kind of services & applications it can provide.

6.42 Presently most of the broadband growth is taking place in urban areas. The common man in the villages is largely unaware of the benefits and potential of broadband in his day to day life. According to IAMAI-IMRB survey, about 84% of the rural people are not aware about Internet. Further, 38% do not feel the need for it. A fairly high percentage of respondents either need

guidance in using a PC (28%) or Internet (25%). A proportion of respondents indicate the need for infrastructural setup such as lack of electricity, Internet connection to appropriate access points (refer figure 6.2).

Figure 6.2: Reason for non Usage of Internet among Rural users



Source: IAMAI survey: Internet for Rural India 2009

6.43 Some of the stakeholders suggested the need for taking up specific initiatives for increased awareness about the benefits of broadband based Net services through the mass media (including TV and Cinema screens) as also demonstration kiosks at shopping centers and shopping markets.

6.44 One of the stakeholders suggested that the Government should involve associations and NGOs at the grass root level in the awareness building campaigns and all these initiatives should be funded by the Government. Programs similar to the CCAOI

Project Gyan, a 10 day Internet learning Program which is offered for Free from Cybercafés/ CSC's and taught in the preferred language of the citizen, could be promoted by the Government.

6.45 There is a need for mass awareness campaign to sensitize the people about broadband and its benefits – through mass media as well as through other means of communication including physical demonstration through road shows. Government may identify suitable agencies for this purpose and allocate fund for awareness campaign across the country.

6.46 Department of Information Technology has drawn up an awareness campaign for NeGP which include:

- Communication Need Assessment Exercise
- NeGP awareness stalls at key events and conferences across the country
- Advertisements in TV, Radio and Press
- CSC awareness through personal contact and van based activities
- Publicity films on subjects like e-District, MCA21, CSCs etc
- Support to Conferences and Workshops

This program could perhaps include awareness regarding computer and broadband.

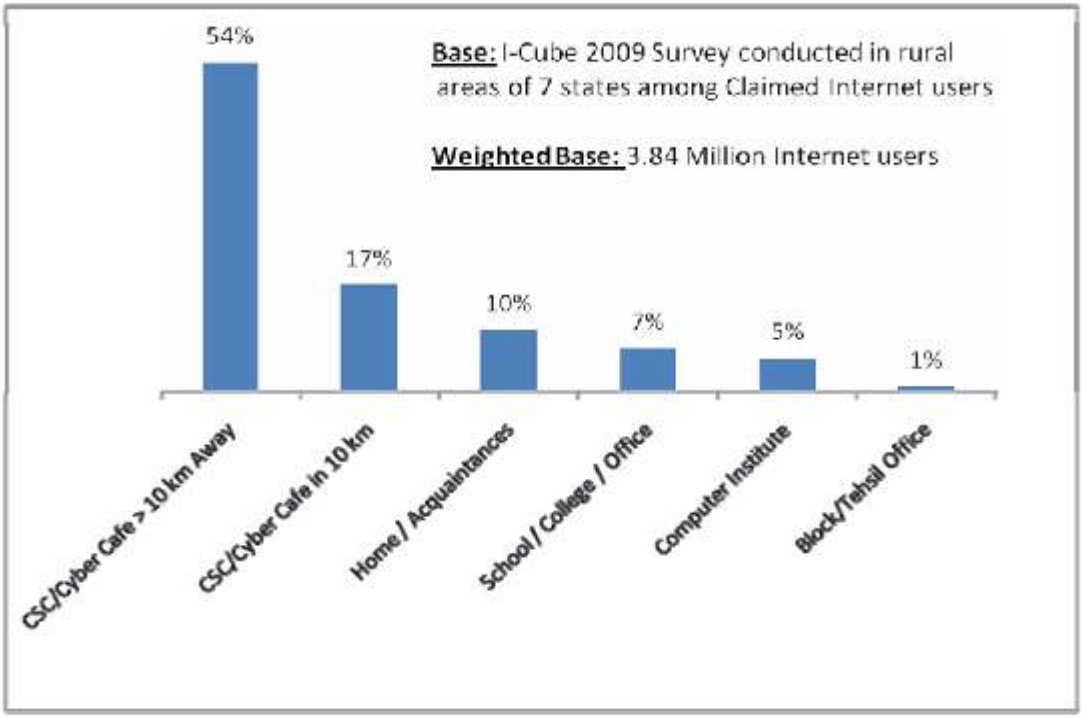
B-2 Cost of CPE (Customer Premises Equipment)

6.47 High Cost of PC and other access devices commonly known as CPEs is also one of the impediments in the spread of

broadband in the country. Though, over the years, the cost of computers has come down and there are newer devices such as smartphones, but for most users the cost of access device remains a challenge. Compared to 150-180 million new mobile phones, we are adding just about 8-9 million PCs every year; the mobile phone base is touching 700 million while the PC base is just about 40 million.

6.48 There is a general lack of personal ownership of CPE/ digital gadgets for accessing the Internet. IAMAI study found that CSC and cyber café are the primary mode for accessing Internet in rural areas.. More than 70% of rural users access Internet through CSCs/cyber cafés. (refer figure 6.3)

Figure 6.3: Modes of Internet Access in Rural Areas



Source: IAMAI survey: Internet for Rural India 2009

6.49 Most of the stakeholders agreed that there is a need to establish

easy accessibility and affordability to Internet devices like PC, laptops, netbooks, mobile Internet devices and other broadband enabled devices. In their view this can be enabled by eliminating or minimizing tax on Internet access devices, such as computers, net books, mobile Internet devices, etc. They also mentioned that reducing the taxes and duties on these devices to Zero will help affordability and hasten the pace of broadband penetration and proliferation. Another suggestion was that duties levied on inputs (parts, components and spares) and finished products used in providing broadband and Internet services should be reduced to levels equivalent to that for mobile phones. It was also suggested that for SMEs, 100% depreciation should be allowed in the first year for PC's and broadband Customer Premise Equipment (CPE) including modems and routers. Some also suggested that one PC upto Rs. 30K and/or Laptop (upto Rs. 45 K) should be exempted from the Income of the individual and self employed on the production of valid Invoice.

6.50 Some of the stakeholders were of the opinion that there is still a considerable gap between PC penetration and Internet penetration which indicates that incentives to CPEs do not necessarily mean increased Internet penetration. Therefore, incentives if any should be given to innovative and new gadgets that specifically promote Internet use.

6.51 Currently computers and broadband equipment get 100% depreciation in three years, though the advancement of technology often makes such equipment obsolete much earlier than that. In order to stimulate investment in the equipment sector and also to enable consumers to keep abreast of

technological advancements, accelerated depreciation allowance may be provided for these equipments i.e. 100% depreciation in the first year itself.

6.52 **The Authority recommends that Government may review the Duties levied on inputs (parts, components and spares) and finished products used in providing broadband and Internet services.**

The Authority also recommends that Customer Premise Equipment (CPE) including modems and routers should be considered for 100% depreciation in first year.

B-4 Training

6.53 The term digital literacy is gaining importance in today's scenario. The goal of Digital Literacy is to teach and assess basic computer concepts and skills so that people can use computer technology in everyday life to develop new social and economic opportunities for themselves, their families, and their communities.[57]

6.54 The English literate population in the country is only 91 Million and the computer literate are only 87 Million[58]. Nearly 25% of Indian population stay in cities, out of which, 32% are computer literate. PC literacy is a major challenge in rural areas - only 3% of the total rural population is PC literate. In various other countries including the USA, computer literacy programmes have been rolled out to promote digital literacy. Though there is no standard definition, digital literacy

[57] & [10] Microsoft Digital Literacy Curriculum : http://www.microsoft.com/about/corporatecitizenship/Citizenship/giving/programs/UP/digitalliteracy/default.mspx
[58] IAMAI – IMRB : Vernacular Content Report - 2009

generally refers to a variety of skills associated with using ICT to find, evaluate, create and communicate information.

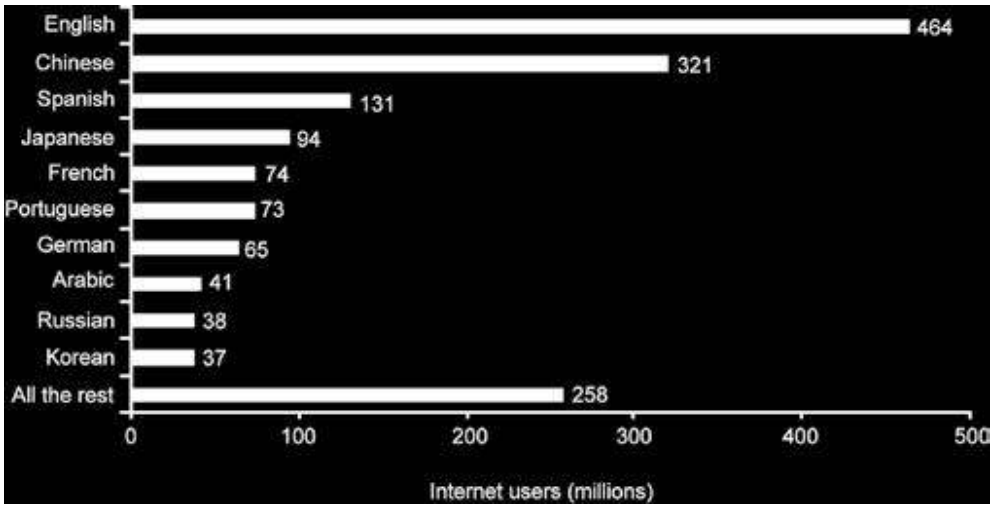
6.55 A stakeholder suggested that Government of India may launch a National Digital Literacy Program (under National Skills Development Corporation) that creates a Digital Literacy Corps, increases the capacity of digital literacy partners and creates an Online Digital Literacy Portal.

6.56 Broadband is not only through computers but through different media. The literacy is required at various levels. Several software periferals support usage through graphics. Nevertheless, there is a need for focus on digital literacy.

B-5 Content and Application Development

6.57 The distribution of Internet users by language suggests that the largest share (about 30 percent) of Internet users speaks English, followed by Chinese (20 percent) and Spanish (8 percent). At the same time, the percentage of English-speaking Internet users dropped from 80% in 1996 to 30% in 2007, reflecting the fact that an increasing number of non English speakers are going online. (refer figure 6.4)

Figure 6.4: Top ten languages (by Internet users) on the Internet, 2009



Source: Internet World Stats, quoted in ITU world telecommunication development report 2010.

6.58 Most of the content on Internet is in English although the English speaking population constitutes only 8% of India. Websites that currently exist in local languages are insufficient to cater to the needs of the users. The content that is available today on the Internet is largely in English and is not customized to local needs. The task is to make this content available in Indian languages.

6.59 There are 18 official languages in the country. There are more than 36,000 Hindi newspapers, more than 4000 Bengali newspapers, more than 4400 Tamil newspapers published in the country, including regional variants of the same publication. In the list of top 10 most read newspapers in India [as per Indian Readership Survey (IRS) for Q1, 2010] 5 are in Hindi, 4 in other regional languages and only one in English. The aforementioned figures provide a clear indication of the large proportion of population which is inclined towards non-English content for information assimilation.

6.60 Presently, there are only around 1,250 websites providing vernacular content[59]. There is also a need for a higher proliferation of vernacular user interface (keyboards, software etc) to facilitate usage of local language content.

6.61 Some of the stakeholders mentioned that Government should ensure availability of the Government services in the local languages. They also suggested that Cybercafés/CSC's and public access systems should be encouraged to promote local language Internet. Another suggestion was that small organisations developing people centric content should be encouraged and incentivised. Content policy which incentivises content providers to provide content in Indian languages & to telecom operators who partner with such content providers was formed.

[59] http://www.iamai.in/PRelease_detail.aspx?nid=1744&NMonth=12&NYear=2008

CHAPTER 7: NATIONAL BROADBAND PLAN

7.1. ICT in general and broadband in particular contribute substantially to growth of GDP and towards poverty elevation by improving access with equity.

7.2. As per study, 10% increase in broadband penetration accounts for 1.38 percentage increase in theper capita GDP growth in developing economies.

7.3. Currently in India, the penetration of broadband is 0.8% as against the tele-density of 60.99 as of Sep'2010. The number of broadband connections is only 10.3 million as against a target of 20 million by the year 2010.Therefore, there is an urgent need to facilitate rapid growth of broadband.

7.4. Towards this end, a National Broadband Network will be established. This network will be an open access optical fibre network connecting all habitation with population of 500 and above. This Network will be established in two phases. The first phase covering all cities, urban areas and Gram Panchayats will be completed by the year 2012. Phase II will see the extension of the network to all the habitations having a population more than 500, to be completed by the year 2013.

7.5. A National Optical Fibre Agency (NOFA) will be set up to establish this broadband network. NOFA is proposed to be a 100% Central Government-owned holding company. Besides being a Holding company, NOFA will also establish the networks in all the 63 cities covered under Jawahar Lal Nehru Urban Renewal Mission (JNURM).

7.6. A State Optical Fiber Agency (SOFA) would be formed in every State with 51% equity held by National Optical Fibre Agency(NOFA) and 49% by the respective State Government. NOFA would be the holding company of all the SOFAs.

7.7. All the SOFAs, under the overall guidance of NOFA will establish the networks and backhaul in the rural areas and in the urban areas other than those cities covered under Jawahar Lal Nehru Urban Renewal Mission (JNURM).

7.8. The optical fibre network would support backhaul bandwidth requirement for provision of broadband and facilitate broadband growth.

7.9. This network will be established at a cost of about Rs 60000 crore. It will be financed by USO fund and the loan given/ guaranteed by Central Government.

7.10. The National Broadband Plan envisages provision of 75 million broadband connections (17 million DSL, 30 Million cable and 28 million wireless broadband) by the year 2012 and 160 million broadband connections (22 million DSL, 78 million cable and 60 million wireless broadband) by the year 2014.

7.11. Right of way will be issued to the executing agency without delay and without any charges but subject to reinstatement by the concern agency. The work related to national broadband network will be taken up in a state only on an undertaking to this effect.

7.12. Government may notify the charges for Right of Way in consultations with the State Governments on priority basis and ensure availability of RoW to telecom service providers to provide various telecom services.

7.13. The program is expected to bring immense benefit when fully operational. The estimated revenue of NOFA and all SOFA is expected to be Rs 26000 crore per year.

7.14. The Network will provide easy access to high speed data and information to citizens, promoting thereby the efforts in the field of education, health etc.

7.15. The optical fibre network would support following bandwidths:

- 10 Mbps download speed per household in 63 Metro and large cities (covered under JNURM) for every wireline connection by the year 2014.
- 4 Mbps download speed per household in 352 cities for every wireline connection by the year 2014.
- 2 Mbps download speed per household in towns and villages for every wireline connection by the year 2014.

* Upload speed would be half of the download speed.

7.16. The objective of national broadband Network is to provide fibre to home in 63 cities covered under JNURM, Fibre to kerb in all other cities (0.5 Km from any residence).

7.17. In order to enable cable industry to go fully digital, the recommendations of TRAI dated 5th august 2010 on "Implementation of Digital addressable system in India" will need to be implemented on priority basis.

7.18. In order to ensure affordability of Customer premises equipment cost, Government may review the duties levied on inputs and finished products used in providing broadband and Internet services.

7.19. Customer premises equipment including modem and routers used for Internet and broadband may be considered for 100% depreciation in the first year.

ANNEXURE - I

ICT Development Index

Economy	Rank 2008	IDI 2008	Rank 2007	IDI 2007
Sweden	1	7.85	1	7.27
Luxembourg	2	7.71	6	6.98
Korea (Rep.)	3	7.68	2	7.23
Denmark	4	7.53	3	7.18
Netherlands	5	7.37	5	7.06
Iceland	6	7.23	4	7.06
Switzerland	7	7.19	8	6.83
Japan	8	7.12	7	6.89
Norway	9	7.11	9	6.78
United Kingdom	10	7.07	12	6.70
Hong Kong, China	11	7.04	10	6.78
Finland	12	7.02	11	6.70
Germany	13	6.95	13	6.60
Singapore	14	6.95	15	6.47
Australia	15	6.90	14	6.51
New Zealand	16	6.81	16	6.38
Austria	17	6.72	19	6.25
France	18	6.55	22	6.09
United States	19	6.54	17	6.33
Ireland	20	6.52	20	6.14
Canada	21	6.49	18	6.30
Estonia	22	6.41	25	5.86
Belgium	23	6.36	21	6.10
Macao, China	24	6.29	28	5.73
Spain	25	6.27	26	5.84
Slovenia	26	6.26	27	5.77
Israel	27	6.19	23	5.93
Italy	28	6.15	24	5.91
United Arab Emirates	29	6.11	33	5.20
Greece	30	6.03	31	5.28
Malta	31	5.82	29	5.48
Portugal	32	5.77	30	5.32
Bahrain	33	5.67	35	4.95
Hungary	34	5.64	34	5.18
Lithuania	35	5.55	32	5.22
Croatia	36	5.53	37	4.95
Czech Republic	37	5.45	39	4.92
Slovak Republic	38	5.38	41	4.86
Cyprus	39	5.37	40	4.91
Poland	40	5.29	36	4.95
Latvia	41	5.28	38	4.95
Brunei Darussalam	42	5.07	42	4.77
Bulgaria	43	4.87	43	4.42
Romania	44	4.73	48	4.11
Qatar	45	4.68	45	4.25
St. Vincent and the Grenadines	46	4.59	49	4.10
Montenegro	47	4.57	44	4.36
Russia	48	4.54	46	4.13
Argentina	49	4.38	47	4.13
Uruguay	50	4.34	51	3.96
TFYR Macedonia	51	4.32	63	3.40
Saudi Arabia	52	4.24	54	3.76
Serbia	53	4.23	52	3.85
Chile	54	4.20	50	3.99
Belarus	55	4.07	53	3.77
Malaysia	56	3.96	55	3.66
Turkey	57	3.90	56	3.63
Ukraine	58	3.87	58	3.56
Trinidad & Tobago	59	3.83	57	3.61
Brazil	60	3.81	61	3.49
Venezuela	61	3.67	66	3.33
Panama	62	3.66	64	3.39
Colombia	63	3.65	69	3.27
Bosnia and Herzegovina	64	3.65	65	3.38
Kuwait	65	3.64	59	3.54
Seychelles	66	3.64	62	3.44
Jamaica	67	3.54	60	3.52
Maldives	68	3.54	72	3.11
Kazakhstan	69	3.47	70	3.17
Costa Rica	70	3.46	67	3.31
Oman	71	3.45	71	3.17
Mauritius	72	3.44	68	3.30
Moldova	73	3.37	73	3.11
Jordan	74	3.33	79	2.98
Peru	75	3.27	74	3.03
Thailand	76	3.27	75	3.03
Mexico	77	3.25	76	3.03
Libya	78	3.24	80	2.92
China	79	3.23	77	3.03
Georgia	80	3.22	81	2.87
Azerbaijan	81	3.18	82	2.77
Lebanon	82	3.17	78	3.02
Albania	83	3.12	84	2.74
Iran (I.R.)	84	3.08	86	2.73
Tunisia	85	3.06	83	2.74
Viet Nam	86	3.05	93	2.61
Ecuador	87	2.95	85	2.73
Armenia	88	2.94	89	2.66
Dominican Rep.	89	2.91	87	2.73
Philippines	90	2.87	95	2.61
Fiji	91	2.81	88	2.69
South Africa	92	2.79	91	2.64
Syria	93	2.76	90	2.65
Paraguay	94	2.75	98	2.46
Mongolia	95	2.71	94	2.61
Egypt	96	2.70	100	2.44
Morocco	97	2.68	103	2.33
Cuba	98	2.66	92	2.62
Kyrgyzstan	99	2.65	96	2.52
Algeria	100	2.65	97	2.47
Bolivia	101	2.62	101	2.39
Cape Verde	102	2.62	107	2.27
El Salvador	103	2.61	99	2.45
Guatemala	104	2.53	102	2.35
Sri Lanka	105	2.51	104	2.32
Honduras	106	2.50	105	2.32
Indonesia	107	2.46	108	2.15
Turkmenistan	108	2.38	106	2.27
Botswana	109	2.30	110	2.08
Uzbekistan	110	2.25	113	2.06
Tajikistan	111	2.25	109	2.11
Nicaragua	112	2.18	112	2.08
Gabon	113	2.16	111	2.08
Namibia	114	2.04	114	1.95
Swaziland	115	1.90	115	1.78
Ghana	116	1.75	119	1.54
India	117	1.75	116	1.62
Lao P.D.R.	118	1.74	117	1.60
Myanmar	119	1.71	118	1.60
Cambodia	120	1.70	120	1.53
Kenya	121	1.69	121	1.52
Nigeria	122	1.65	134	1.36
Bhutan	123	1.62	124	1.48
Gambia	124	1.62	123	1.50
Djibouti	125	1.57	125	1.48
Mauritania	126	1.57	128	1.43
Sudan	127	1.57	122	1.50
Pakistan	128	1.54	127	1.45
Yemen	129	1.52	126	1.48
Zimbabwe	130	1.51	129	1.43
Senegal	131	1.49	136	1.34
Congo	132	1.48	135	1.36
Lesotho	133	1.46	131	1.40
Comoros	134	1.46	130	1.41
Côte d'Ivoire	135	1.45	133	1.37
Zambia	136	1.42	142	1.26
Bangladesh	137	1.41	137	1.34
Cameroon	138	1.40	132	1.37
Angola	139	1.40	138	1.31
Togo	140	1.36	140	1.27
Benin	141	1.35	146	1.20
Nepal	142	1.34	141	1.27
Haiti	143	1.31	143	1.24
Madagascar	144	1.31	139	1.27
Uganda	145	1.30	144	1.21
Malawi	146	1.28	145	1.20
Mali	147	1.19	149	1.08
Rwanda	148	1.19	148	1.11
Tanzania	149	1.17	151	1.05
Congo (Dem. Rep.)	150	1.16	147	1.13
Papua New Guinea	151	1.08	150	1.06
Eritrea	152	1.08	152	1.03
Mozambique	153	1.05	154	0.97
Ethiopia	154	1.03	153	0.97
Burkina Faso	155	0.98	155	0.93
Guinea-Bissau	156	0.97	156	0.88
Guinea	157	0.93	158	0.85
Niger	158	0.90	157	0.86
Chad	159	0.79	159	0.73

ANNEXURE - II

Government of India
Ministry of Communications & IT
Department of Telecommunications
Sanchar Bhawan, 20, Ashoka Road. New Delhi - 110 001
(DS- Cell)

No 813-07/1/2010-DS **Dated 01/04/ 2010**

To,

Secretary
Telecom Regulatory Authority of India
Mahanagar Doorsanchar Sadan
Jawahar Lal Nehru Marg, Old Minto Road
New Delhi.

Subject: Review of the definition of Broadband connectivity

Broadband policy was announced in 2004. The definition of Broadband connectivity as mentioned in the policy is reproduced as below:

*"1.0 **Broadband connectivity:***

Keeping in view the present status, Broadband connectivity is defined at present 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 licence is specifically required, for example, real-time voice transmission, except to the extent that it is presently permitted under ISP licence with Internet Telephony."*

2. Under the Broadband Policy 2004, the definition of Broadband connectivity, inter-alia, covers an **'always-on'** data connection that has

1 of 2

the capability of the minimum download speed of 256 kilo bits per second (kbps).

3. Even though the minimum download speed data capability may be 256 kbps to an individual subscriber from the Point of Presence (POP) of the service provider using wireless technologies like 3G and BWA etc., but it may not meet the requirement of "**always on**" data connection due to technological limitations.

4. Predominant media of provision of Broadband has been through wireline technology so far and all data connections meeting the definition of Broadband connectivity are being taken as broadband connections. However, with the use of more and more wireless technologies, it would be appropriate to review the definition of Broadband connectivity in the Broadband policy 2004.

5. Accordingly, TRAI is requested to provided their recommendations on review of the definition of Broadband connectivity in terms of the Clause 11(1)(a) of the TRAI Act, 1997 as amended by TRAI amendment Act 2000.

01/04/10

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